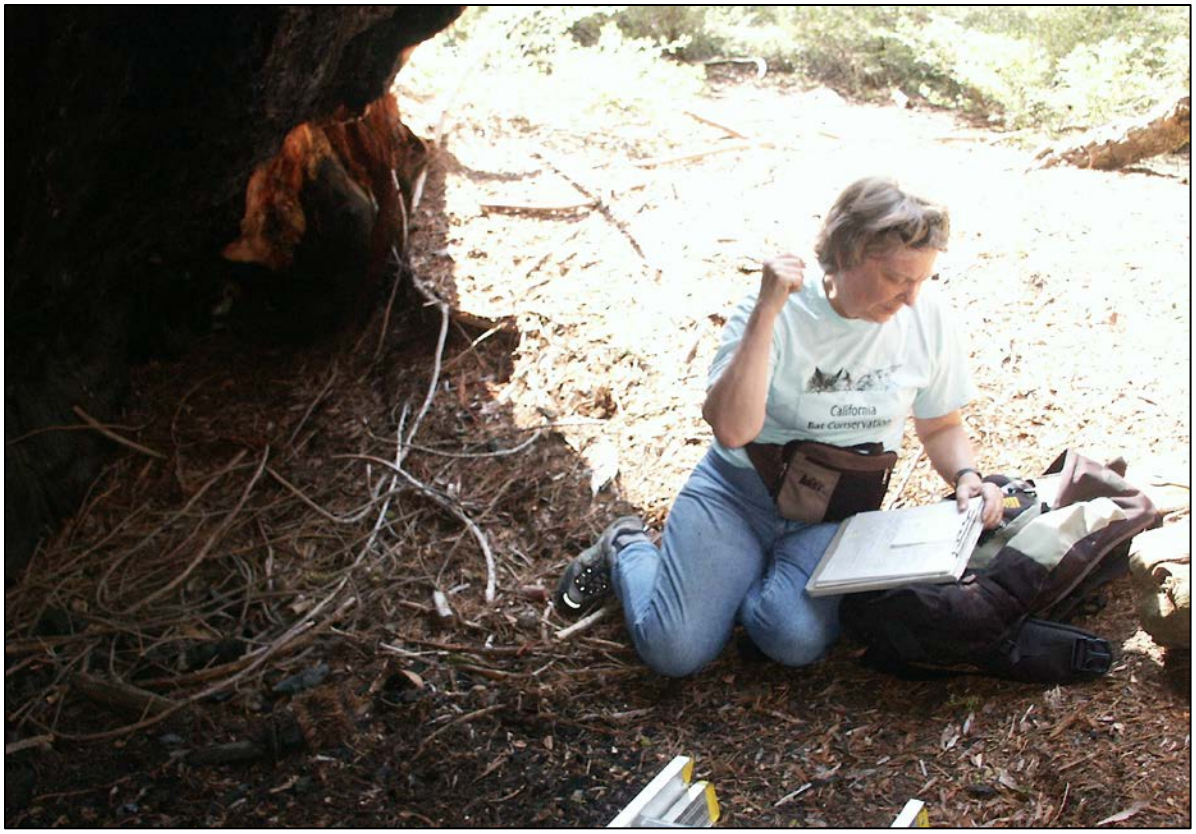
National Park Service
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Sierra Nevada Network

Bat Inventory for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument





ON THIS PAGE
Photograph of lead author Elizabeth (Dixie) Pierson recording bat data under a giant sequoia fire-scarred cavity.
Photograph by: William Rainey.

ON THE COVER
Photograph of bat detector set up to record bat calls in Sequoia and Kings Canyon National Parks.
Photograph by: William Rainey.

Bat Inventory for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument

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Deceased April 2, 2014

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This report is available in digital format from the Sierra Nevada Network website (http://science.nature.nps.gov/im/units/sien/), and we provide the associated data tables and a geodatabase through the National Park Service Integrated Resource Management Application (https://irma.nps.gov/DataStore/Reference/Profile/2242313).

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A Note about the Release of this Report

The Sierra Nevada Network (SIEN) staff has made the decision not to formally publish this report but rather make it available online due to the important baseline information it provides about bats in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Shortly after a draft of this report was provided to SIEN and park staff for review, the lead author Elizabeth "Dixie" Pierson became ill and was unable to work further on the manuscript; she passed away April 2, 2014. The second author was not available to respond to reviewer comments. We received two reviews – one from the Wildlife Ecologist for Sequoia and Kings Canyon National Parks. We did extensive editing and formatting of this report, and revised content to the extent possible in response to reviewer comments. Although we had some guidance from former USGS Wildlife Ecologist and retired SIEN Data Manager Leslie Chow who had worked closely with the investigators, it was not possible to address all of the reviewer concerns without author involvement.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, however, we determined that not all of the comments could be adequately addressed. Significant issues that could not be addressed included:

- The Generalized Linear Model statistical test looking at likelihood of capuring bats in different habitats was not sufficiently explained, and in particular, it is unclear if count data or capture rates were used for the analysis.
- The discussion of bat assemblage by park (section 3.3) does not discuss factors influencing capture rates (net effort, moon, weather, season, bat behavior/biology, etc.) or interpret the results within the context of these biases. It is not clear if the authors standardized for these factors.
- It is unclear if Figure 9 makes comparisons for each species between acoustic and mist-netting, and it was not stated if this analysis only included sites where both acoustic and mist-netting was done. The comparison is not valid if it includes additional acoustic sites where mist-netting did not occur.
- The bat species maps in Appendix VI are at a scale that results in many of the sample sites or species observations being obscured by other sites. The maps were left in the report, but the Sierra Nevada Network Data Manager created a geodatabase that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Edits were done to clarify the purpose and scope of this study and the time frame and spatial extent of the field work. Updated climate change references and statements were added to the discussion in Section 4.2, and a reference to a recent North American Bat Monitoring Project (Loeb et al. 2015) to Section 5.0, Recommendations for Long-term Monitoring. The individual species descriptions in Appendix VI were edited, but no significant changes or updates were made.

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Executive Summary

In response to a need for more information about the condition of natural resources in national parks, the National Park Service (NPS) established an Inventory and Monitoring Program (I&M) to expand existing resource inventories and develop efficient ways to monitor indicators of resource condition (NPS 1999, 2009; Fancy et al. 2009). To plan and implement this I&M Program the NPS established 32 networks of parks that are linked by geography and shared natural resource characteristics. The Sierra Nevada Network includes Devils Postpile National Monument (DEPO), Sequoia and Kings Canyon National Parks (SEKI), Yosemite National Park (YOSE), and the more recently (2012) designated César E. Chávez National Monument (CECH).

The Sierra Nevada Network (SIEN) Inventory & Monitoring Program identified a bat inventory as a high priority biological inventory for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument (National Park Service 2001). A review of existing literature and museum records revealed that very few bat records existed for these parks, while Yosemite had more historic as well as recent bat surveys and research

The goals of this inventory were to fill information gaps on bat distribution and relative abundance and assist park personnel in assessing the potential impacts of management actions on bat populations using park lands. This project had four primary objectives:

1. Characterize the distribution and relative abundance of bat species along elevation gradients of major watersheds in Sequoia and Kings Canyon National Parks (Kern, Kaweah, South Fork Kings, Middle Fork Kings, and South Fork San Joaquin) and in Devils Postpile National Monument (Middle Fork San Joaquin).

2. Characterize gross habitats, identify the bats found and document their specific uses of those habitats (foraging, day roosting and rearing young). Through literature review and/or field data, identify preferred habitats by species for these activities.

3. Identify species sensitive to disturbance (visitor impacts and management actions) through literature review and/or field data.

4. Make recommendations for long-term monitoring of bat species in Sierra Nevada parks.

This study maximized the probability of documenting bat species by targeting habitats where bat foraging and roosting activities were expected to be prevalent. Sample sites were not randomly selected thus the results of this inventory cannot be extrapolated to the larger park landscapes. The main purpose of this inventory was to document species present in the parks and their associated habitats. While the study suggests habitat and elevation associations for bat species, there is not a study design that allows inference to areas not sampled.

This study was conducted between 2001 and 2006 and documented a total of seventeen species of bats in the three parks: ten in Devils Postpile National Monument, sixteen in Kings Canyon National Park, and sixteen in Sequoia National Park.

We used literature reviews, museum searches, and existing wildlife observations to document bat records for these parks and identify species expected to occur. Our field sampling targeted bat foraging and roosting habitats and documented bats through a combination of acoustic and mist-net sampling methods. To gain a better understanding of habitat use for various species, we categorized sampling stations in five general categories: 1) roost sites; and foraging areas associated with 2) forest; 3) meadow/scrub; 4) water; or 5) rock habitats. Acoustic methods using an Anabat system enabled us to identify a subset of bat species based on the call frequency, pattern, and duration; seven Sierra Nevada bat species are readily identified acoustically. Using mist-netting, we captured bats and collected data on age, sex, and reproductive status for 15 species. We conducted statistical analyses to determine how strongly numbers of bats captured in mist nets were associated with the five habitat categories.

We captured 655 bats in 68 mist-netting sessions conducted at 64 sites. This assemblage included 15 of the 17 species known to occur in the parks. The spotted bat (*Euderma maculatum*) and the western mastiff bat (*Eumops perotis*) were detected only acoustically. Two species, *Eptesicus fuscus* and *Myotis yumanensis*, account for 50% of all captures. Taken together, the five most frequently captured species accounted for nearly 80% of all captures.

We describe bat diversity, abundance, and distribution for each major river drainage. The individual species accounts in appendix VI provide detailed information on each of the 17 species documented in SIEN parks and include identifying characteristics, distribution, habitat associations, and management issues.

To assist managers in identifying bat sensitivity to management activities and large-scale stressors, we conducted two ranking exercises for the bats of Devils Postpile National Monument and Sequoia and Kings Canyon National Parks. One ranking evaluates species status, and the other provides an overview of stressors affecting bats' life history, and how various management activities might affect individual species. Four of the five ranked as species of greatest conservation concern occur in Sequoia and Kings Canyon. They are: Townsend's big-eared bat *(Corynorhinus townsendii),* western red bat (*Lasiurus blossevillii*), pallid bat (*Antrozous pallidus),* and fringed myotis (*Myotis thysanodes).* While rankings are based largely on issues that affect these species outside park boundaries, they serve to highlight the importance of National Park Service lands as potential refugia, and signal a potentially heightened sensitivity of these species to management activities within the parks.

In our closing section, Recommendations for Bat Monitoring, we highlight acoustic monitoring as a tool that can accommodate various monitoring approaches – including geographically extensive programs using walking detector transects or driven vehicle routes, or longer-term deployments of unattended equipment to record bats in specific habitats or at areas of concern like wind energy generating sites. The recently developed North American Bat Monitoring Program (NABat, Loeb et al. 2015) provides a framework for coordinated bat population monitoring to enable regional and rangewide inferences about changes in the distribution and abundance of bat populations and would be a useful starting point for a local bat monitoring program.

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We are deeply grateful to the staff at Sequoia and Kings Canyon National Parks (SEKI), who provided essential information and logistic support, and without whom this project would not have been possible. Most particularly, we thank Linda Mutch, David Graber, and Harold Werner. We are grateful to Les Chow for developing the maps in this report. We are grateful for the skill of the parks' helicopter pilot and the helitack crew. Our trips into the Kern were made possible with the skilled support of the Cottonwood Pack Station. Much appreciated stock and field support was provided by Paul Heady, Winifred Frick, Edith Frick, and their mules in Kings Canyon. Paul Heady and Winifred Frick also provided field support and housing for our efforts in Devils Postpile. Much appreciated field support was also provided by Erica Helling, Michael Buchalski, and Cynthia Poett. We thank Frank Helling for providing information on bats in Grant Grove. Ward Eldredge provided us with invaluable access to the parks' specimen collection; Janine Koshear and Jim Petterson generously shared information from their earlier survey efforts. Vance Vredenburg ran a bat detector for us at Sixty Lakes Basin. Joe Ventura provided invaluable support to our field effort in the Kern. We received invaluable assistance in obtaining and clarifying museum records from Paul Collins at the Santa Barbara Museum of Natural History, Larru Heaney at the Field Museum in Chicago, and Annie Lussier at the Museum of Comparative Zoology at Harvard. Thomas Ingersoll conducted the statistical modeling. This work was funded by the NPS Sierra Nevada Network Inventory & Monitoring Program.

−Elizabeth Pierson and William Rainey

Thank you to Harold Werner, Alice Chung-MacCoubrey, and Daniel Gammons for helpful reviews. Leslie Chow provided valuable input to clarify methods and approach in response to reviewer comments. Alex Eddy created a geodatabase and assisted with developing metadata and making the project data accessible via the National Park Service on-line database - Integrated Resource Management Applications. Linda Mutch and Sonya Daw edited and formatted the report.

−Sierra Nevada Network Inventory & Monitoring Program

List of Acronyms and Terms

Bat Names

Scientific Name	Four-letter Code	Common Name
Antrozous pallidus	ANPA	Pallid bat
Corynorhinus townsendii	COTO	Townsend's big-eared bat
Eptesicus fuscus	EPFU	Big brown bat
Euderma maculatum	EUMA	Spotted bat
Eumops perotis	EUPE	Western mastiff bat
Lasionycteris noctivagans	LANO	Silver-haired bat
Lasiurus blossevillii	LABL	Western red bat
Lasiurus cinereus	LACI	Hoary bat
Myotis californicus	MYCA	California myotis
Myotis ciliolabrum	MYCI	Small-footed myotis
Myotis evotis	MYEV	Long-eared myotis
Myotis lucifugus	MYLU	Little brown bat
Myotis thysanodes	MYTH	Fringed myotis
Myotis volans	MYVO	Long-legged myotis
Myotis yumanensis	MYYU	Yuma myotis
Parastrellus hesperus	PAHE	Canyon bat
Tadarida brasiliensis	TABR	Mexican free-tailed bat

Akaike's Information Criteria	AIC
Analysis of Variance	ANOVA
Devils Postpile National Monument	DEPO
Generalized Linear Model	GLM
National Electrical Manufactures' Association	NEMA
Sequoia and Kings Canyon National Parks	SEKI
Sierra Nevada Network	SIEN
Wildlife Observation Database for Sequoia & Kings Canyon	WODB
Yosemite National Park	YOSE
Zero-crossing analyzers	ZCAIMS

1.0 Introduction

Globally, bats comprise almost one-fourth of all mammals–nearly 1,000 species–yet they are often misunderstood by the public, and land managers typically have insufficient information to evaluate their status. Many species are becoming endangered, and others are declining from destruction of their nesting caves, habitat loss, direct persecution from ignorance, indiscriminate use of pesticides, large-scale stressors such as climate change, and disease caused by a non-native fungus.

Bats are unique as the only true flying mammals and due to their exceptionally long lives (5-15 years) and unusually low reproductive rates (typically one young per year) for their small size. Sierra Nevada bats feed almost exclusively on insects and are the only major predators of night-flying insects. The guano they deposit in caves and other roost areas adds significant nutrient inputs to these sites (Chung-MacCoubrey 2013). Thus, bats play a role in regulating insect populations, insect-related ecological processes, and nutrient redistribution and cycling (Ross 1967) and are integral to the function and integrity of many ecosystems. Bats also provide notable economic benefits by consuming significant quantities of insects that are known agricultural pests (Cleveland et al. 2009).

Bats represent more than 20 percent of the mammalian diversity in Sequoia and Kings Canyon National Parks and approximately 25 percent for Devils Postpile. At least 74 percent of the bat species (17 of 23) in California use Sierra Nevada habitats. Of the seventeen bat species expected in the Sierra Nevada parks, eleven have special status designated by a federal, state, or other organization (Pierson et al. 2001, Chung-MacCoubrey 2013). Known threats to bats include habitat loss and non-native disease. White-nose syndrome (WNS), caused by a fungal pathogen (*Pseudogymnoascus destructans*), emerged in New York in 2006 and has killed millions of bats in eastern North America (Frick et al. 2010). In March 2014, the first case of WNS in the western United States was confirmed in a Little Brown Bat near Seattle, Washington (Washington Department of Fish and Wildlife 2017). Other factors that may affect bats include altered fire regimes, climate change, and pollutants.

The Sierra Nevada Network (SIEN) Inventory & Monitoring Program identified a bat inventory for Devils Postpile and Sequoia and Kings Canyon as a high priority biological inventory (National Park Service 2001). Prior work on bats in Yosemite had already met basic inventory objectives for that park (Pierson and Rainey 1993, 1995, 1996a). The primary purpose of the NPS natural resource inventories is to document the presence of resources in parks, and to assess and document the current condition and knowledge of these resources. Inventories allow comparison of existing conditions to reference conditions or the desired state of parks and establish a solid baseline for making scientifically sound management decisions (National Park Service 2009).

Broad objectives of biological inventories conducted by the National Park Service Inventory & Monitoring program are: 1) to document through existing, verifiable data and targeted field investigations, the occurrence of at least 90 percent of the species of vertebrate and vascular plants currently estimated to occur in the parks and 2) to describe the distribution and abundance of species of special management concern, such as listed Threatened and Endangered species and invasive species (National Park Service 2001, 2009) .

Little information was available on the distribution and abundance of bats in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument. Fieldwork for this inventory was conducted between June 2001 and September 2006, and its primary goal was to fill information gaps on bat distribution and relative abundance and assist park personnel in assessing the potential impacts of management actions on bat populations using park lands. Park staff regularly must assess potential impacts of management activities such as building or road maintenance, bridge removal or maintenance, prescribed fire or fire suppression activities, ecological restoration projects, and other management actions on species of concern. This bat inventory provides information that will assist staff with evaluating potential impacts on bats, as well as providing a baseline inventory for future research and monitoring efforts.

1.1 Project Purpose and Scope

This project had four primary objectives:

1. Characterize the distribution and relative abundance of bat species along elevation gradients of major watersheds in Sequoia and Kings Canyon National Parks (Kern, Kaweah, South Fork Kings, Middle Fork Kings, and South Fork San Joaquin) and in Devils Postpile National Monument (Middle Fork San Joaquin).

2. Characterize gross habitats, identify the bats found and document their specific uses of those habitats (foraging, day roosting and rearing young). Through literature review and/or field data, identify preferred habitats by species for these activities.

3. Identify species sensitive to disturbance (visitor impacts and management actions) through literature review and/or field data.

4. Make recommendations for long-term monitoring of bat species in Sierra Nevada parks.

This study maximized the probability of documenting bat species by targeting habitats where bat foraging and roosting activities were expected to be prevalent. Sample sites were not randomly selected thus the results of this inventory cannot be extrapolated to the larger park landscapes. The main purpose of this inventory was to document species present in the parks and their associated habitats. While the study suggests habitat and elevation associations for bat species, there is not a study design that allows inference to areas not sampled.

1.2 Background

A review of the literature (Allen 1919, Constantine 1998, Dial et al. 1979, Grinnell, H. 1916 &1918, Grinnell, J. 1913, Hall 1981, Lengas and Bumpus 1992, 1993, Pierson and Heady 1996, Pierson and Rainey 1998b, Sumner and Dixon 1953, Szewczak et al. 1998) and examination of museum records revealed that very few bat records exist for portions of the Sierra Nevada that encompass Sequoia and Kings Canyon National Parks and Devils Postpile National Monument. Grinnell's extensive work in the 1920's focused on transects through Yosemite and Lassen National Parks (Grinnell and Storer 1924, Grinnell et al. 1930) and did not include the southern Sierra Nevada. These early faunal surveys did not have the current survey tools (e.g., mist nets, bat detectors, night vision devices) available to them, and were largely based on shooting at dusk with a shotgun. Consequently, the

number of bats collected was relatively limited. For example, only nine species were collected on the Yosemite transect (Grinnell and Storer 1924).

Based on information about the distribution and habitat requirements of California's 25 bat species, 17 bat species were expected to occur in Sequoia and Kings Canyon National Parks, and up to 13 expected to occur in Devils Postpile National Monument. In a preliminary inventory in Devils Postpile National Monument August 23-24, 2001, 10 species of bats were documented for the monument (Pierson and Rainey 2001). Recent work in Yosemite National Park examined the seasonal distribution of bat species over an elevation gradient and documented 17 species occurring in the park (Pierson and Rainey 1993, 1995, 1996b, Pierson et al. unpublished data). This research also found that the species assemblages (particularly where the breeding females are found) are strongly influenced by elevation. In the vicinity of Yosemite National Park, the zone of highest bat diversity is between 1,000 to 2,000 meters (Pierson et al. unpublished data) where the ranges of species found primarily at lower elevations and those found primarily at higher elevations, appear to overlap.

Latitude also affects bat distribution, leading to the expectation that there are differences in species assemblages between Yosemite National Park and Sequoia and Kings Canyon National Parks. For example, a study conducted in the Giant Forest area found pallid bats (*Antrozous pallidus*) to be one of the species most commonly associated with the giant sequoias (*Sequoiadendron giganteum*) (Pierson and Heady 1996).Yet, a parallel study in Yosemite National Park found pallid bats to be relatively rare at comparable elevations in the Mariposa Grove of giant sequoias (Pierson et al. 2006a). By examining bat distribution along altitudinal gradients within Sequoia and Kings Canyon and Devils Postpile, we hoped to provide a basis for comparison with comparable transects elsewhere in the Sierra Nevada, and thus contribute to a larger landscape-level view of bat distribution and habitat preferences in this mountain range.

While bat populations are not currently monitored by the Sierra Nevada Network or the Sierra Nevada parks, the data on distribution and abundance from this inventory provide a baseline for designing and implementing a long-term monitoring program for bat populations. In addition, natural resource managers are increasingly called upon to assess impacts of park management actions and visitor activities on park resources. There is currently deficient information on bats, resulting in recurring inadequate assessments of various management actions on bat habitat requirements in these parks. Information provided by this inventory is intended to assist park staff in making recommendations on proposed management actions.

2.0 Methods

2.1 Study Area

The study area consisted of Kings Canyon National Park, Sequoia National Park and Devils Postpile National Monument (Figure 1). Kings Canyon and Sequoia, which are contiguous and under the same management, are large and topographically diverse, extending from relatively low elevation to the Siera Nevada crest. Kings Canyon extends from 36.26643 to 36.59245 North latitude, encompasses 717.1 square miles (459,089.416 acres/185,790 ha), and has an elevation range from 3,937 ft (1,200 m) near Tehipite Valley to 14,245 ft (4,342 m) on North Palisade. Sequoia extends from 36.29890 to 36.70099 North latitude, encompasses 635.5 square miles (406,875.416 acres/ 164,660 ha), and has an elevation range from 1,377 ft (420 m) at the Ash Mountain entrance station to 14,494 ft (4,417 m) on Mt. Whitney. Devils Postpile is a small park, located farther north, with the "Postpile," a remarkable example of columnar basalt, as its central focus. It extends from 37.59617 to 37.63400 North latitude, encompasses 1.25 square miles (799.702 acres/323.63), and has an elevation range from 7,182 to 8,202 ft (2,189 to 2,500 m). The three parks include within their boundaries the primary headwaters and upper reaches of four major river drainages: the San Joaquin, Kings, Kaweah, and Kern.

These parks contain a wide diversity of habitats due to the elevation gradient and the diversity of physical and biotic resources. Sequoia and Kings Canyon National Parks contain a variety of cave and karst resources; spectacular rocky terrain of cliffs, peaks, and boulder fields; and diverse wetlands and riparian areas. Though small in size, Devils Postpile National Monument supports diverse habitats, including forests, chaparral, riparian corridors, meadows, seeps, and ponds.

The vegetation of Sequoia and Kings Canyon National Parks can be categorized broadly into the following vegetation zones: oak woodland, chaparral scrubland, lower montane, upper montane, subalpine, and alpine. Vegetation changes dramatically along west-east elevation gradients from the lowest elevation oak woodlands up to ancient foxtail pines and western juniper, krumholz whitebark pine, and alpine perennial herbs at the highest elevations. Some areas have a mix of west and east slope species due to their proximity to the Sierra Nevada crest, such as Devils Postpile National Monument (Arnett et al. 2014). Sparse forests on the upper east slope of the Sierra Nevada grade into semi-arid Great Basin scrublands in the mountains' rain shadow. More detailed information is available in Appendix III about the Holland vegetation types referenced in this inventory.

2.2 Locating Pre-Existing Records

To examine background information on the recent and historic distribution of bat species in Sequoia and Kings Canyon National Parks, we compiled records from the literature (Allen 1919, Barbour and Davis 1969, Elliot 1904 & 1907, Grinnell, H. 1916 &1918, Grinnell, J. 1933, Miller and Allen 1928, Sumner and Dixon 1953)**,** previous work we and others had conducted in the park (Koshear and Lawton 1993, Pierson and Fellers 1998, Pierson and Heady 1996, Pierson and Rainey 1996a) and a survey of 39 museum collections (for Fresno and Tulare counties) (Appendix I). We identified museums with bat records in California and then searched the collections based on counties and park names.

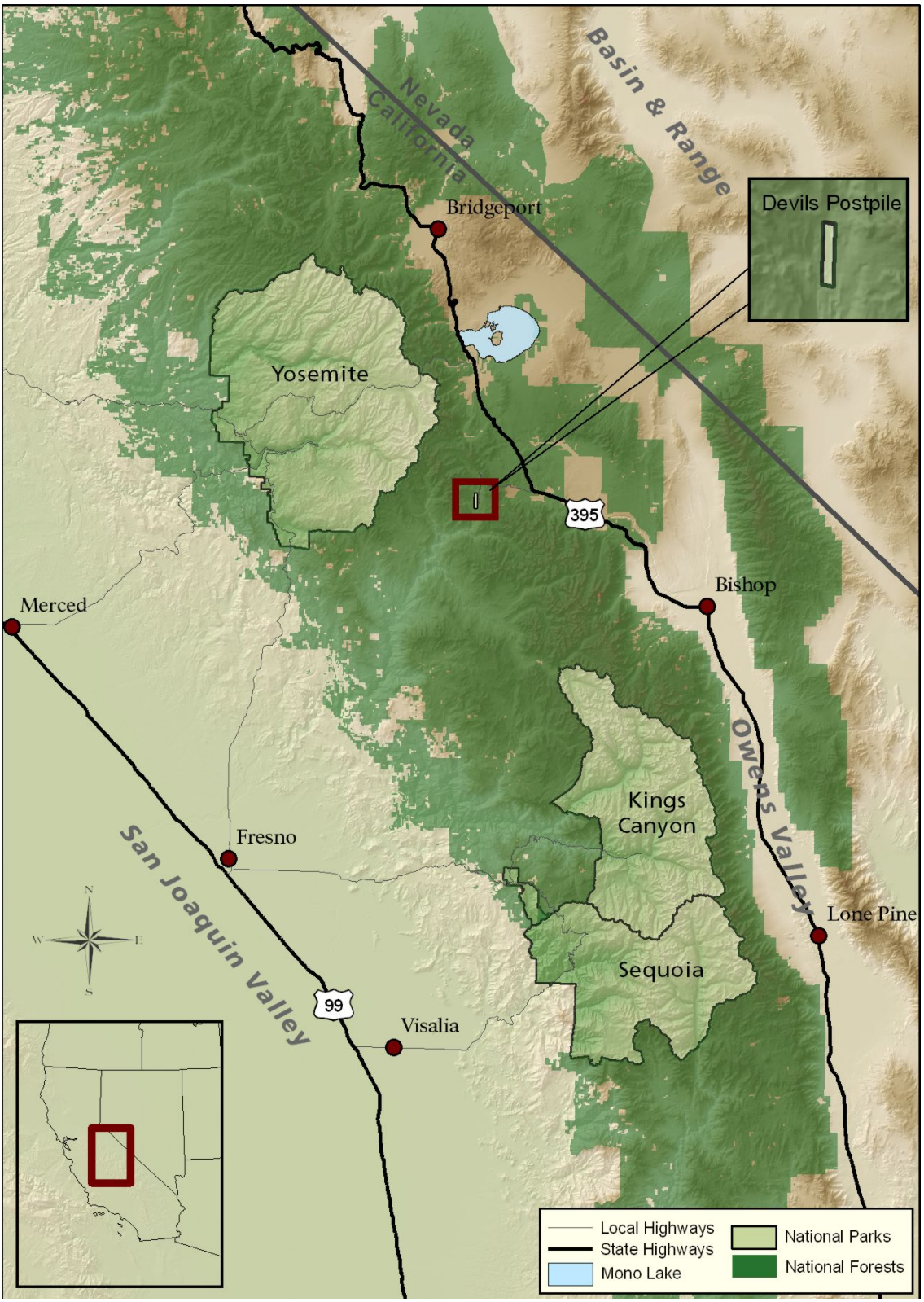


Figure 1.The location of the three study areas: Kings Canyon and Sequoia National Parks and Devils Postpile National Monument. Yosemite National Park is also shown as there are numerous references to bat data collected there in previous studies.(NPS map by Sandra Graban)

We used this information to develop an intial species list for the parks and identify target areas for further inventory.

2.3 Collecting Field Data

2.3.1 Site Selection

Based on the large geographic scope of this project and the assumption that bats are most readily sampled at water sources (Grindal et al. 1999, Pierson et al. 2001), we chose to focus our sampling on the four river drainages, and associated water features (e.g., tributaries, ponds, flooded meadows). Although the challenges of conducting field work in remote back country locations occasionally intervened, we attempted to distribute our sampling along an elevational gradient within each river drainage, giving weight to areas for which prior survey information was lacking and access required the kind of logistic support this project made available. Sites were allocated opportunistically along river and stream drainages and targeted areas having a high probability of bat foraging activity, such as stream corridors, ponds, meadows, and cliff or forest areas with roosting habitat. Since we expected the species assemblage to change with altitude and latitude, we sampled four generally westward flowing river drainages (the San Joaquin, Kings, Kaweah, and Kern), selecting sampling sites at approximately 600 m intervals where logistically feasible, between 600 and 3000 m.

Geographical coordinates for sampling sites were collected in decimal degrees (Datum: NAD27 CONUS), using hand-held GPS units (Garmin 12XL).

To gain a better understanding of habitat use for various species, we categorized sampling stations in five general categories: one being a roost site and four being foraging areas in association with forest, meadow/scrub, water, or rock habitat. We then identified more specific subcategories within each of these general categories. For the “Forest” category we indicated whether the site was more or less than 20 m from the forest edge. For “Meadow/Scrub” our sub-categories were wet meadows, dry meadows, riparian scrub, and dry scrub. For “Water” our subcategories were river, creek/side channel, marsh, flooded meadow, lake, and pond. For “Rock” our subcategories were rock outcrop, talus/cliff base, and gravel bar. Each sampling station was ranked for each of these sub-categories, and elevation was also included as a variable. Sites were identified into categories as they were sampled, rather than allocated prior to sampling.

All the sampling sites are mapped in Figures 2 and 3a and b. In addition, net sites are summarized within each drainage by elevation band and habitat categories (Table 1).

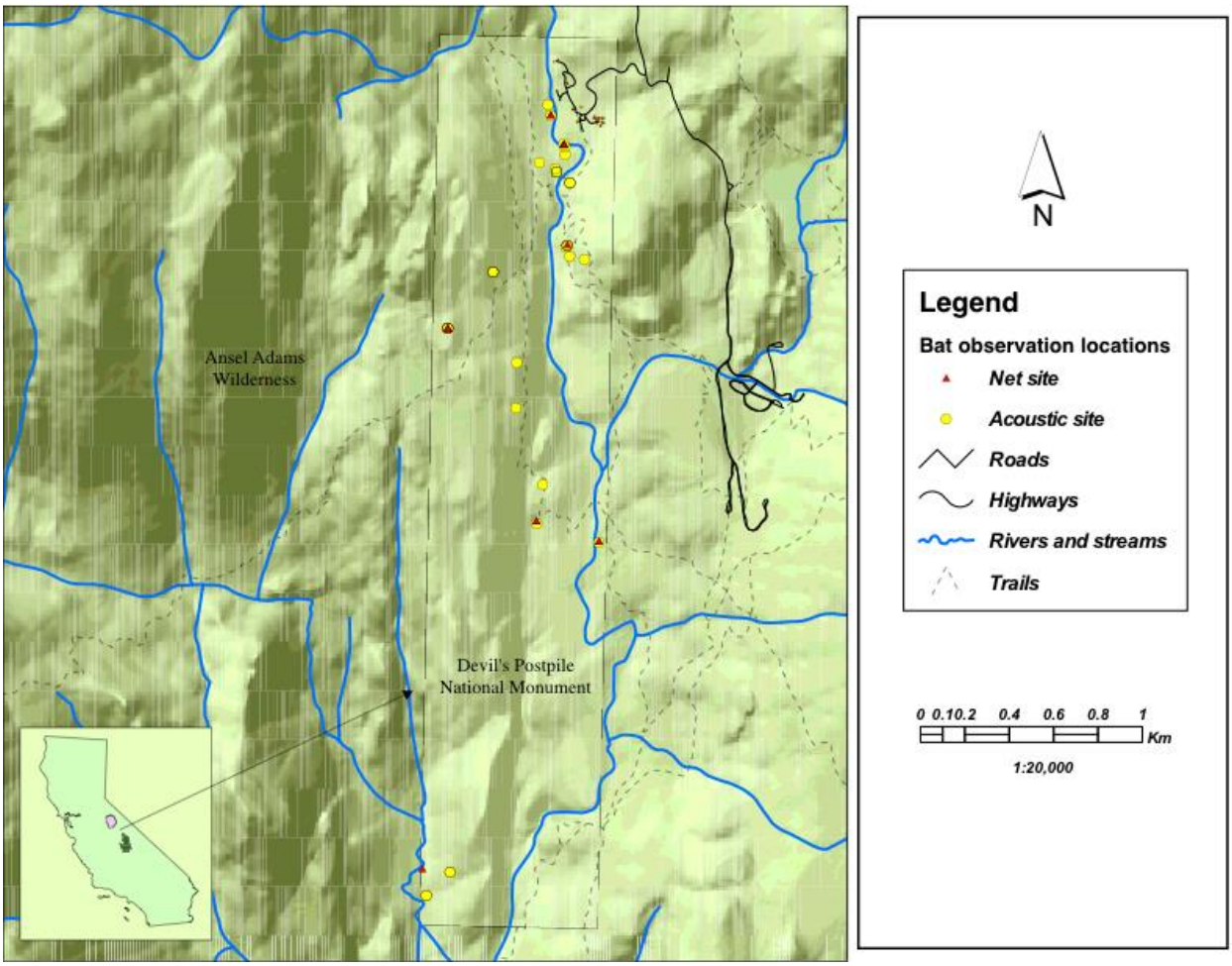


Figure 2. Sampling sites at Devils Postpile National Monument.

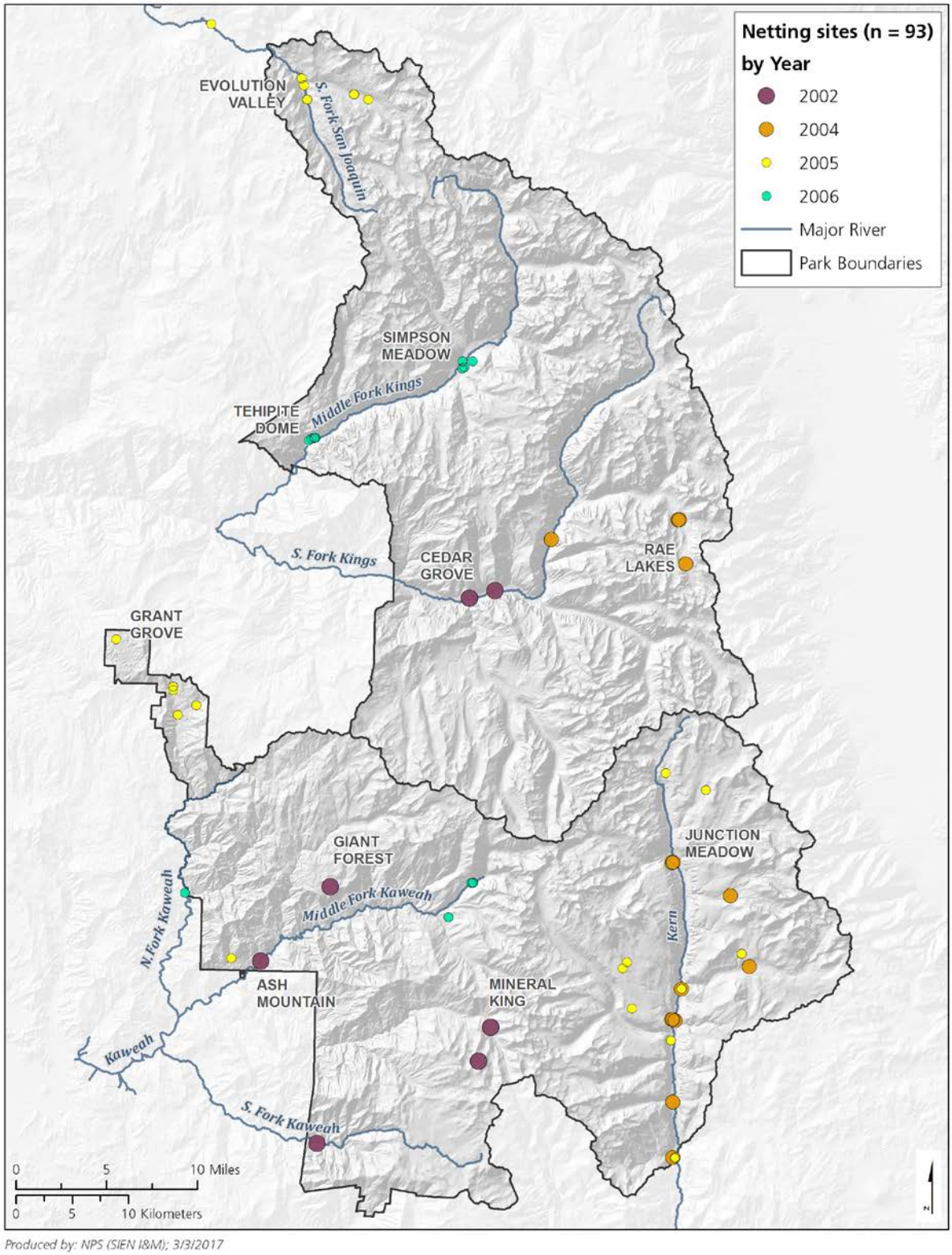
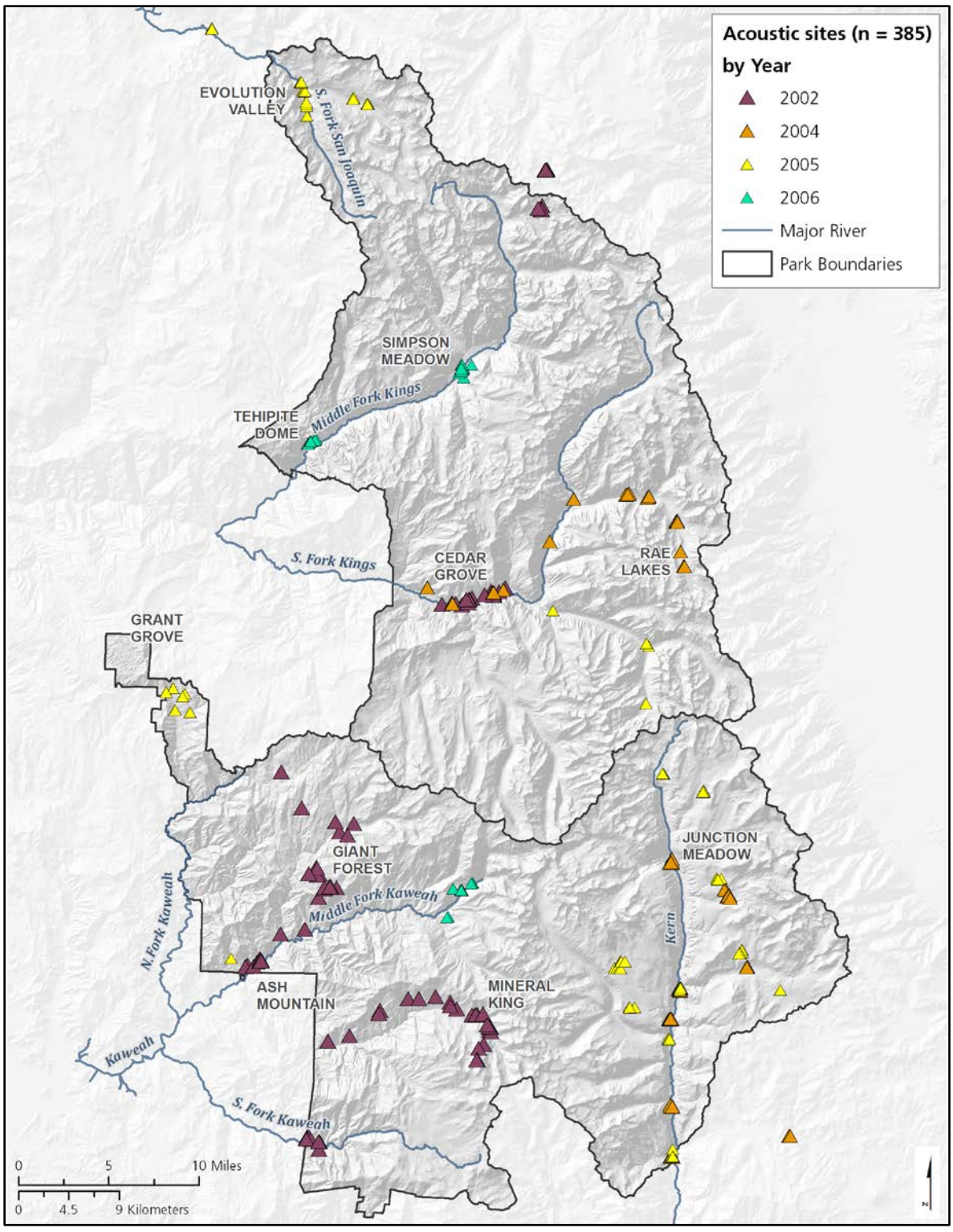


Figure 3a. Bat netting sites in Sequoia and Kings Canyon National Parks.



Produced by: NPS (SIEN I&M); 3/3/2017

Figure 3b. Bat acoustic sampling sites in Sequoia and Kings Canyon National Parks.

Table 1. Numbers of net sample sites that fall into the different elevation band, habitat, and sample year categories for each river drainage. Acoustic monitoring accompanied mist-netting at these sites, and was also done at additional sites not shown in this table.

Rivers	Elevation Band (meters)					Habitat Category					Sample Year				
	<1000	1000-2000	2000-2500	2500-3000	>3000	Roost	Forest	Meadow/ Scrub	Water	Rock	2001	2002	2004	2005	2006
San Joaquin	--	--	16	9	--	--	1	6	16	2	6	--	9	10	--
Kings	--	18	2	3	2	1	3	3	13	5	--	4	7	--	14
Kaweah	5	16	5	--	2	4	3	--	15	6	--	10	--	9	9
Kern	_	7	10	2	9	--	6	4	18	2	--	--	14	16	--
Total	**5**	**41**	**43**	**14**	**13**	**5**	**13**	**13**	**62**	**15**	**6**	**14**	**30**	**35**	**23**

2.3.2 Sampling Methods

Sampling methods vary considerably in their effectiveness among species (Kalko et al. 1996, Pierson and Rainey 1996b, Simmons and Voss 1998). To obtain the most complete characterization of the bat community it is necessary to use both acoustic and capture methods. Acoustic methods offer the most effective way for assessing overall levels of bat activity at a sampling site, and for detecting the presence of certain species that are rarely captured in nets and have distinctive echolocation calls (e.g., red bats, *Lasiurus blossevillii* [Pierson et al. 2000a], mastiff bats, *Eumops perotis* [Pierson and Rainey 1998a], and spotted bats, *Euderma maculatum* [Pierson and Rainey 1998b]). Capture methods, while labor intensive, offer the only opportunity to obtain demographic data critical to proper management (particularly important for locating breeding females). These methods also allow positive species identification for those species that are difficult to distinguish acoustically (e.g., big brown bats, *Eptesicus fuscus* versus silver-haired bats, *Lasionycteris noctivagans* [Betts 1998]; the three *Myotis* species that echolocate at 40 kHz, *Myotis ciliolabrum*, *Myotis lucifugus*, and *Myotis volans*).

2.3.2.1 Capture Methods

Mist-net capture involves setting fine-meshed nets over water, meadows, or other known flyways. After capture in the mist-net, the bats are handled to collect data on age, sex, reproductive condition, and body measurements, then are released.

Mist net surveys followed the procedures outlined by Kunz and Kurta (1988) − 1.5 inch mesh black nylon or polyester mist nets of a size appropriate to the location (7 or 10 feet height; lengths of 42 and 60 feet) were set on sectional poles in foraging areas. We conducted mist-netting between late June to early September from 2001 to 2006 (all years except 2003). Due to logistics and time constraints, sites were sampled only one time. The timing of when various drainages were sampled depended primarily on logistical support available to access remote areas. We coordinated helicopter support with NPS staff and stock support with private contractors or colleagues. Thus sampling among drainages varied by year (Table 2).

Table 2. Years of sampling by park and drainage.

Park	Drainage	Years Sampled
Devils Postpile	San Joaquin Middle Fork	2001, 2004
Kings Canyon	San Joaquin South Fork	2002, 2005
	Kings Middle Fork	2006
	Kings South Fork	2004, 2005
	Kaweah North Fork	2005
Sequoia	Kaweah North Fork	2006
	Kaweah Marble Fork	2002
	Kaweah East Fork	2002
	Kaweah Middle Fork	2006
	Kaweah South Fork	2002
	Kern	2004, 2005

Nets were generally opened 0.5 hrs after local sunset and remained open and closely tended for at least four hours. Given that bat activity is greatest in association with water (Grindal et al. 1999, Pierson et al. 2001), mist nets were most frequently set over creeks, or in association with water sources. At several localities, nets were also set in areas expected to be flyways or terrestrial foraging areas for certain species (*e.g.*, pallid bat).

We often set multiple nets in an area, sampling different habitat types (*e.g.*, nets were set over water, over land or at a potential roost) (Figure 4). In analyzing these data, we have treated all nets set on a single night in one habitat type as a "station." Thus nets set over a river and an adjacent gravel bar were treated as two "stations" to permit examination of habitat preferences by foraging bats (*e.g.*, is a particular species more likely to be captured over open water or over a gravel bar?). For each netting station, we calculated the number of bats captured per unit effort. We defined effort as (m^2 of net area* time [hours] nets were open)*100. See NPS (2017) to access netting data.



Figure 4. Two mist-netting "stations": Over water (left), and at a roost site (right).

2.3.3 Acoustic Methods

Survey Approach and Acoustic Equipment

Acoustic sampling involves the use of an Anabat Detector System to record the ultrasonic echolation calls of bats flying overhead. Each species has unique call characteristics (e.g. call frequency, shape, duration, and pulse intervals) which can often be used to identify the species of bats in recorded calls. This method can be used to identify seven of the 17 species documented by this inventory.

Acoustic sampling was usually conducted with broad-band frequency dividing Anabat detectors (Titley Electronics, Ballina, NSW, Australia) and zero-crossing analyzers (zcaims). This system records compressed bat echolocation calls on compact flash cards and has been used elsewhere within NPS for bat inventory and activity assessment (e.g., Gorresen et al. 2008, Rodhouse et al. 2005).

Two recent acoustic studies (Hayes 1997, Ballantyne and Sherwin 1999) showed that night to night variation in bat activity is sufficiently high that comparing activity data requires several nights of repeat sampling at the same sites or by establishing multiple survey points that are sampled concurrently. We used both approaches. We typically deployed four to six acoustic detectors, sometimes without other sampling methods concurrently, but more often in the vicinity of mist-netting localities. In areas with road access acoustic sites were often a number of kilometers from the netting site; in areas with walking trail access, sites were selected within a kilometer of the net site.

We did acoustic monitoring associated with each capture site. In general, acoustic sampling locations were selected to sample particular habitat features (e.g., rock outcrop, pond, meadow), particularly those that could not be sampled by capture methods (Figure 5a-c). Detectors were deployed in late afternoon, prior to setting up mist nets, and run overnight, or, if feasible, for multiple nights. In the backcountry, acoustic unit batteries were recharged daily when feasible using 6.5 watt flexible solar panels (Global Solar Energy, Tucson, AZ) (Figure 5d). Detector microphones in weather shrouds on 5m extension cables were placed on 30cm-1m masts and directed downward at a reflector plate to avoid precipitation damage.

a. 

b. 

c. 

d. 

Figure 5. Short-term detection systems sampling different habitat elements at (a) a water site on the edge of Lower Rae Lake (b) a dry meadow in Tehipite Valley, and (c) foxtail pine forest near Guyot Flat. (d) Detectors being recharged with portable solar panels at McClure Meadow, Evolution Basin.

We also ran four solar-powered long-term acoustic monitors that recorded bat calls from sunset to sunrise for extended intervals at several localities (Figure 6a-d). In each case we selected open, uncluttered habitat where we stood the best chance of obtaining acoustic files that could be identified to species. Also, these were all sites that would be difficult or unproductive to sample by any available capture methods. We also selected road accessible sites to sample at a range of elevations. The longest running detectors were in the Ash Mountain area, at the waterfall on Sycamore Creek (642 m) from 5/28/04-09/11/04, and Shepherd's Saddle near Ash Mountain (925 m) from 5/28/04 to present; an open manzanita flat just west of Knapp's Cabin in Cedar Grove (1466 m), from 11/11/2004 to 12/26/2007; and at Beetle Rock in Giant Forest (1954 m) from 5/28/2004-06/17/2006. We also ran one detector from 5/29/04-11/10/04 in Mineral King (2336 m), and one over winter (11/11/2004-3/17/2005) on the river edge near Zumwalt Meadow in Cedar Grove. A monitor deployed in a meadow along the Middle Fork Kaweah above park headquarters was damaged and removed.

The long-term, passive acoustic monitoring systems were also based on AnaBat system components (AnaBat II detector and ZCAIM zero-crossing analyzer; Titley Electronics, Ballina, NSW, Australia) fitted in a NEMA-rated gasketed weathertight enclosure (assembled EME Systems, Berkeley, CA). These systems were powered by 12V lead acid batteries, and provided with cables extending through the case wall for an external five-watt solar panel, microphone extension, and a digital temperature/humidity sensor (Sensirion, Inc., prepared by EME systems). The ZCAIMs were also modified to allow external activation and shutdown by a multi-channel data logger/controller (OWL2pe) with custom firmware.

Use of the system relies on two Windows™ programs – CFCread and AnalookW. These are available at:

http://www.titley.com.au/ViewContent-AnaBat-Systems-Software-by-Titley-Scientific

http://users.lmi.net/corben/anabat.htm#Latest%20ZCAIM%20Software

A detailed description of the analytic tools is available in Rainey et al. 2009. Only a limited portion of these long-term data has been analyzed and summarized graphically (see *Eumops perotis*, *Lasionycteris noctivagans*, and *Lasiurus blossevillii* species accounts in Appendix VI). Further analyses of these long-term acoustic data to evaluate seasonal patterns in bat habitat use are outside the scope of this report, which focuses primarily on documenting species occurrence and distribution.

a.  b. 

c.  d. 

Figure 6. Solar-powered, long-term detectors at (a) flat west of Knapp's Cabin, Cedar Grove, (b) Shepherd's Saddle above Ash Mountain, (c) Beetle Rock in Giant Forest, and (d) Mineral King valley.

Acoustic Identification of Species

The effectiveness of acoustic surveys for locating and identifying bats depends on two parameters: 1) how readily a bat can be detected, and 2) with what degree of reliability it can be identified once detected. Detectability is a function of call frequency, call intensity, and distance. In general, those species with low frequency, high intensity calls will be detected at the greatest distance. Detection of bat species that call in the audible range (<20 kHz) is lessened, however, by filters in the detectors designed to reduce extraneous noise from insects, wind, etc.

Identifying bat species based on echolocation calls relies on analysis of a number of call parameters including base frequency, call shape (slope as measured in octaves per second and overall pattern), pattern of calls within a sequence, inter-pulse interval, and call duration.

For some species, particular combinations of call characteristics allow them to be readily distinguished from all other taxa that might occur in a survey area. Basic knowledge of the species expected is important because some species could be readily distinguished from all other local species in one area and not in another.

Conducting bat acoustic surveys generally requires knowledge not only of the species specific call characteristics, but also of the biology and ecology of the species involved. For the 17 species that we identified as occurring in the study area, there are seven that can be readily identified from Anabat call sequences alone, and six for which identification is frequently problematic. The seven species that can be readily identified using the Anabat system are: *Antrozous pallidus*, *Euderma maculatum*, *Eumops perotis*, *Lasiurus blossevillii*, *Lasiurus cinereus*, *Myotis thysanodes*, and *Parastrellus hesperus*.

Identification based solely on echolocation calls is problematic for three sets of taxa. *Eptesicus fuscus*, *Lasionycteris noctivagans*, and *Tadarida brasiliensis* produce similar echolocation calls in a frequency range of between 20 kHz and 30 KHz. Although all three (especially *T. brasiliensis*) do produce sequences that are diagnostic, a large percentage of calls in this frequency range cannot be assigned to a species unless the animal has also been visually observed.

Likewise, *Myotis californicus* and *Myotis yumanensis*, both of which give echolocation calls with a characteristic frequency of circa 45-50 KHz, can be difficult to distinguish based on call structure alone, although some calls of each species appear to be diagnostic. If visual observation is possible, differences in flight style and foraging behavior often serve to distinguish these species – e.g., *M. yumanensis* commonly forage by skimming the water surface and *M. californicus* often forage along an irregular flight path in close association with vegetation, often at canopy height. We generally made no attempt to distinguish between these two species for passive acoustic data. However, we were able to confirm by active acoustic monitoring (spot-lighting flying bats while recording their echolocation calls) that the majority of 50 kHz animals in the groves were *M. californicus*.

Another currently unresolved group includes three *Myotis* species (*M. ciliolabrum*, *M. lucifugus*, and *M. volans*) that have characteristic frequencies of 35-45 KHz. Although visual observations of body size and flight behavior can sometimes serve to distinguish these species, all three are sufficiently

poorly known in California that there are many situations in which positive identification of animals in flight is also very difficult.

2.4 Data Analysis

2.4.1 Statistical Analysis for Capture Data

We considered whether counts of mist-netted bats were associated with the habitat categories described above by using a generalized linear model (GLM—Nelder and Wedderburn 1972) for counts, with a log link function and Poisson distributed errors. We used a forward stepping model selection process and Akaike's information criterion (AIC—Akaike 1973) to choose covariates for counts of each species. These analyses were performed in the mathematical programming language R, version 2.70 (R Development Core Team 2008) using the functions GLM and AIC. Model selection was presented as AIC tables, with the terms of the selected model presented as an analysis of variance (ANOVA) table.

2.4.2 Acoustic Data Analysis

Initial analysis of acoustic files utilized software filters available in AnalookW (Rainey et al. 2009). For the seven species for which all acoustic samples were reviewed, each file was individually examined to confirm identification assigned by the filters. For the majority of our analyses we focused on the seven species most reliably identified. In a number of cases, however, we included information on other species when we were able to obtain reliable identification and the data contributed important information on distribution, primarily to document presence at sites where the particular species had not been captured but was known from acoustic information to be present.

3.0 Results and Discussion

3.1 Pre-Existing Records

Prior to the current inventory effort relatively little was known regarding bat distribution in any of the three parks. The records outlined below come from several sources: published literature, museum records, the park database, and prior work conducted by the current investigators.

3.1.1 Literature Records

Published accounts addressing bat distribution in areas now contained in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument are rare. To this day, the only published, and still most comprehensive review of bat distribution for all of California is a synthesis by H.W. Grinnell in 1918 (Grinnell 1918). She makes reference to two interesting records: a *Myotis volans* collected at Kearsarge Pass, Inyo County in July 1912 (MVZ17791), and an adult male *Lasiurus blossevillii* collected at Three Rivers on September 16, 1891 (USNM31177). Grinnell also includes in her distributional data localities provided by a 1903 survey conducted by the Chicago Field Museum of Natural History (Elliot 1904, 1907). This collection effort yielded specimens of *Myotis evotis* and *Myotis volans* from "Mt. Whitney, Long Canyon, Hot Springs." While we had long assumed this was a locality within Sequoia National Park, Elliot (1904) makes it clear this site is Jordan Hot Springs in the Inyo National Forest, well south of Mt. Whitney, and outside the park boundary.

In another early publication, G.M. Allen (1919) identifies four species (*Myotis lucifugus, Myotis yumanensis, Myotis volans,* and *Eptesicus fuscus*) from Mt. Whitney. While one of the specimen tags for *M. lucifugus* (MCZ11747) at the Museum of Comparative Zoology (MCZ) at Harvard University indicates this collection was made in Tulare County, the locality description in Allen's paper (Allen 1919) would suggest the locality was on the east side, most likely at either Lower Boy Scout or Mirror Lakes: "Starting at Lone Pine, at the eastern foot, we ascended to the upper limit of timber and there camped… by the outlet of a mountain lake, at an altitude of about 11,000 feet." He further adds that the locality was at "the lower end of a large valley encroaching upon the main peak."

Miller and Allen (1928) provide a review of the systematics and distribution of the species of *Myotis*, including all seven species which are now known to occur within most of the jurisdictions covered by this report. They refer to the records discussed above that are held by the Field Museum in Chicago and Museum of Comparative Zoology at Harvard. The only record they report that likely falls within National Park boundaries is a July 2, 1912 record for a male *Myotis volans* from Kearsarge Pass (MVZ17791), first referred to by Grinnell (1918).

J. Grinnell (1933), in his review of the mammals of California, provides brief descriptions of known ranges for each of the 17 bat species covered in this report, relying primarily on information provided by Grinnell (1918) and Miller and Allen (1928). He does not report on any new records for any of the species.

Sumner and Dixon (1953) summarize by species accounts what was known in 1953 regarding the birds and mammals of the Sierra Nevada, with a particular emphasis on Sequoia and Kings Canyon

National Parks. In 1916 the Museum of Vertebrate Zoology (MVZ) at University of California, Berkeley organized field surveys of the Kings Canyon area as a parallel effort to other transect surveys, now known as the "Grinnell Surveys," that were being conducted farther north in the Yosemite (Grinnell and Storer 1924) and Mt. Lassen (Grinnell at al. 1930) areas. Additional surveys of Sequoia National Park were conducted by Dixon between 1933 and 1942, and in the Kings Canyon area by Sumner between 1935 and 1950. Their co-authored book (Sumner and Dixon 1953) reports on the results of all these surveys. As was typical during the era when shooting bats was the only way to collect them, the records for bats are very sparse. They provide species summaries for eight species, and most of the records are those that are reported in the earlier publications cited above (*e.g.*, Grinnell 1933, Miller and Allen 1928), and are outside park boundaries. While they offer visual observations of various species foraging, these are somewhat tentative, and have not been included in evaluation of species distribution. They do report on a *Myotis californicus* shot at Cedar Grove in September 1916, a *Parastrellus hesperus* found dead at a cabin near Hospital Rock in May 1935, and a *Tadarida brasiliensis* taken at the Ash Mountain Recreation Hall in November 1940. They also describe collection of *Eptesicus fuscus* at 5,000 ft in Kings Canyon (Kanawyers Site, Cedar Grove, MVZ 24818-24821), and multiple, likely reliable visual observations of this species flying in Goddard Canyon, over Evolution Creek, and at Colby Meadow.

J. Koshear and B. Lawton (1993) conducted bat surveys in Sequoia and Kings Canyon in 1993. Their records are included in the park wildlife observation database (Appendix III).

3.1.2 Museum Records

A review of 39 museum collections (Appendix I) in the United States and Canada revealed nine records for Kings Canyon, 39 for Sequoia National Park, and none for Devils Postpile (Appendix II). While these specimens are held by seven institutions, the largest collections are at Santa Barbara Museum of Natural History (SBMNH, the J. von Bloeker collection), and at California State University at Northridge (CSUN).

The Kings Canyon records, while sparse, are significant. They include the only museum record for *Euderma maculatum* for the park, which constitutes one of only 14 known localities for this species in California prior to 1991 (Pierson and Rainey 1998b). The record for *P. hesperus* from Baldy Ridge appears to be the highest elevation record for this species in California. The record for *M. volans* from Kearsarge Pass is also the highest known elevation record for this species.

The 39 records for Sequoia National Park are from eight localities. With the exception of an isolated record from the Ash Mountain area, there are multiple records per locality, and some localities are clustered – *e.g.*, nine specimens from four localities in the Giant Forest area. Approximately half the records (21 specimens representing four species) come from three collection efforts at Clough Cave.

Appendix II also includes 27 records from localities close to, but outside, park boundaries on the assumption that these records contribute to our understanding of bat distribution within park boundaries.

3.1.3 Park Database and Collection

The park database includes 147 records (Appendix III), 14 of which are supported by specimens (Appendix IV). The remaining records, not supported by specimens, come from a number of sources that vary in their reliability. We accepted all records collected by J. Koshear from bat surveys she conducted in the park in 1993. Also, we accepted all records that fit within the distributional range established by our inventory project. We did not include in our analysis some low elevation records for *Myotis lucifugus*, the localities for which were outside its documented elevational distribution. These observations are more likely to have been of *Myotis yumanensis*, a species that can be readily confused with *M. lucifugus*.

The park has 19 bat specimens in its collection at Ash Mountain, 14 of which are listed in the park database, and five which are not (Appendix IV). We reviewed all the specimens and corrected erroneous species identification for five specimens. The specimen labeled as *Antrozous pallidus* from Treehouse Meadow on the Chagoopa Plateau, long thought to be the highest elevation record for this species in California, has now been correctly identified as a *Myotis evotis*. Two specimens identified as *Myotis lucifugus* from the Middle Fork of the Kaweah are *Myotis yumanensis*, and two other specimens identified as *M. lucifugus* (one from Redwood Creek and the other from Redwood Mountain Grove) are actually *Myotis volans*. Another specimen identified as *M. yumanensis* from Cascade Creek is actually a *Myotis californicus*.

3.1.4 Prior Surveys by Current Investigators

We had done prior survey work in Sequoia National Park, which provided 92 bat records (Appendix V). Efforts in 1987 and 1988 focused on the Clough Cave area as part of survey for Townsend's Big-eared bat, *Corynorhinus townsendii*, under contract with California Department of Fish and Game (Pierson and Rainey 1996a), and yielded 27 capture records. Surveys conducted in the Giant Forest area in 1995 for the National Park Service, in the context of the environmental assessment for restoration of Giant Forest (particularly the removal of numerous human structures) (Pierson and Heady 1996), yielded 62 capture records. Three additional records came from a single capture effort conducted with Harold Werner (SEKI Resources Management and Science Division) on the North Fork of the Kaweah.

3.1.5 Pre-existing Records Summary

In Table 3, we summarize the bat species documented by these four types of pre-existing records. None of these pre-existing records documented bat species for Devils Postpile, but they did inform our survey efforts for Sequoia and Kings Canyon. We used these records to establish the initial species list for Sequoia and Kings Canyon and to estimate the expected number of species for Devils Postpile. These lists also helped us target species that were not yet well-documented.

3.2 Overall Bat Diversity: This Study

This study documented a total of seventeen species of bats in the three parks: ten (possibly thirteen) in Devils Postpile National Monument, sixteen in Kings Canyon National Park, and sixteen (possibly seventeen) in Sequoia National Park (Table 4). We obtained possible acoustic records for one species in Sequoia and three species in Devils Postpile for which there were no prior records. Because these species had not previously been documented and the acoustic records were not definitive (*i.e.*, unlikely to be anything else, but did not exactly fit our diagnostic profile), we have included them in Table 4 with a question mark, and have not recognized them as present in subsequent analyses of bat distribution in these parks.

Table 3. Summary of bat species documented through literature searches, museum records, the Sequoia and Kings Canyon National Parks wildlife observation database, and prior survey efforts.

Species	**Literature Search**		**Museum Records[1]**		**Wildlife Observation Database**		**Prior Studies (Pierson & Rainey)[2]**
	KICA	**SEQU**	**KICA**	**SEQU**	**KICA**	**SEQU**	**SEQU**
Antrozous pallidus			--	3	--	8	15
Corynorhinus townsendii			--	1	--	23	1
Eptesicus fuscus	X	X	9	2	19	21	29
Euderma maculatum			1	--	3	1	1
umops perotis			--	--	--	--	2
Lasionycteris noctivagans			--	1	2	--	--
Lasiurus blossevillii			1	--	--	1	--
Lasiurus cinereus			--	--	1	--	--
Myotis californicus	X		3	12	2	15	5
Myotis ciliolabrum			--	--	--	--	--
Myotis evotis			--	3	5	7	7
Myotis lucifugus		X	--	--	6	6	--
Myotis thysanodes			--	21	2	1	4
Myotis volans	X	X	1	1	--	3	4
Myotis yumanensis		X	2	--	--	12	3
Parastrellus hesperus		X	1	--	--	--	2
Tadarida brasiliensis			--	--	--	7	17
Total species	**3**	**5**	**7**	**8**	**8**	**12**	**12**

[1]Museum records include 39 outside museums and the Sequoia & Kings Canyon National Parks museum. Corrections to the Sequoia & Kings Canyon museum records are accounted for in this table. See appendices I, IV, and V for more details.

[2]Surveys of bats conducted in Giant Forest and foothill areas of Sequoia National Park between1986-1995. See appendix VI for more information.

Table 4. List of species documented as occurring in Sequoia & Kings Canyon National Parks and Devils Postpile National Monument in this study. C=capture; A=acoustic record; A/V=acoustic + visual observation; A?=probable, but not definitive, acoustic record; ND=not detected; *=first record for the park.

Species	**Common Name**	**Devils Postpile**	**Kings Canyon**	**Sequoia**
Antrozous pallidus	Pallid bat	A?*	C*, A*	C, A
Corynorhinus townsendii	Townsend's big-eared bat	ND	ND	C
Eptesicus fuscus	Big brown bat	C*	C	C
Euderma maculatum	Spotted bat	A*	A	A
Eumops perotis	Western mastiff bat	A*	A*	A
Lasionycteris noctivagans	Silver-haired bat	C*	C	A?*
Lasiurus blossevillii	Western red bat	A?*	C, A*	C, A
Lasiurus cinereus	Hoary bat	C*	C	C*
Myotis californicus	California myotis	ND	C	C
Myotis ciliolabrum	Small-footed myotis	ND	C*	C*
Myotis evotis	Long-eared myotis	C*	C	C
Myotis lucifugus	Little brown bat	C*	C, A/V	C, A/V
Myotis thysanodes	Fringed myotis	A?*	C	C
Myotis volans	Long-legged myotis	C*	C*	C
Myotis yumanensis	Yuma myotis	C*	C	C
Parastrellus hesperus	Canyon bat	ND	C	C
Tadarida brasiliensis	Mexican free-tailed bat	C*	C*	C
	Total # Species Detected	**10 (13)**	**16**	**16 (17)**

Using the definitive records from this study, and excluding those with questionmarks, we succeeded in meeting the inventory goal of documenting at least 90 percent of expected bat species for both Sequoia and Kings Canyon National Parks and made good progress in meeting this goal for Devils Postpile (Table 5).

Table 5. Number of expected (pre-survey) and documented (post-survey) bat species for Devils Postpile National Monument, and Sequoia & Kings Canyon National Parks. Percent of expected species documented exceeded the inventory objective for the two large parks.

	Devils Postpile	**Kings Canyon**	**Sequoia**
Number expected species	13	17	17
Number documented species	10	16	16
Percent (documented/expected)	**77%**	**94%**	**94%**

We captured 655 bats in 68 mist-netting sessions conducted at 64 sites between 2001 and 2006 (Appendix VI). This assemblage included 15 of the 17 species known to occur in the parks. The spotted bat (*Euderma maculatum*) and the western mastiff bat (*Eumops perotis*) were detected only acoustically, although we had a capture record for *E. maculatum* from a previous study in Giant Forest (Pierson and Heady 1996). Two species, *Eptesicus fuscus* and *Myotis yumanensis*, account for 50% of all captures (Figure 7). Taken together, the five most frequently captured species accounted for 79.58% of all captures, with the remaining 10 species accounting for 17.06%. The 10 rarer species ranged from 0.15% (*Corynorhinus townsendii*) to 3.66% (*Myotis thysanodes*) of all captures.

Relative abundance can be influenced by other factors than actual bat abundance. Bat capture rates can vary due a number of factors, including net effort, moon phase, weather, season, bat behavior and biology. Some species of bats are caught more frequently than others, and a few species, such as *Eumops perotis* and *Euderma maculatum*, are not easy to capture in a mist net due to their flight behavior. Thus relative abundance data must be interpreted with caution given the factors influencing capture rates.

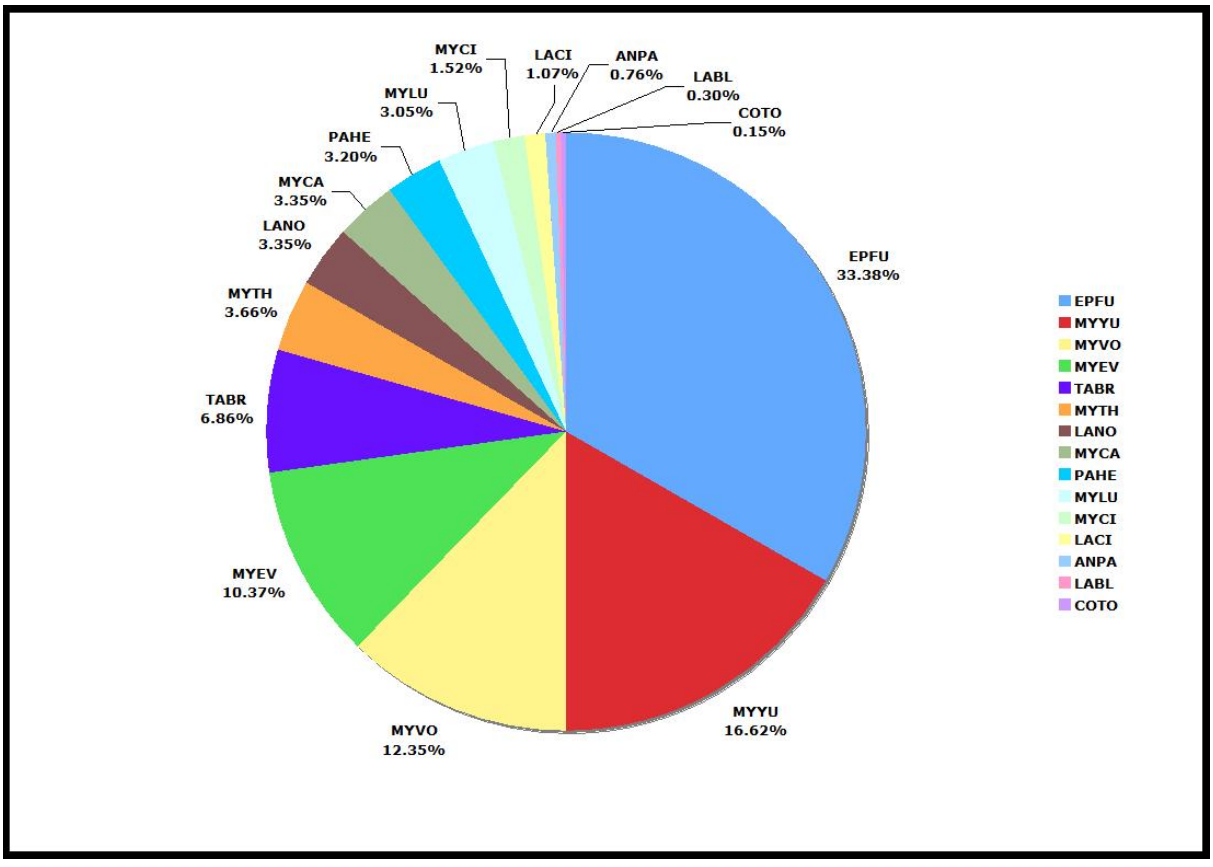


Figure 7. The relative abundance of the 15 species detected in mist-net captures.

Figure 8 plots the number of individuals captured for each species against the number of sites at which they were detected. *E. fuscus* (EPFU) and *Myotis evotis* (MYEV) are both distinct outliers. They appear to be the two most widely distributed species, with *E. fuscus* being more abundant than

expected and *M. evotis* less abundant than expected based on the number of sites at which they were encountered.

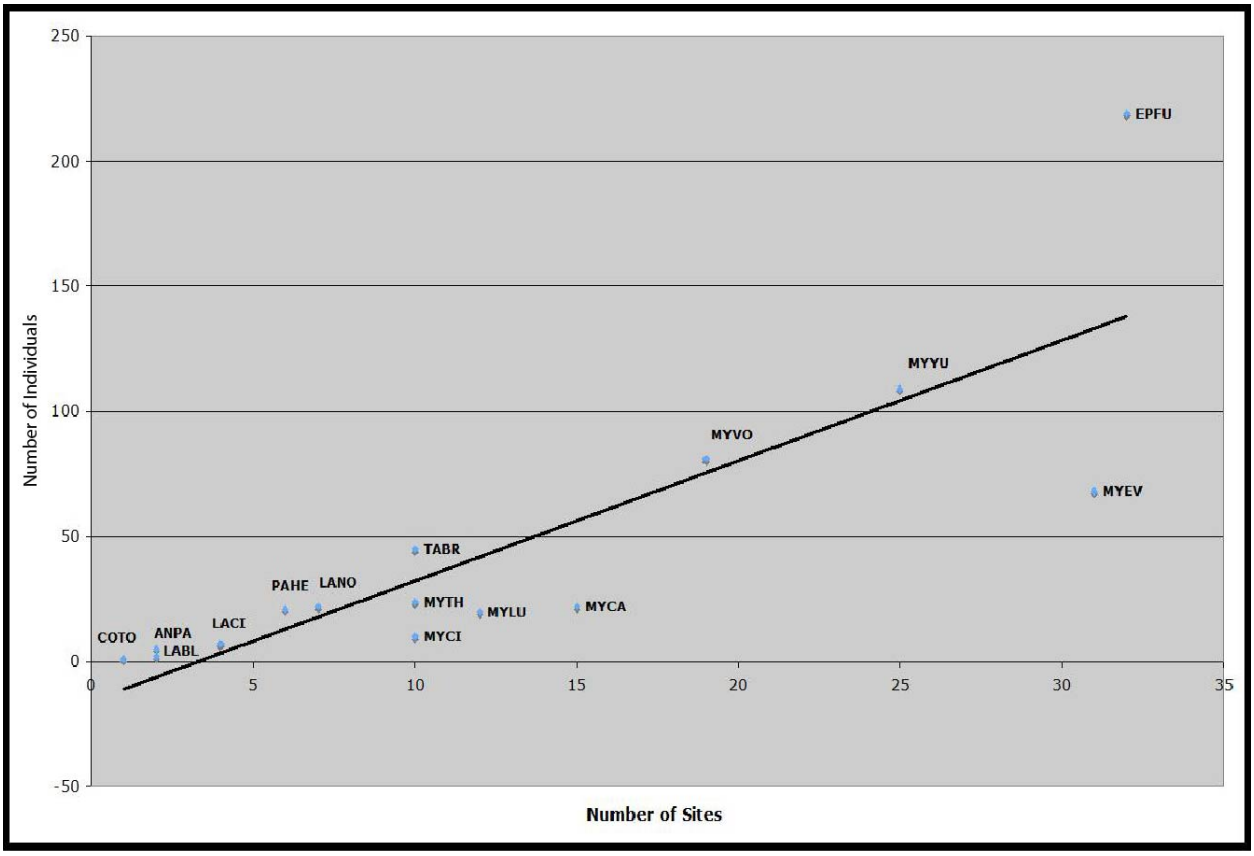


Figure 8. The number of individuals for each species plotted in relation to the number of sites at which they were found.

Due to current limitations regarding acoustic analysis (see Section 2.4.2), we restricted a complete acoustic analysis to the seven species most reliably identified acoustically. These include five species that were among the most rare in net captures (*Antrozous pallildus*, *Lasiurus blossevillii*, *Lasiurus cinereus*, *Myotis thysanodes*, and *Parastrellus hesperus*), plus the two (*Euderma maculatum* and *Eumops perotis*) that were not captured at all.

Figure 9 compares the percentage of sites at which these seven species occurred by acoustic and capture methods. As is evident, for all species except *Myotis thysanodes* (MYTH), the detection rate was markedly higher using acoustic methods, the logical conclusion being that capture methods are inadequate for evaluating presence/absence for six of the seven species. The implications of acoustic data for understanding the distribution of each of these species is discussed in the respective species accounts (Appendix VI).

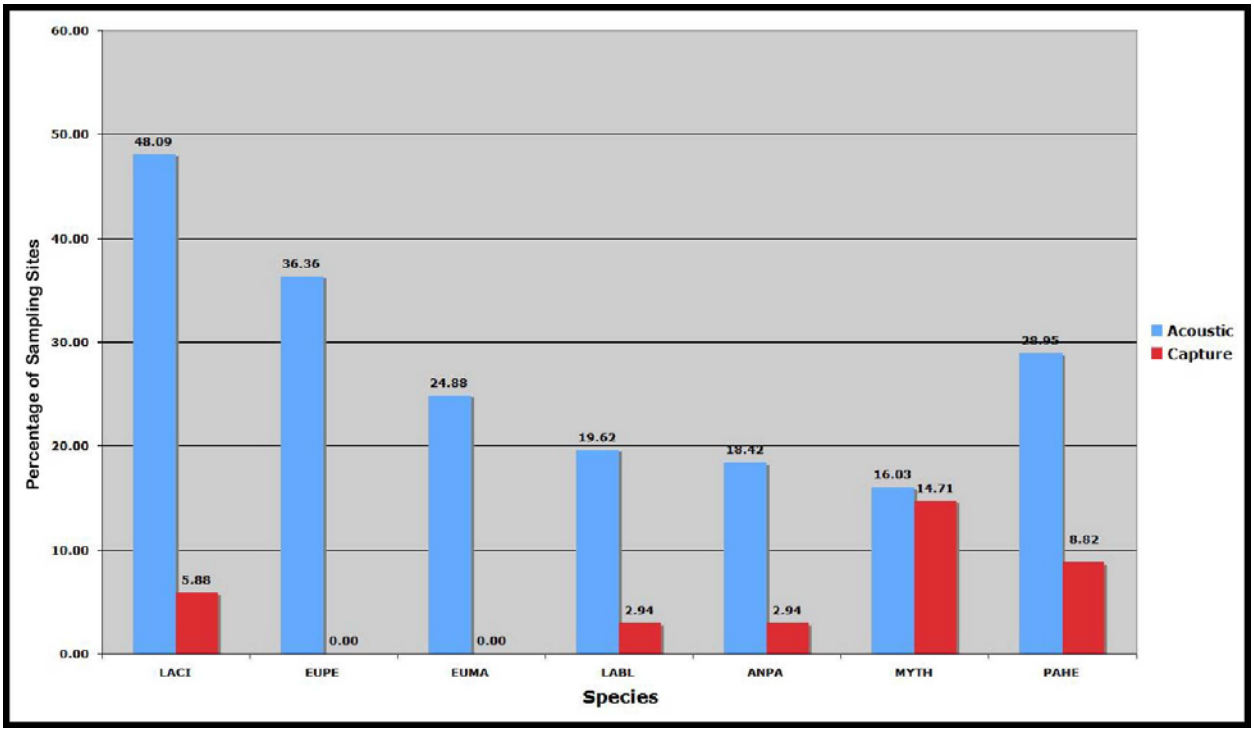


Figure 9. The percentage of sampling sites at which the seven species noted on the x-axis were detected by capture and acoustic methods. Acoustic sampling was done at all mist-net stations as well as at additional sites without mist-netting.

An analysis of our netting data, considering four foraging habitat categories plus elevation showed that bats were most likely to be captured at sites in association with water (Table 6).

Table 6. AIC Values for Univariate Model for four foraging habitat categories.

Foraging Habitat	df	AIC
Meadow_Scrub	4	1248.3792
Forest	2	1257.9017
Elevation (m)	2	1249.4910
Water	7	843.1044
Rock	4	1215.1275

Using a generalized linear model (GLM) we then looked at the various sub-categories for water. The analysis, which uses creeks as the intercept, indicates that the value for creeks is significantly different from zero, and that most of the water categories differ significantly from creeks, with significantly fewer bats expected at lakes and marshes, and more at ponds and rivers. Flooded meadows were not significantly different from creeks (Table 7, Figure 10). It is important to note, however, that capture rates are likely to be higher at creeks or ponds than meadows or lakes because bats are more widely distributed over the meadows and lakes, thus reducing capture rates. Some of the pattern seen in higher capture rates over ponds and rivers may be attributable to the methodology used and the probability of increased capture rates over areas where bats are more concentrated due to geography and feeding behavior.

Table 7. Terms of the model for water categories.

Coefficients	Estimate	Std. Error	Z Value	Pr(>|z|)
Creek(Intercept)	2.05645	0.06226	33.032	< 2e-16 ***
Flooded Meadow	0.05376	0.18488	0.291	0.771207
Lake	-2.05645	0.58070	-3.541	0.000398 ***
Marsh	-1.36330	0.50386	-2.706	0.006816 **
Not Water	-2.24366	0.18245	-12.297	< 2e-16 ***
Pond	0.93928	0.12797	7.340	2.14e-13 ***
River	0.50368	0.09331	5.398	6.74e-08 ***

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Null deviance: 1094.75 on 102 degrees of freedom

Residual deviance: 582.52 on 96 degrees of freedom

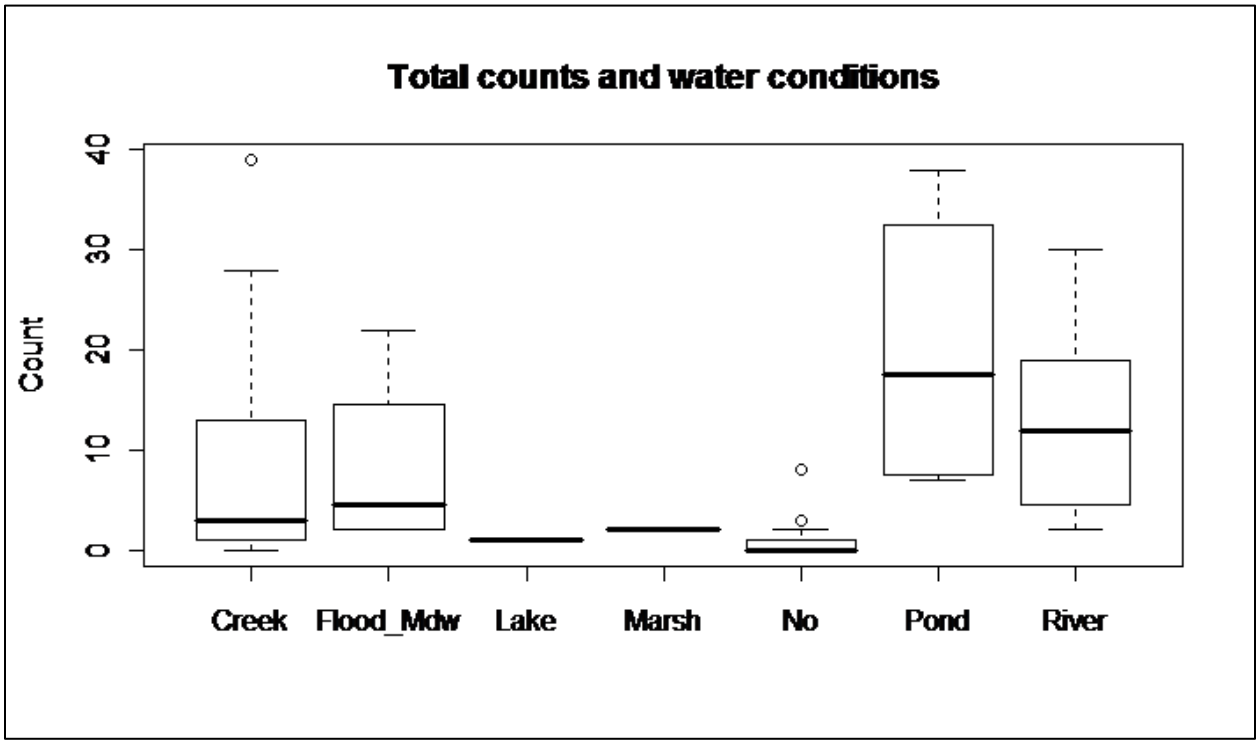


Figure 10. The quartiles (with median values as bold horizontal lines) for number of bats captured at six types of water sites, and sites that were not at water.

3.3. Bat Assemblage by Park

The following sections (3.3.1 through 3.3.3) discuss in detail the results of our current inventory for each of the three jurisdictions, based on both capture and acoustic data. In overview of our capture records, *E. fuscus* was the most frequently encountered species in Devils Postpile and Kings Canyon, and *M. yumanensis* in Sequoia. *E. fuscus*, *M. evotis*, *M. yumanensis*, and *M. volans* are among the five most commonly encountered species in all three parks. The most striking differences among the

parks are that *M. yumanensis* is far more common in Sequoia than in the other two parks, and *Tadarida brasiliensis* is among the five most freqeuntly encountered species in both Sequoia and Kings Canyon, but not at Devils Postpile. While *Myotis lucifugus* and *Lasionycteris noctivagans* are among the five most frequently encountered in Devils Postpile, the former is among the rarer species in both Sequoia and Kings Canyon, and the latter appears rare in Kings Canyon and may not occur in Sequoia. The most likely explanation for all these differences is the elevational range covered by each jurisdiction. For example, the predominance of *M. yumanensis* in Sequoia can be explained by the concentration of this species at lower elevation sites (particularly Ash Mountain), and the relative abundance of *M. lucifugus* and *L. noctivagans* at Devils Postpile by the restricted elevation range within this park that corresponds to the restricted elevational distribution of these two species (see Section 3.5)

3.3.1. Devils Postpile

3.3.1.1. Overview

We sampled Devils Postpile for a total of five nights: two nights in 2001 (August 23-24), and three nights in 2004 (July 28-30). Working with two teams, we conducted 10 mist-netting sessions at four sites in 2001, and six sites in 2004 (with a repeat sampling of three sites: two on the San Joaquin River near the Ranger Station and the Sag Pond) (see Pierson and Rainey 2017 to link to data). We also deployed between 5 and 10 remote acoustic detectors per night, for a total of 37 sampling nights at 22 different acoustic stations. A number of stations were repeat sampled, both within and between years (see Pierson and Rainey 2017 to link to data). We detected a total of 10 species; eight were captured in mist-nets and two were detected only acoustically (Table 4).

3.3.1.2. Capture Data

We captured a total of 111 bats (Table 8). At least four of the eight species appeared to have reproductive populations in the area (*E. fuscus*, *M. lucifugus*, *M. volans*, and *M. yumanensis*). The capture of a lactating *M. yumanensis* on July 30, 2004 over the San Joaquin River is notable as it represents the highest elevation record known for a lactating female for this species. The species identity was confirmed by genetic analysis of a guano sample taken from this individual (J. Zinck, personal communication). We captured a post-lactating *Lasiurus cinereus* on 23 August 2001. Given that this species is not known to raise young in California, and that the vast majority of records for female *L. cinereus* in California are from the spring and fall migration periods, with migration thought to begin in mid-August (Pierson et al. 2006b), we presumed this to be a migrating individual. The presence of post-lactating females for *M. evotis* and *L. noctivagans* is, however, suggestive that these two species have reproductive populations in the park.

Table 8. Age and reproductive condition for bats captured in Devils Postpile National Monument, Middle Fork San Joaquin River. Preg = pregnant; Lact=lactating; Plact=post-lactating; Null=nulliparous; Par = parous; Juv=juvenile; Unk=unknown.

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Eptesicus fuscus											
8/24/01	Sag Pond, King Ck Trail			6			20		1		27
7/28/04	Sag Pond, King Ck Trail			6	1		7	1	1	1	17
7/29/04	Kings Ck, abv. river confluence			4			2				6
7/29/04	San Joaquin, blw. Muir Trail			4	1		1	1			7
8/24/01	Sag Pond, King Ck Trail			6			20		1		27
	Subtotals	**0**	**0**	**20**	**2**	**0**	**30**	**2**	**2**	**1**	**57**
Lasionycteris noctivagans											
8/24/01	Sag Pond, King Ck Trail						7				7
7/28/04	Sag Pond, King Ck Trail						3				3
7/29/04	Kings Ck, abv. river confluence			1			4				4
7/29/04	San Joaquin, blw Muir Trail						1				1
7/30/04	San Joaquin, nr. Ranger Station						1				1
	Subtotals	**0**	**0**	**1**	**0**	**0**	**16**	**0**	**0**	**0**	**16**
Lasiurus cinereus											
8/23/01	San Joaquin, nr. Ranger Station			1							1
	Subtotals	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Myotis evotis											
8/23/01	San Joaquin @Meadow			1	1					1	3
7/28/04	Sag Pond, King Ck Trail									1	1
7/29/04	Kings Ck, abv. river confluence				1						1
7/29/04	San Joaquin, blw. Muir Trail				2						2
	Subtotals	**0**	**0**	**1**	**4**	**0**	**0**	**0**	**0**	**2**	**7**
Myotis lucifugus											
8/23/01	San Joaquin, nr. Ranger Station						1	2	1		4
7/30/04	San Joaquin, nr. Ranger Station		2								2
8/23/01	San Joaquin @ Meadow			1			1				2
7/30/04	San Joaquin @ Meadow				1						1
7/28/04	Sag Pond, King Ck Trail			2					1		3
	Subtotals	**0**	**2**	**3**	**1**	**0**	**2**	**2**	**2**		**12**

Table 8. Age and reproductive condition for bats captured in Devils Postpile National Monument, Middle Fork San Joaquin River. Preg = pregnant; Lact=lactating; Plact=post-lactating; Null=nulliparous; Par=parous: Juv=juvenile; Unk=unknown. (continued)

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Myotis volans											
8/23/01	San Joaquin, nr. Ranger Station								1		1
8/24/01	Sag Pond, King Ck Trail						2	1	1		4
7/28/04	Sag Pond, King Ck Trail				3						3
8/23/01	San Joaquin, nr. Ranger Station								1		1
Subtotals		**0**	**0**	**0**	**3**	**0**	**2**	**1**	**2**		**8**
Myotis yumanensis											
8/23/01	San Joaquin, nr. Ranger Station								2		2
7/30/04	San Joaquin, nr. Ranger Station		1								1
8/23/01	San Joaquin@ Meadow						1				1
7/30/04	San Joaquin@ Meadow						1		1		2
7/29/04	San Joaquin, blw. Muir Trail						1				1
Subtotals		**0**	**1**	**0**	**0**	**0**	**3**	**0**	**3**		**7**
Tadarida brasiliensis											
7/29/04	San Joaquin, blw. Muir Trail			1			1				2
	Subtotals	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**2**
	TOTALS	**0**	**3**	**27**	**10**	**0**	**54**	**5**	**9**	**3**	**111**

The three most frequently captured species, accounting for 77.5% of all captures, were *E. fuscus*, *L. noctivagans,* and *M. lucifugus* (Figure 11). While *E. fuscus* was relatively common in all the parks, it represented a greater percentage of captures (51.4%) in Devils Postpile than in either of the other jurisdictions. It also was a clear outlier, being captured more frequently than expected based on the number of sites at which it was found (Figure 12). The most significant difference between Devils Postpile and the other jurisdictions was the relatively high capture rate for *L. noctivagans* and *M. lucifugus* in Devils Postpile. *M. lucifugus* is known to be a higher elevation species in the Sierra Nevada, not occurring below 2100 m in Yosemite National Park (Pierson et al. 2001). Thus it was neither surprising nor unexpected that it was relatively abundant and represented by both sexes and all age classes at Devils Postpile. The distribution of *L. noctivagans* is less well understood, but appears to reach its southern limit in the Sierra Nevada near the boundary between Sequoia and Kings Canyon National Parks (with there currently being no records from Sequoia). While populations in the Trinity Mountains and along the Upper Sacramento River are represented by both adult males and reproductive females (Pierson and Rainey 2007, Rainey and Pierson 1996), our capture sample of 17 individuals at Devils Postpile included 16 adult males and one post-lactating

female. This is consistent with findings elsewhere in the Sierra Nevada (Pierson et al. 2001), and with a seasonal sexual segregation observed in the Oregon Cascades (Cross et al. 1976).

The relatively high elevation of Devils Postpile likely explains the absence of some species, especially *Myotis californicus* and *Parastrellus hesperus*. It is also reaching the elevational limit for *Antrozous pallidus* and *Myotis thysanodes*. Thus if they occur there, they are likely rare.

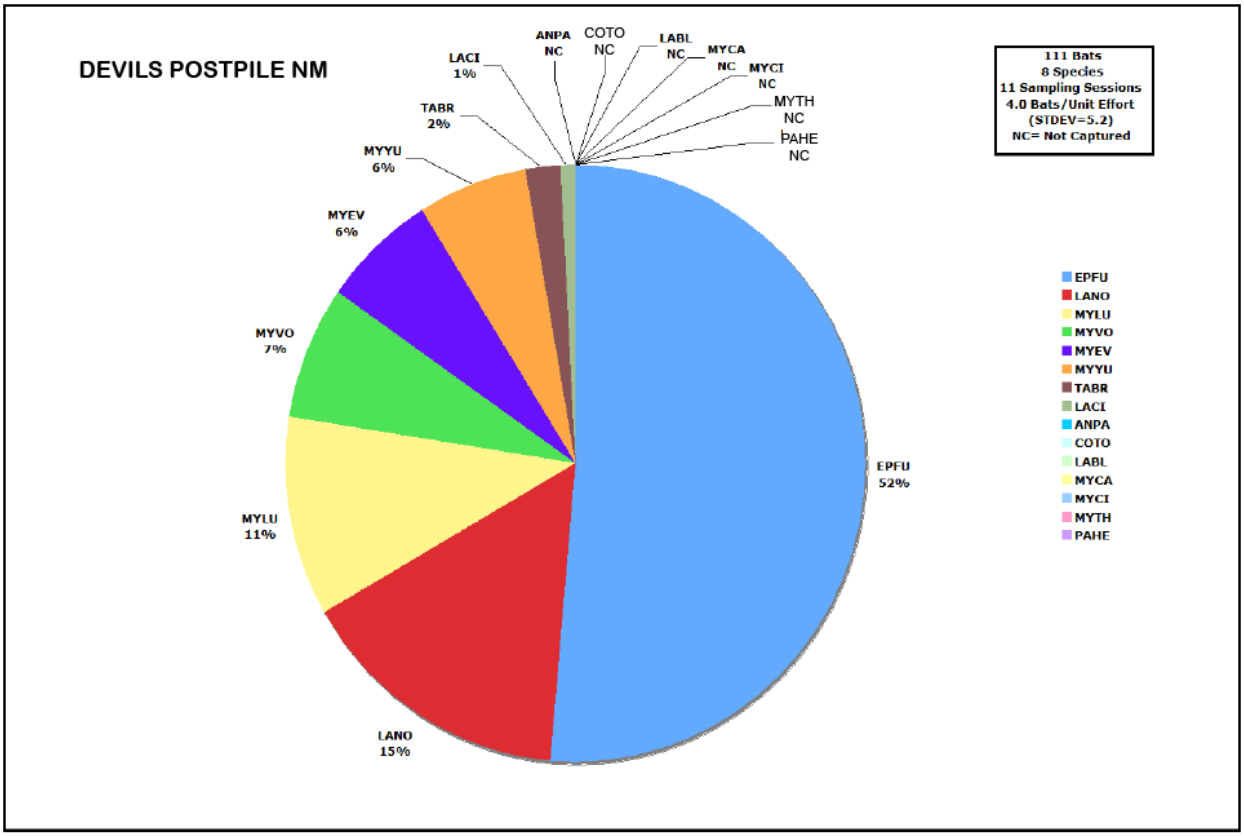


Figure 11. The relative abundance of species in net captures at Devils Postpile National Monument.

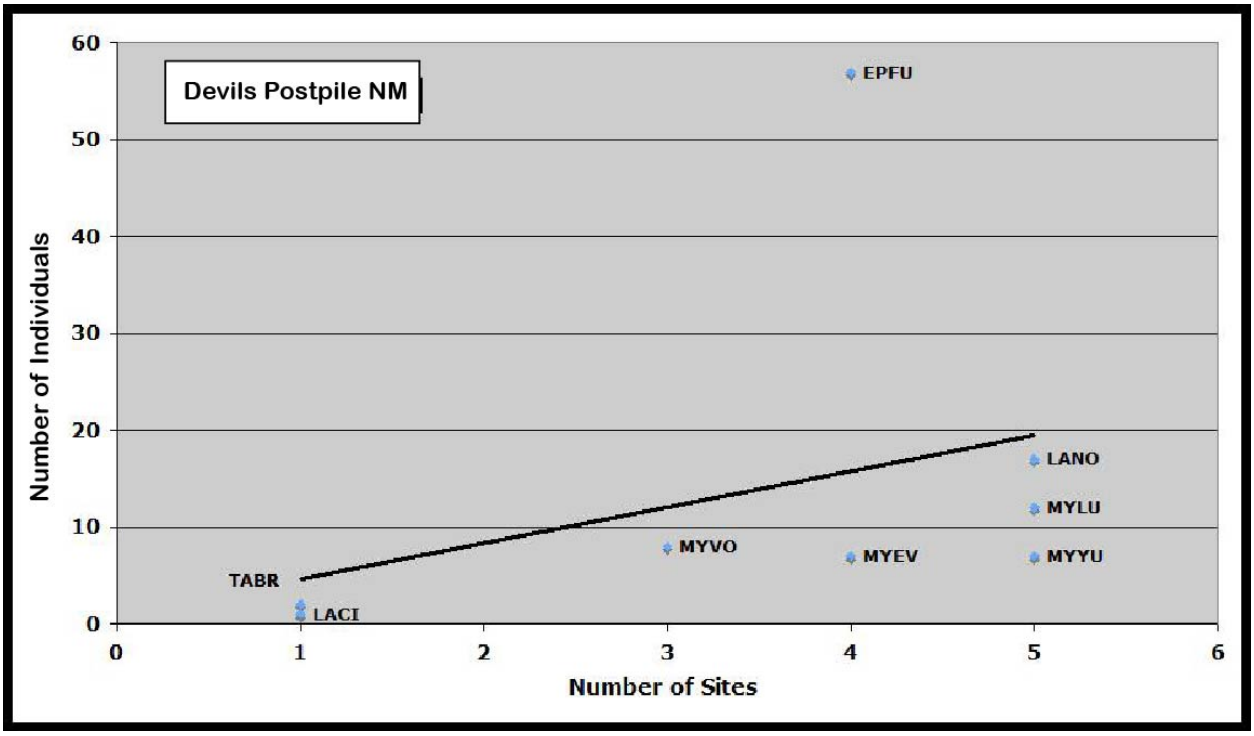


Figure 12. The number of individuals for each species plotted against the number of sites where they were found in Devils Postpile National Monument.

3.3.1.3. Acoustic Data

The results of our acoustic sampling are presented in Figure 13. The most striking result was the relative abundance and widespread distribution of *Lasiurus cinereus* in both the July and August samples (see Pierson and Rainey 2017 for link to project data). Also, there were two species, *Eumops perotis* and *Euderma maculatum*, that were detected only acoustically. Both of these cliff-dwelling species are known to travel long distances (>10 km) from their roosts to feed. Thus it is not known whether they are roosting in the Monument. Six sampling nights in association with the Postpile yielded only one foraging record for *E. perotis*. It thus seems unlikely either species is roosting at the Postpile cliffs.

Although we obtained single records that were potentially (but not unequivocally) attributable to *Antrozous pallidus* and *Myotis thysanodes*, we are treating these species as absent, with the comment that if present they are likely rare. Cottonwood habitat, thought to be preferred by *Lasiurus blossevillii*, was targeted for acoustic sampling at several sites. Nevertheless, we obtained only one possible record for this species. Given the sporadic detection of this species at higher elevations in Yosemite and in both Sequoia and Kings Canyon, we think it highly likely this species occurs in Devils Postpile, if perhaps only seasonally (e.g., spring or fall migration).

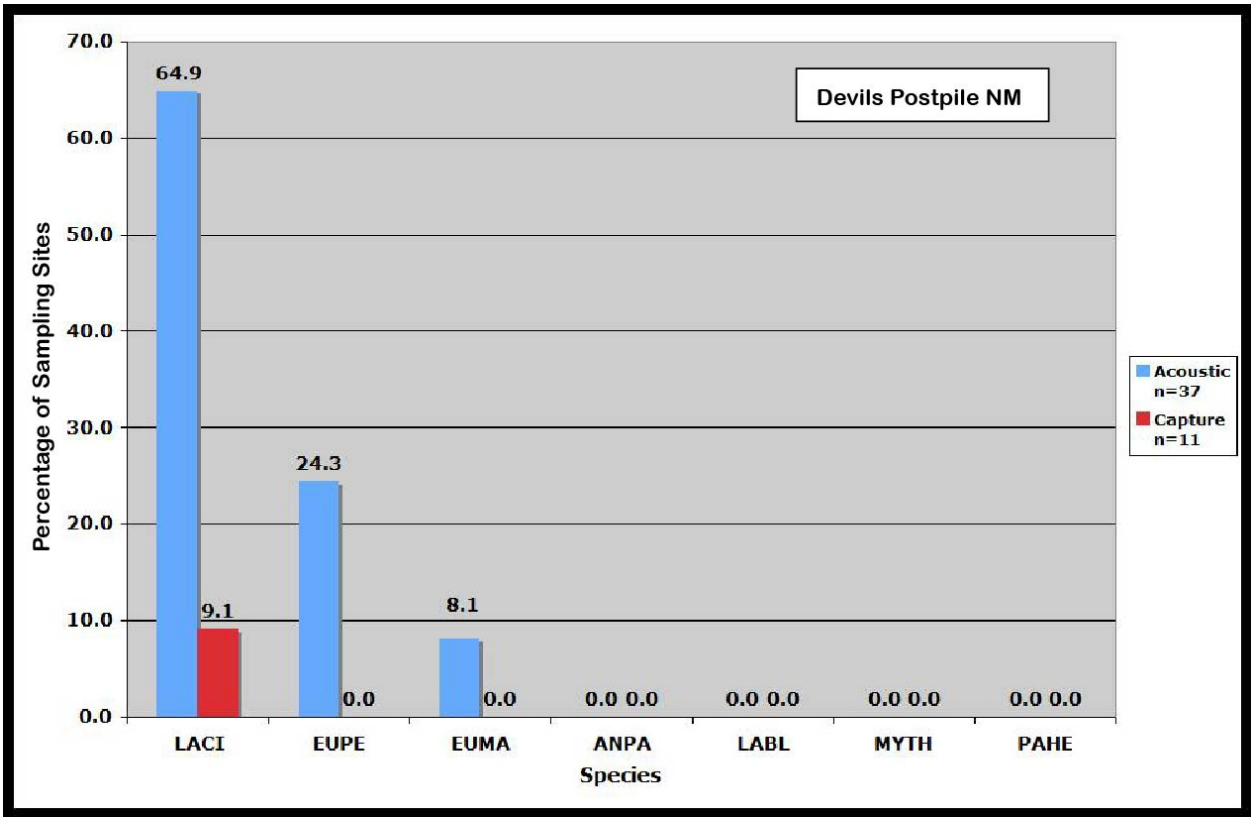


Figure 13. The percentage of sampling sites at which the species noted on the x-axis were detected by capture and acoustic methods in Devils Postpile National Monument. Acoustic monitoring always accompanied mist-net capture of bats, and was also done in areas without mist-net sampling.

3.3.1.4. Sampling Areas

Figure 14 shows the number of bats captured per unit effort and the number of species detected for each sampling site. In summary, bats were captured at all water sites except one seep, and the only land site at which bats were captured was a dry meadow site on the banks (within 10 m) of the San Joaquin River (Appendix VI).

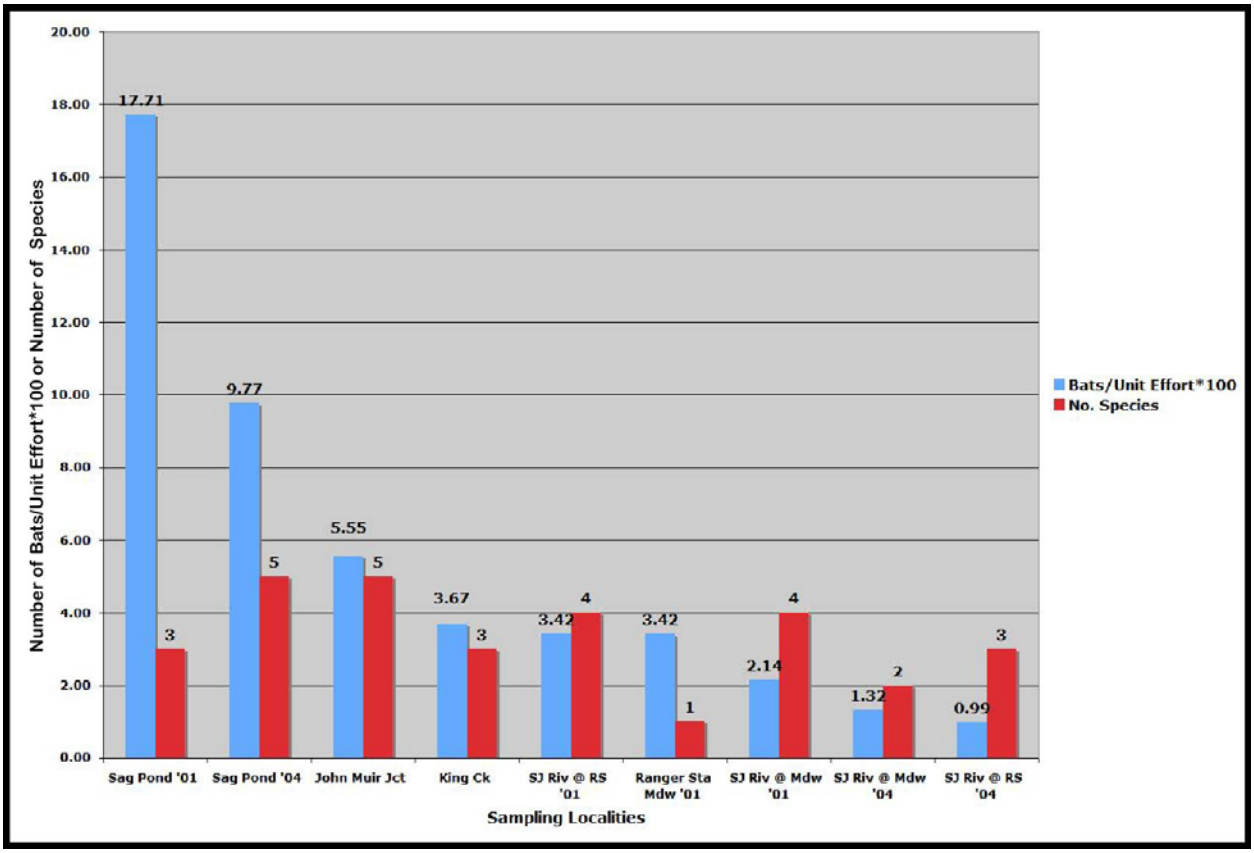
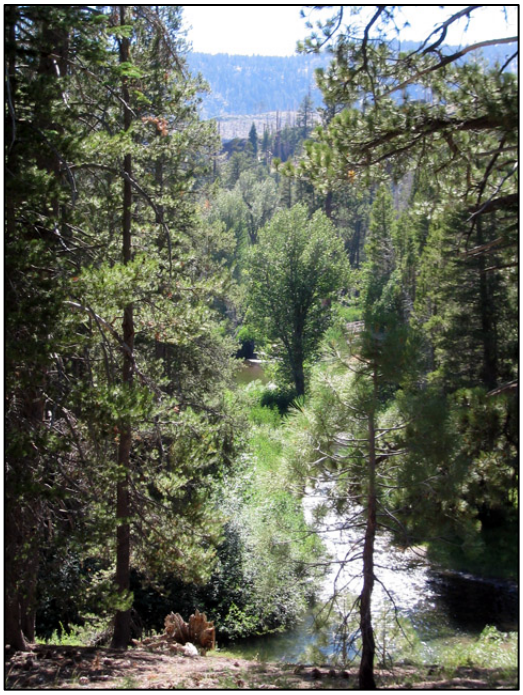


Figure 14. The number of bats captured/unit effort*100 and the number of species detected per site in Devils Postpile National Monument. All sites where bats were captured are included.

By far the most significant site we sampled in Devils Postpile was a small mountain tarn, which we called the Sag Pond (Figure 15a). It yielded more bats/unit effort than any other site, and along with the river (below the John Muir trail crossing), more species per site (five) than any other site (Figure 14, Appendix VI). Although our mist-netting efforts at the tarn represented only two out of 10 mist-netting sessions, we captured 65 bats here, or 58.6% of all bats captured. This site was highly favored by several species as indicated by the percentage of individuals (= total number for the monument) captured at this site: 77.2% for *E. fuscus*, 58.8% for *L. noctivagans*, and 87.5% for *M. volans*. Twenty-five percent of all *M. lucifugus* were also captured here. Our results here, and at similar mountain tarns in Sequoia National Park suggest these sites are very important to bats.

The next most important area in terms of capture yield (bats/unit effort and number of species detected) was a site on the San Joaquin River about 100 m below where the John Muir Trail crosses the river (Figure 15b), although bats were also captured at King Creek (Figure 15c) and two other sites on the San Joaquin River (Figure 15d).

a.  b. 

c.  d. 

Figure 15. (a) The Sag Pond in Devils Postpile National Monument, the highest yielding capture site in the park. Photographs of net sites on San Joaquin River: (b) 100 m below John Muir Trail crossing, (c) the river near the Ranger Station, and (d) the net site on Kings Creek.

3.3.2. Kings Canyon National Park

3.3.2.1. Overview

We sampled several geographically distinct areas in Kings Canyon National Park: Cedar Grove with a transect up to Rae Lakes through Paradise Valley; Tehipite Valley; Simpson Meadow; the Grant Grove and Redwood Creek area; Goddard Canyon and Evolution Basin. Surveys were conducted during summer months (July and August) between 2002 and 2006. We sampled a total of 24 stations on 22 different nights [see Pierson and Rainey 2017 for link to project data]). No stations were repeat sampled. In conjunction with netting efforts, we generally deployed multiple remote accoustic detectors in the general vicinity of the net site, obtaining 136 acoustic samples from 99 sites. At some

sites, detectors were deployed for up to five nights per station (see Pierson and Rainey 2017 for a link to project data). We detected a total of 16 species; fourteen were captured in mist-nets and two were detected only acoustically (Table 1).

3.3.2.2. Capture Data

We captured a total of 308 bats in Kings Canyon National Park: 48 in areas associated with the San Joaquin drainage (Goddard Canyon and Evolution Basin); 178 at stations associated with the Kings River (Cedar Grove, a transect up to Rae Lakes through Paradise Valley, Tehipite Valley, and Simpson Meadow); and 82 in the Grant Grove and Redwood Creek area (Table 9).

Figure 16 is a composite of sampling in all these areas. The three most frequently captured species, accounting for 59.6% of all captures were *E. fuscus*, *M. volans*, and *T. brasiliensis*. As at Devils Postpile, *E. fuscus* appears to be somewhat of an outlier, being captured in greater numbers than expected based on the number of sites at which it was detected (Figure 17).

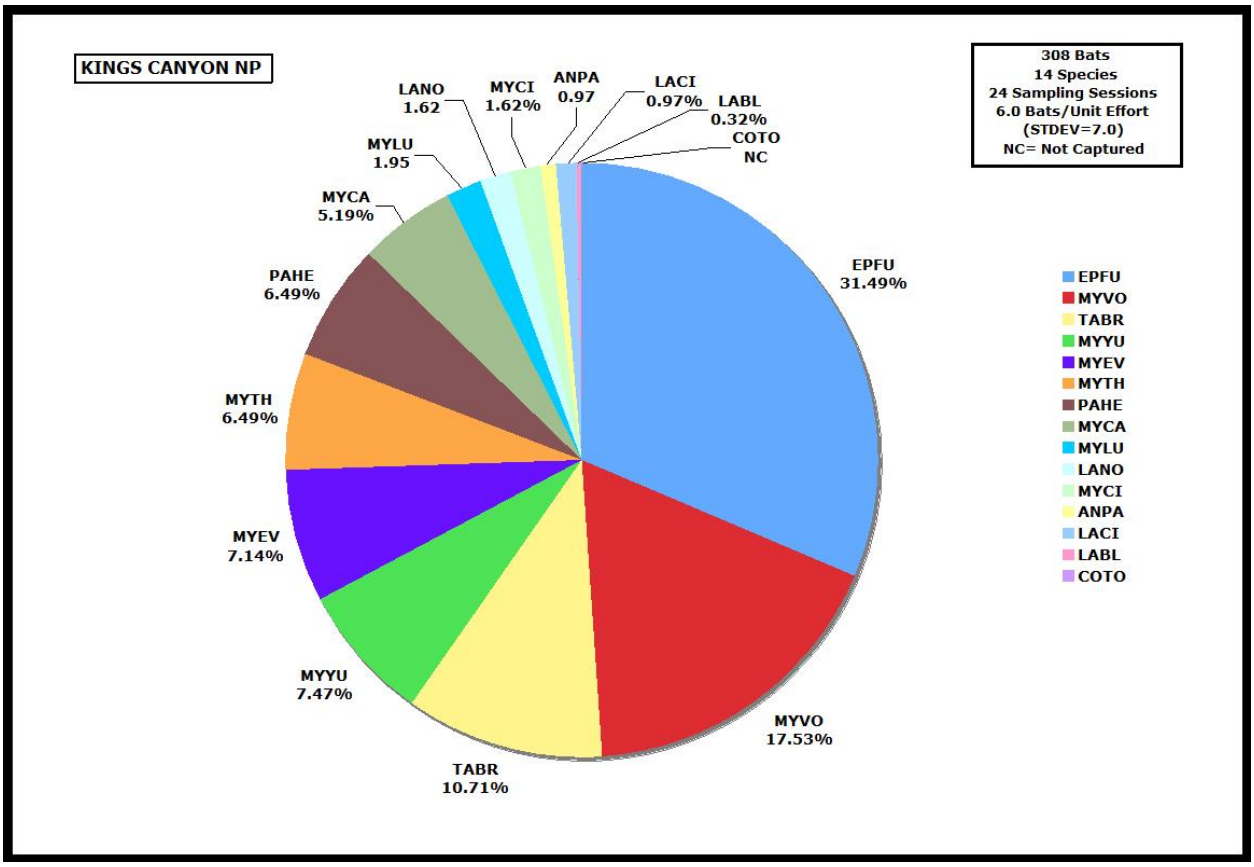


Figure 16. The relative abundance of species in net captures in Kings Canyon National Park.

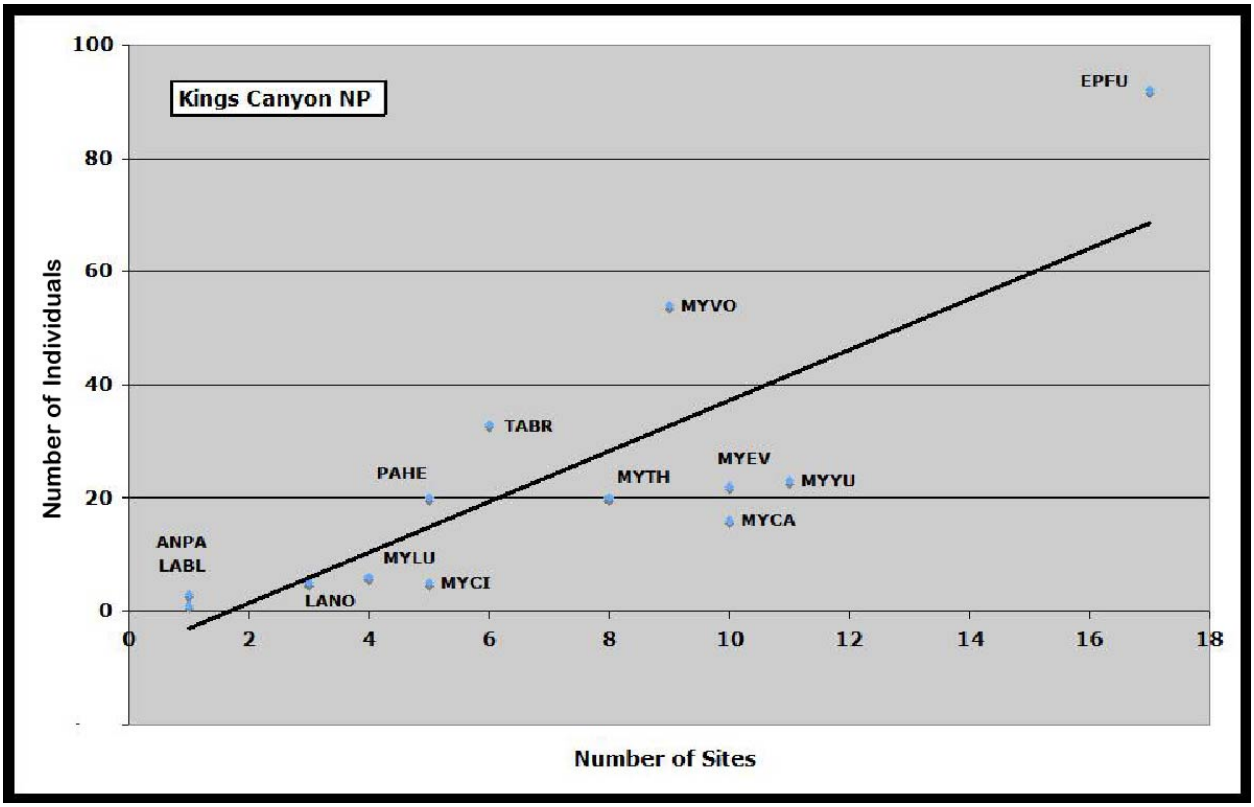


Figure 17. The number of individuals for each species plotted in relation to the number of sites at which they were found in Kings Canyon National Park.

At least ten species appeared to have reproductive populations in the park (Tables 9a-c). Those species represented in our captures by only adult males or non-reproductive adult females were *L. noctivagans*, *L. blossevillii*, *L. cinereus*, and *T. brasiliensis*. These results would be as expected for the three lasiurines (see species accounts), but is somewhat unexpected for *T. brasiliensis*. The absence of reproductive *T. brasiliensis* is likely a sampling anomaly, as large maternity colonies are known in Yosemite National Park, and reproductive females were detected in Sequoia.

Table 9a. Age and reproductive condition for bats captured in the South Fork of the San Joaquin River drainage, Kings Canyon National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par =parous; Juv = juvenile; Unk = Unknown.

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Eptesicus fuscus											
7/29/05	Blayney Mdws (outside park)						5				5
7/30/05	Goddard-Evolution Jctn						3				3
7/31/05	Franklin Meadow			2			11				13
8/1/05	Colby Meadow			1	1		5				7
8/2/05	McClure Meadow						1				1
8/24/01	1km below Goddard Jctn						1				1
	Subtotals	**0**	**0**	**3**	**1**	**0**	**26**	**0**	**0**	**0**	**30**
Myotis evotis											
7/31/05	Franklin Meadow		4				2				6
	Subtotals	**0**	**4**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**6**
Myotis lucifugus											
8/2/05	Franklin Meadow		1								1
	Subtotals	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Myotis volans											
7/31/05	McClure Meadow		1		1		2		1		5
8/3/05	1km below Goddard Jctn		1	1							2
	Subtotals	**0**	**2**	**1**	**1**	**0**	**2**	**0**	**1**	**0**	**7**
Myotis lucifugus											
7/29/05	Blayney Mdws (outside park)			1		1	1				3
	Subtotals	**0**	**0**	**1**	**0**	**1**	**1**				**3**
Tadarida brasiliensis											
8/2/05	McClure Meadow						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**		**1**
	TOTALS	**0**	**7**	**5**	**12**	**1**	**32**	**0**	**1**	**0**	**48**

Table 9b. Age and reproductive condition for bats captured in the Middle Fork and South Fork of the Kings River drainages, Kings Canyon National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par =parous; Juv = juvenile; Unk = Unknown.

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Antrozous pallidus											
7/11/02	Cedar Grove, river side channel		3								3
	Subtotals	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
Eptesicus fuscus											
6/21/06	Tehipite, Side Channel 1					1	3				4
6/22/06	Tehipite, Side Channel 2						1				1
6/27/06	Simpson Mdw, side pool									1	1
6/28/06	Simpson Mdw, deep pool		1	1			9			1	12
6/29/07	Simpson Mdw, Horseshoe Creek						1				1
7/10/02	Cedar Grove, river at Zumwalt				1		2				3
7/11/02	Cedar Grove, river side channel			1	1		22				24
7/19/04	Lower Paradise Valley						6				6
7/21/04	Baxter Meadow, wet		1				1				2
7/22/04	Baxter Meadow, nr camp						1				1
	Subtotals	**0**	**2**	**2**	**2**	**1**	**46**	**0**	**0**	**2**	**55**
Lasionycteris noctivagans											
7/28/06	Simpson Mdw, deep pool						2				2
	Subtotals	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**2**
Lasiurus cinereus											
7/10/02	Cedar Grove, river at Zumwalt						3				3
	Subtotals	**0**	**0**	**1**	**0**	**0**	**3**	**0**	**0**	**0**	**3**
Myotis californicus											
6/30/05	Fallen Monarch, Grant Grove						1				1
7/21/06	Tehipite, Side Channel 1				1		1				2
7/22/06	Tehipite, Side Channel 2						1	1			2
7/23/06	Tehipite, nr Crown Creek		2				1				3
7/24/06	Tehipite, nr camp		1								1
7/10/02	Cedar Grove, river at Zumwalt						1				1
7/11/02	Cedar Grove, river side channel						1				1
7/29/04	Lower Paradise Valley				1						1
	Subtotals	**0**	**3**	**0**	**2**	**0**	**6**	**1**	**0**	**0**	**12**

Table 9b. Age and reproductive condition for bats captured in the Middle Fork and South Fork of the Kings River drainages, Kings Canyon National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par =parous; Juv = juvenile; Unk = Unknown. (continued)

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Myotis ciliolabrum											
7/28/06	Simpson Mdw, deep pool						1				1
7/11/02	Cedar Grove, river side channel						1				1
7/19/04	Lower Paradise Valley							1			1
7/21/04	Baxter Meadow, wet						1				1
7/22/04	Baxter Mdw, near camp						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**4**	**1**	**0**	**0**	**5**
Myotis evotis											
7/22/06	Tehipite, Side Channel 2		1				2				3
7/23/06	Tehipite, nr. Crown Crk.		1		1		1			1	4
7/26/06	Simpson Mdw, Side Channel 1						1				1
7/29/07	Simpson Mdw, Horseshoe Creek						1				1
7/10/02	Cedar Grove, river at Zumwalt				1						1
7/11/02	Cedar Grove, river side channel		1		1						2
7/19/04	Lower Paradise Valley				1						1
	Subtotals	**0**	**3**	**0**	**4**	**0**	**5**	**0**	**0**	**1**	**13**
Myotis lucifugus											
7/27/06	Simpson Mdw, side pool				1						1
7/28/06	Simpson Mdw, deep pool				1	1	1				3
7/22/04	Lower Rae Lake		1								1
	Subtotals	**0**	**1**	**0**	**2**	**1**	**1**	**0**	**0**	**0**	**5**
Myotis thysanodes											
7/21/06	Tehipite, Side Channel 1						1				1
7/22/06	Tehipite, Side Channel 2						1				1
7/10/02	Cedar Grove, river at Zumwalt						1				1
7/11/02	Cedar Grove, river side channel		2		1		2				5
	Subtotals	**0**	**2**	**0**	**1**	**0**	**5**	**0**	**0**	**0**	**8**
Myotis volans											
7/22/06	Tehipite, Side Channel 2				2						2
7/23/06	Tehipite, nr. Crown Crk.						1				1
7/24/06	Tehipite, near Camp					1					1
7/11/02	Cedar Grove, river side channel						2				2
6/30/05	Fallen Monarch, Grant Grove	1	13	2	8		3				27
	Subtotals	**1**	**13**	**2**	**10**	**1**	**6**	**0**	**0**	**0**	**33**

Table 9b. Age and reproductive condition for bats captured in the Middle Fork and South Fork of the Kings River drainages, Kings Canyon National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par =parous; Juv = juvenile; Unk = Unknown. (continued)

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Myotis yumanensis											
6/30/05	Fallen Monarch, Grant Grove		2								2
7/21/06	Tehipite, Side Channel 1						3				3
7/22/06	Tehipite, Side Channel 2						4				4
7/24/06	Tehipite, near Camp						1				1
7/27/06	Simpson Mdw, side pool						3				3
7/10/02	Cedar Grove, river at Zumwalt						1				1
7/11/02	Cedar Grove, river side channel		1								1
7/19/04	Lower Paradise Valley						2				2
	Subtotals	**0**	**3**	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**17**
Parastrellus hesperus											
7/21/06	Tehipite, Side Channel 1		5				1				6
7/22/06	Tehipite, Side Channel 2	1	6				1				8
7/24/06	Tehipite, near Camp		1								1
7/10/02	Cedar Grove, river at Zumwalt		2								2
7/11/02	Cedar Grove, river side channel		2				1				3
	Subtotals	**1**	**16**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**20**
Parastrellus hesperus											
7/27/06	Simpson Mdw, side pool				1						1
7/28/06	Simpson Mdw, deep pool				1	1	1				3
7/22/04	Lower Rae Lake		1								1
	Subtotals	**0**	**1**	**0**	**2**	**1**	**1**	**0**	**0**	**0**	**5**
Tadarida brasiliensis											
7/21/06	Tehipite, Side Channel 1						6				6
728/06	Simpson Mdw, deep pool						5				5
7/10/02	Cedar Grove, river at Zumwalt				2		12				14
7/11/02	Cedar Grove, river side channel						1				1
7/19/04	Lower Paradise Valley		1				5				6
	Subtotals	**0**	**1**	**0**	**2**	**0**	**29**	**0**	**0**	**0**	**32**
	TOTALS	**2**	**47**	**4**	**23**	**3**	**124**	**2**	**0**	**3**	**208**

Table 9c. Age and reproductive condition for bats captured in the North Fork Kaweah River /Redwood Creek drainage, Kings Canyon National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par =parous; Juv = juvenile; Unk = Unknown.

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Eptesicus fuscus											
7/1/05	Redwood Creek, low trail crossing	1					4				5
7/2/05	East Fork Redwood Crk, trail crossing					1	6				7
	Subtotals	**1**	**0**	**0**	**0**	**1**	**10**	**0**	**0**	**0**	**12**
Lasionycteris noctivagans											
7/1/05	Redwood Creek, low trail crossing						2				2
7/2/05	East Fork Redwood Crk, trail crossing						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**3**
Lasiurus blossevillii											
7/1/05	Redwood Creek, low trail crossing						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**
Myotis californicus											
7/1/05	Redwood Creek, low trail crossing		2								2
7/2/05	East Fork Redwood Crk, trail crossing						2				2
	Subtotals	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**4**
Myotis evotis											
7/1/05	Redwood Creek, low trail crossing						1				1
7/3/05	Log Cabin, Redwood Crk						2				2
	Subtotals	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**3**
Myotis thysanodes											
7/1/05	Redwood Creek, low trail crossing						2				2
7/2/05	East Fork Redwood Crk, trail crossing			1	1		1				3
7/3/05	Log Cabin, Redwood Crk		2		4						6
7/3/05	Rock outcrop, above log cabin		1								1
	Subtotals	**0**	**3**	**1**	**5**	**0**	**3**	**0**	**0**	**0**	**12**
Myotis volans											
7/1/05	Redwood Creek, low trail crossing	1	8	1	1		2				13
7/3/05	Log Cabin, Redwood Crk		1								1
	Subtotals	**1**	**9**	**1**	**1**	**0**	**2**	**0**	**0**	**0**	**14**

Table 9c. Age and reproductive condition for bats captured in the North Fork Kaweah River /Redwood Creek drainage, Kings Canyon National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par =parous; Juv = juvenile; Unk = Unknown. (continued)

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Myotis yumanensis											
7/1/05	Redwood Creek, low trail crossing						2				2
7/3/05	Log Cabin, Redwood Crk						1				1
Subtotals		**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**3**
TOTALS		**2**	**14**	**2**	**6**	**1**	**27**	**0**	**0**	**0**	**52**

3.3.2.3. Acoustic Data

The results of our acoustic sampling are presented in Figure 18. Two of the species, *E. perotis* and *E. maculatum*, were detected only acoustically. All except *M. thysanodes* were detected at more stations acoustically than by capture. The distribution of these detection records is discussed in the species accounts (see Appendix VI).

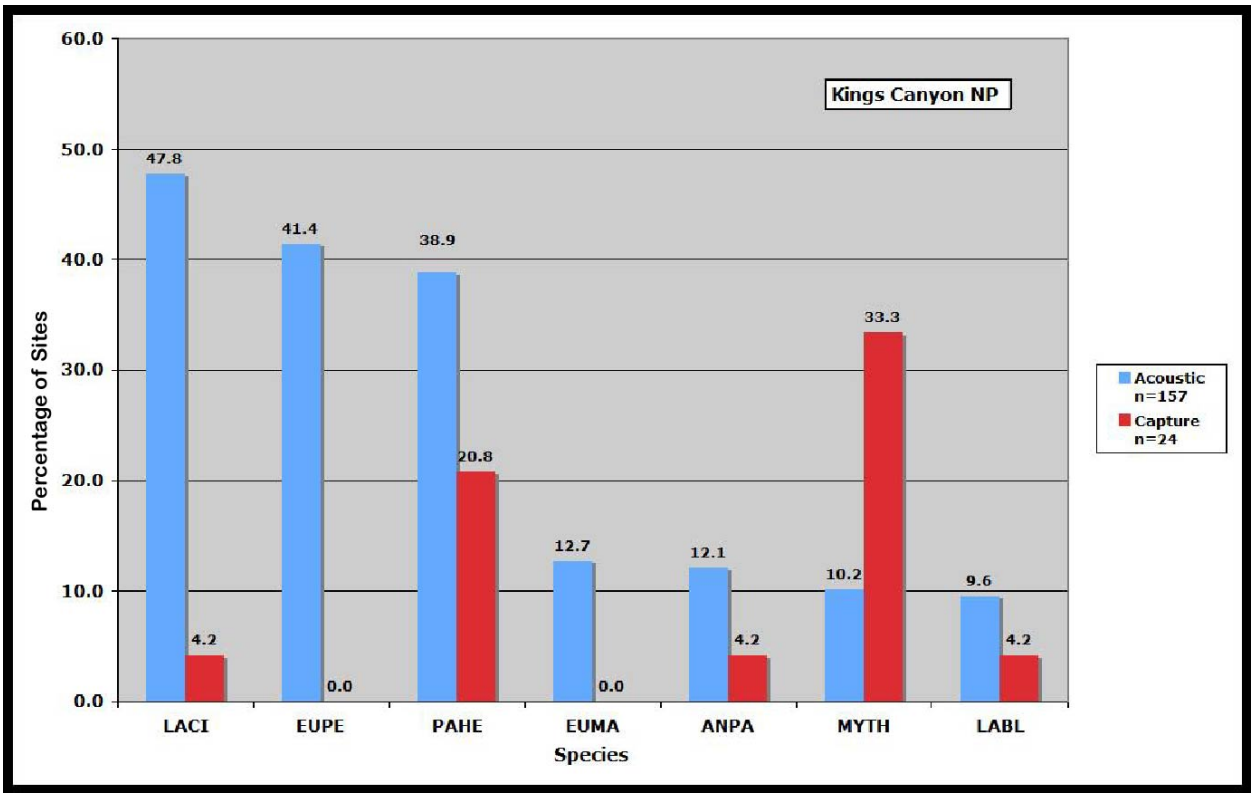


Figure 18. The percentage of sampling sites at which the seven species noted on the x-axis were detected by capture and acoustic methods in Kings Canyon National Park. Acoustic monitoring always accompanied mist-net capture of bats, and was done in additional areas without mist-netting.

3.3.2.4. Sampling Areas

Overall Kings Canyon had a higher capture rate and more species per sampling station than the other two jurisdictions (Pierson and Rainey 2017). There were four sites with capture rates greater than 20 bats/unit effort*100, whereas there were two in Sequoia and none in Devils Postpile. Also, the most species captured at one site in Devils Postpile was five, and the most in Sequoia was six. In Kings Canyon, up to nine species were captured at one site, and there were six sampling sites where six or more species were captured (Figure 19).

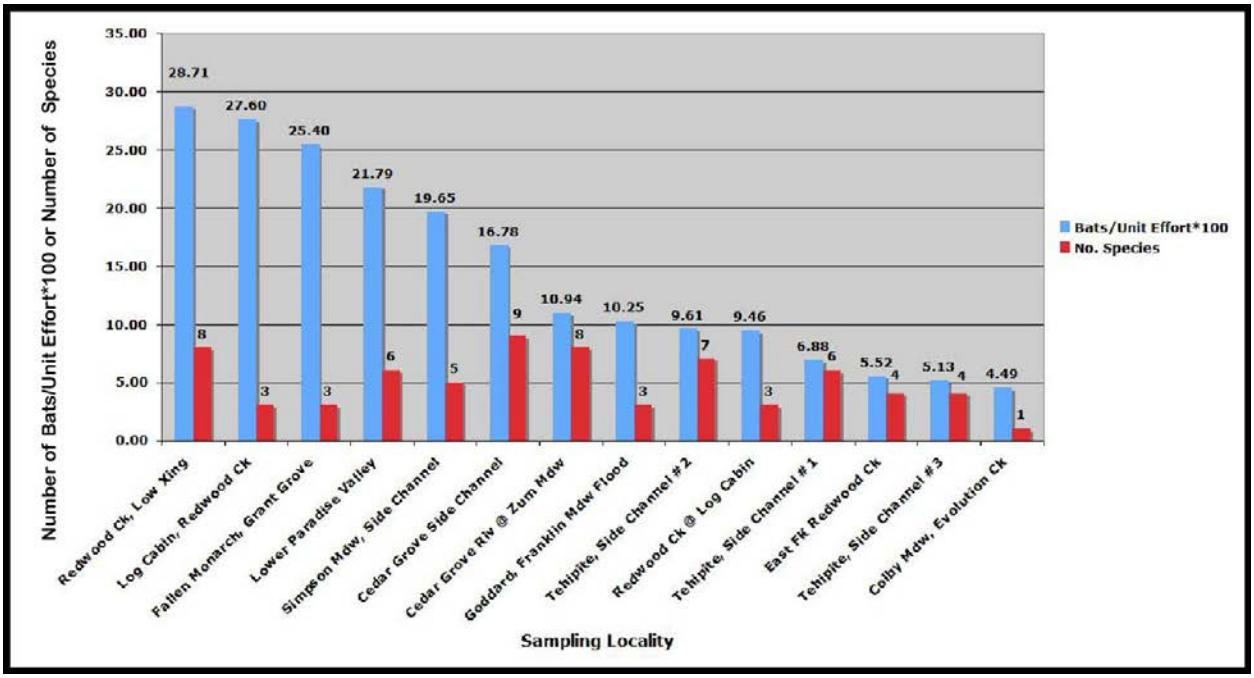


Figure 19. A bar graph showing the number of bats captured/unit effort*100 and the number of species detected per site in Kings Canyon National Park, showing all sites at which more than 4 bats/unit effort*100 were captured, or at least 4 species were detected.

South Fork San Joaquin River: Goddard Canyon and Evolution Basin. Prior to the current study the only bat records for the San Joaquin drainage in Kings Canyon National Park date back to the Dixon surveys and are 1942 records for *E. fuscus* from Goddard Canyon and Colby Meadow (Table 10). We detected a total of seven species within the park boundaries along this drainage, and an additional two species (including the only records for *E. maculatum*) at Blayney Meadow, a site on the San Joaquin River, at lower elevation and outside park boundaries.

Table 10. List of all bat species documented as occurring along the South Fork San Joaquin within Kings Canyon National Park. X= Present, C = Capture, A = Acoustic.

Species	Museum Specimen (Appendix II)	Wildlife Observation Database (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
E. fuscus		X			C, A
E. maculatum					(A)*
E. perotis					A
L. cinereus					A
M. evotis					C, A
M. lucifugus					C
M. volans					C
M. yumanensis					(C)*
T. brasiliensis					C, A

***** Detected only at Blayney Meadow, outside the park.

On July 30 - August 3, 2005, we took a five-night, stock-supported trip up the San Joaquin drainage from Blayney Meadow to Franklin Meadow in Goddard Canyon, and then up to Colby and McClure Meadows in Evolution Basin. This included five nights of capture surveys at nine stations, and five nights of acoustic surveys, yielding data for 19 acoustic detector nights (see Pierson and Rainey 2017 for link to project data). A total of five species were detected by capture, and an additional two (*E. perotis* and *L. cinereus*) by acoustic methods. *E. perotis* was detected at 21.05% of acoustic stations, all in Evolution Basin, and *L. cinereus* at 26.32% of stations, four in Evolution Basin and one on the San Joaquin below the Evolution Junction. *E. fuscus* dominated captures both in Goddard Canyon and Evolution Basin. We captured only two other species in Evolution Basin (*M. lucifugus* and *T. brasiliensis*), both at McClure Meadow (Figure 20). The most interesting site was a flooded area of Franklin Meadow (Goddard Canyon), where at 2,933 m elevation we captured lactating females of two species: *M. evotis* and *M. volans*. This site was also among our most productive in terms of number of bats captured per unit effort (Figure 19). Figure 20c shows one of the detector stations where both *E. perotis* and *L. cinereus* was detected.

a.  b. 

c. 

Figure 20. (a) photograph of flooded net site; (b) net site; and (c) detector site at McClure Meadow, Evolution Basin.

Middle Fork Kings River: Tehipite Valley, Simpson Meadow, and Dusy Basin. Prior to the current study the only records for the Middle Fork Kings drainage were from survey work conducted by J. Koshear in 1994, which yielded records for *E. fuscus* and *E. maculatum* from Simpson and Grouse Meadows (Table 11). There were no records for Tehipite Valley or Dusy Basin. This inventory added 13 species to the known assemblage for this drainage.

Table 11. List of all bat species documented as occurring in Tehipite Valley, Simpson Meadow or Dusy Basin. X = Present, C = Capture, A = Acoustic.

Species	Museum Specimen (Appendix II)	Wildlife Observation Database (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
E. fuscus		X			C
E. maculatum		X			A
E. perotis					A
L. noctivagans					C
L. blossevillii					A
L. cinereus					A
M. californicus					C
M. ciliolabrum					C
M. evotis					C, A
M. lucifugus					C
M. thysanodes					C
M. volans					C
M. yumanensis					C
P. hesperus					C, A
T. brasiliensis					C, A

In July 2006, facilitated by heliocopter transport to and from the sites, we sampled for five nights (July 20-24) in Tehipite Valley and five nights (July 25-29) in Simpson Meadow. On August 20-22, 2002 we backpacked into Dusy Basin from South Lake.

We detected a total of 10 species in Tehipite Valley. We captured 55 bats belonging to eight species in four nights of netting at six stations (see Pierson and Rainey 2017 for link to project data), and detected two additional species (*E. perotis* and *L. cinereus*) acoustically (21 detector nights distributed over five nights). As would be expected for a relatively low elevation xeric site *P. hesperus* was the dominant species in both net captures and acoustic surveys. Due to high flow in the Kings River, netting efforts were confined to small side channels and their associated habitats (e.g., Figure 21a). Although habitat appeared suitable we obtained no records for either *A. pallidus* or *E. maculatum*. This was especially surprising for *A. pallidus* which appears, based on records at other sites, to be associated with both oak forest and ponderosa parkland, the two dominant forest types in Tehipite Valley. We speculate that had we been able to cross Crown Creek (too dangerous due to high water), we would likely have detected *A. pallidus* in the more open terrain on the west side of the creek. Records for *E. perotis* and *L. cinereus* were also rather scanty, occurring at only one (4.76%) and four (19.05%) stations respectively. This is likely explained by the fact this narrow forested canyon had relatively little open habitat typically frequented by these two species. Both were detected in one of the few open areas, a talus slope at the base of Tehipite Dome (Figure 21b).

We detected a total of 12 species in Simpson Meadow. We captured 31 bats belonging to seven species in four nights of netting at eight stations (Pierson and Rainey 2017), and detected five additional species (*E. maculatum*, *E. perotis*, *L. blossevillii*, *L. cinereus*, and *P. hesperus*)

acoustically in 23 detector nights distributed over five nights (Pierson and Rainey 2017). As in Tehipite Valley, we were forced by high river flows to confine our netting efforts to side channels, like the deep pool pictured in Figure 21c, which proved to be one of the most productive sites we sampled in Kings Canyon (Figure 19). The most productive detector stations, yielding the most species, were at the interface between a talus slope and the large meadow (Figure 21d), and on the drier sagebrush slope overlooking the meadow (Figure 21e).

There were some interesting differences in the bat assemblage between this area (dominated by a large meadow, significant patches of sagebrush, and a dense black cottonwood riparian) and Tehipite Valley (550 meters lower in elevation and dominated by rock walls and a narrow strip of oak and ponderosa pine forest). Although our sampling effort was limited in both places, it is evident from acoustic records (Table 12, and Pierson and Rainey 2017) that the abundance of *P. hesperus* is much lower in Simpson Meadow (likely a consequence of change in elevation), the densities of *E. maculatum*, *E. perotis* and *L. cinereus* higher (likely a consequence of more suitable open habitat, *i.e.,* meadows and shrub). The occurrence of *L. blossevillii* in Simpson Meadow is likely explained by the presence of a large gallery cottonwood forest along the river. The netting and acoustic records taken together suggest that Simpson Meadow lies at an important interface where lower elevation species like *P. hesperus* still persist, albeit in lower densities, and mid to higher elevation species like *L. noctivagans* and *M. lucifugus* also occur.

While sampling at Dusy Basin was extremely limited (only one night), we were able to confirm with acoustic sampling the presence of three species in this barren high elevation habitat (Pierson and Rainey 2017). Both *T. brasiliensis* and a 40 kHz *Myotis* (most likely *M. lucifugus*) were detected multiple times at all four acoustic stations. The most surprising result was six detections of *L. cinereus* at a lake site (Figure 21f), providing a high elevation record for this species.

a. 

b. 

c.  d. 

e.  f. 

Figure 21. (a) photograph of the most productive netting site in Tehipite Valley and (b) acoustic site where *E. perotis* was detected; (c) most productive netting site in Simpson Meadow, a side channel of the Kings River; and most important acoustic sites at (d) base of talus slope overlooking Simpson Meadow; (e) sage brush habitat at the edge of Simpson Meadow; and (f) the lake in Dusy Basin where both *E. perotis* and *L. cinereus* were detected.

Table 12. Comparison of acoustic records for five species at three sites along an elevational transect in the Middle Fork Kings drainage.

Species	% Stations Detected (n= 22) Tehipite Valley (1,260 m)	% Stations Detected (n= 23) Simpson Mdw (1,815 m)	% Stations Detected (n= 4) Dusy Basin (3,425 m)
E. maculatum	0.00	21.74	0.00
E. perotis	4.76	39.13	0.00
L. blossevillii	0.0	4.34	0.00
L. cinereus	19.05	69.57	25.00
P. hesperus	90.48	8.70	0.00

Cedar Grove. Prior to the current study there were records for five species from the Cedar Grove area (Table 13). This study documented 14 species from this area.

Table 13. List of all bat species documented as occurring in Cedar Grove. X= Present, C = Capture, A = Acoustic. WODB = Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
A. pallidus					C, A
E. fuscus	X	X			C, A
E. maculatum					A
E. perotis					A
L. blossevillii					A
L. cinereus		X			C, A
M. californicus	X	X			C
M. ciliolabrum					C
M. evotis		X			C, A
M. lucifugus		(X)*			
M. thysanodes		X	X		C, A
M. volans					C
M. yumanensis					C
P. hesperus					C, A
T. brasiliensis					C, A

* Records reported in the WODB as *M. lucifugus* are most likely in error. No confirmed *M. lucifugus* are known from this elevation.

The bat fauna of Cedar Grove is rich and diverse. We netted in only two areas for two nights (July 10-11, 2002) and captured 11 of the 16 species we would expect to occur there. In one area, where we set nets over a side channel to the river (Figure 22a), plus a gravel bar and open ponderosa stand (both adjacent to the side channel), we captured 10 species, including all six *Myotis* species that we would expect to occur at that elevation.

During the same period we sampled 22 acoustic stations over three nights (Table 14), detecting four additional species that were not captured in mist nets, leaving only *C. townsendii* and *L. noctivagans*

as species expected but not detected in the area. We note that *L. cinereus,* rare in net captures, occurred in 95.5 % of our acoustic samples. Likewise, both *E. perotis* and *E. maculatum* were prevalent in the valley, being detected respectively at 77.3 and 45.5 % of our acoustic sites. Areas that were particularly rich and diverse acoustically were both Zumwalt Meadow (Figure 22b) and the open shrub habitat just west of Knapp's Cabin, which based on this preliminary data was selected as the site for one of the long-term detectors, depicted in Figure 6a.

Table 14. Acoustic Records for Cedar Grove, July 9-11, 2002.

Species	Number of Acoustic files	% Acoustic Nights/Stations Detected (n = 22)
A. pallidus	78	63.6
E. maculatum	50	45.5
E. perotis	404	77.3
L. blossevillii	7	27.3
L. cinereus	1,680	95.5
L. noctivagans	12	13.6
M. thysanodes	25	27.3
P. hesperus	314	90.9
T. brasiliensis	4,475	100.0

a. 

b. 

Figure 22. (a) Photograph of the most productive netting site in Cedar Grove, a side channel of the South Fork Kings and adjacent gravel bar; and (b) acoustic site at Zumwalt Meadow

Paradise Valley to Rae Lakes and Bubbs Creek. Prior to the current study there were only two records for the South Fork Kings above Cedar Grove – a 1981 record by D. Easterla for *L. noctivagans* and a 1994 record by J. Koshear for *E. fuscus*, both from Lower Paradise Valley (Table 15). Additionally, there were 1993 records by J. Koshear for *E. fuscus* and *M. thysanodes* from Junction Meadow on Bubbs Creek.

Table 15. List of all bat species documented as occurring in the area from Paradise Valley to Rae Lakes and Bubbs Creek. X= Present, C = Capture, A = Acoustic. WODB = Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
E. fuscus		C			C
E. maculatum					A
E. perotis					A
L. noctivagans		X			
L. blossevillii					A
L. cinereus					A
M. californicus					C
M. ciliolabrum					C
M. evotis					C, A
M. lucifugus					C
M. thysanodes		X			
M. yumanensis					C
T. brasiliensis					C, A

This inventory added 10 species to the bat assemblage documented for this area, and included trips up both the South Fork Kings and Bubbs Creek. On July 19-22, 2004, we took a five-night, stock-supported trip up the South Fork Kings and Woods Creek drainage to Rae Lakes, sampling at Paradise Valley, Woods Creek Crossing, Baxter Meadow, Rae Lakes, and Castle Dome Meadow. This included 4 nights of capture surveys at seven stations, and five nights of acoustic surveys, yielding data for 24 acoustic detector nights (Pierson and Rainey 2017). A total of seven species were detected by capture, and an additional four by acoustic methods. As shown in Figure 19, Lower Paradise Valley (Figure 23a) was a rich site, with the capture of six species and a capture rate of 21.79 bats/unit effort*100, and the detection acoustically of three more – *E. perotis*, *L. blossevillii* and *L. cinereus* (Pierson and Rainey 2017). *E. perotis* was detected at all sites along the transect except Castle Domes Meadow, including both Arrowhead and Lower Rae Lakes. *L. cinereus* was detected at all sites up to and including Baxter Meadow. *L. blossevillii* was detected only at Lower Paradise Valley. The capture of a lactating female *M. lucifugus* at the outlet to Lower Rae Lake (Figure 23b) confirmed that this high elevation species has a reproductive population in this drainage. Three out of five *M. ciliolabrum* captured in Kings Canyon National Park were captured on this transect. While we obtained only one detection of *E. maculatum* (at Baxter Meadow), we were using bat detectors with standard microphones, and the detection of *E. maculatum* generally requires the use of low frequency microphones. We thus consider this sampling effort inadequate for *E.*

maculatum. While on this trip we also left four acoustic detectors in Cedar Grove, where four stations were sampled simultaneously for five consecutive nights (Pierson and Rainey 2017). This effort did not add any species not already detected in our 2002 survey.

We also took a five-night backpack trip on September 23-27, 2005 up the Bubbs Creek drainage to Lake Reflection. Our sampling was limited to one acoustic detector, and hindered by a 24-hour storm on September 26. Nevertheless, we were able to add at least five species to the assemblage previously documented from this drainage: *E. perotis*, *L. cinereus*, *T. brasiliensis*, and both 40 kHz and 50 kHz *Myotis*. At Lake Reflection, both *Myotis* were detected out over the lake, strongly suggesting they were *M. lucifugus* and *M. yumanensis*.

a.  b. 

Figure 23. (a) photograph of the netting site in Lower Paradise Valley; and (b) outlet of Lower Rae Lake, netting site where *M. lucifugus* was caught.

Grant Grove and Redwood Mountain Grove. Prior to the current study, there were records for seven species for the Grant Grove and Redwood Mountain Grove area, including one of only 14 records for *E. maculatum* known for California prior to 1991 (Pierson and Rainey 1998b) (Table 16). The records in the WODB and those supported by specimens in the park collection largely reflect survey work conducted by Jim Petterson, a park employee, in the 1980s. With this inventory effort, eight species were added to the list, yielding a total of 15 species known from this area.

Table 16. List of all bat species documented as occurring in the vicinity of Grant Grove and Redwood Mountain Grove. X= Present, C = Capture, A = Acoustic. WODB = Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
A. pallidus					A
E. fuscus	X	X	X		C, A
E. maculatum	X	X			A
E. perotis					A
L. noctivagans		X	X		C
L. blossevillii					C, A
L. cinereus					A
M. californicus					C
M. evotis		X			C, A
M. lucifugus		X			
M. thysanodes					C, A
M. volans			X		C
M. yumanensis					C
P. hesperus	X				A
T. brasiliensis					A

We conducted capture surveys for three nights (July 1-3, 2005) in Redwood Mountain Grove, sampling seven stations in three areas (Appendix VI): the lower and upper (= Log Cabin) crossings of Redwood Creek, and the trail crossing of the East Fork of Redwood Creek. We also sampled one night (June 30, 2005), at the Fallen Monarch tree in Grant Grove, based on reports from park staff of bats at this tree.

The station with the highest capture rate per unit effort in all of Kings Canyon was at the lower trail crossing of Redwood Creek in the Redwood Mountain Grove (Figure 24a). This was the only site in the park where *L. blossevillii* was captured, and one of only three sites where *L. noctivagans* was captured. The species that dominated our captures at this site was *M. volans* (46 % of captures at this site).

We also, as would be expected, had high capture rates per unit effort, at two fallen sequoias that were being used as night roosts. The Fallen Monarch in Grant Grove appeared to be an important roost for *M. volans* (Figure 24b), and the Log Cabin in the Redwood Mountain Grove was being used by both *M. thysanodes* and *M. yumanensis*.

We sampled acoustically for four nights (30 June-3 July 2005) in Redwood Mountain Grove, obtaining data for 18 detector nights, distributed at six stations. The four species most common in our acoustic samples were not captured in mist nets (Table 17). The parking area for the grove (which was not sampled with mist nets) had the the vast majority of the acoustic records, paricularly for *E. maculatum*, *E. perotis*, and *L. cinereus* (Pierson and Rainey 2017).

Although *M. thysanodes* is not the most abundantly detected species by either sampling method, it was detected at more sites by capture than any other species, and was detected at all six acoustic stations. Given that this species is rare in most habitats, its prevalence in the Redwood Mountain Grove is noteworthy (see Species Account for discussion of association of this species with giant sequoias).

Table 17. Acoustic Reocrds for Redwood Mountain Grove, June 30 – July 3, 2005.

Species	Number of Acoustic files	% Acoustic Nights Detected (n = 18)	% Acoustic Stations Detected (n = 6)
A. pallidus	2	11.1	33.3
E. maculatum	49	22.2	33.3
E. perotis	72	38.9	66.7
L. blossevillii	13	27.8	33.3
L. cinereus	576	66.7	100.0
M. thysanodes	55	61.1	100.0
P. hesperus	5	11.1	16.7
T. brasiliensis	96	44.4	66.7

a.  b. 

Figure 24. (a) photograph of netting site at lower trail crossing of Redwood Creek in the Redwood Mountain Grove; (b) photograph taken from the inside the Fallen Monarch in Grant Grove.

3.3.3. Sequoia National Park

3.3.3.1. Overview

Because there had been a bat survey of the Giant Forest area in 1995 (Pierson and Heady 1996), our sampling efforts there were limited (with the exception of the long-term acoustic detector at Beetle Rock), and we focused our attention on other less studied areas of the the park – particularly the Kern drainage, Ash Mountain, the Middle Fork of the Kaweah below Bearpaw, and Mineral King. We also conducted limited sampling in two other areas for which there was some prior data: the North and South Forks of the Kaweah (Pierson and Rainey 2017). We conducted a total of 33 netting sessions on 31 different nights. A total of 30 different stations were sampled, with three being repeat sampled in different years. In the vicinity of netting stations we deployed multiple detectors per night for a total of 214 acoustic samples. Given our sampling regime in Sequoia National Park, which often required us moving our location daily, acoustic sampling was typically one or two nights per station. We detected a total of 16 species; fourteen were captured in mist-nets and two *(E. maculatum* and *E. perotis*) were detected only acoutistically (although there was an earlier capture record for *E. maculatum* from the park [Appendix V; Pierson and Heady 1996]). The only species expected but not captured was *L. noctivagans.*

3.3.3.2. Capture Data

We captured a total of 236 bats in Sequoia National Park, 138 at stations associated with the Kaweah drainages (Table 18a), and 98 in the Kern drainage (Table 18b). Figure 25 is a composite of sampling in both these areas. The three most frequently encountered species, *M. yumanensis*, *E. fuscus*, and *M. evotis*, accounted for 77.5% of all captures. Our capture results for Sequoia differ from those for the other two parks in that *M. yumanensis* was the most frequently captured species, and *M. evotis* represents a considerably higher percantage of captures here than in the other jurisdictions (see Species Accounts, Appendix VI, for discussion). Eight of the fourteen captured species were represented by lactating females or juveniles (Tables 18a and b). Earlier studies would suggest that both *A. pallidus* and *M. thysanodes*, represented only by adult males or nulliparous females in this effort, have reproductive populations in the park. While no *E. maculatum* were captured in this study, the prior record was for a recently lactating female, suggesting that this species also has a reproductive population in the park.

Table 18a. Age and reproductive condition for bats captured in the Kaweah River drainage of Sequoia National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par=parous; Juv = juvenile; Unk = Unknown.

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Antrozous pallidus											
7/31/02	Marble Fork, Huckleberry Creek						2				2
	Subtotals	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**2**
Corynorhinus townsendii											
8/30/06	Main Fork, below Bearpaw, pool #3						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**
Eptesicus fuscus											
7/31/02	Marble Fork, Huckleberry Creek						1				1
8/2/02	East Fork, Mineral King			2			1				3
7/14/02	Main Fork, Ash Mountain							1			1
6/28/05	Main Fork, Sycamore Ck						2				2
8/30/06	Main Fork, below Bearpaw, pool #3						3				3
8/31/06	Main Fork, below Bearpaw, pool #6			4			5				9
9/1/06	Main Fork, below Bearpaw, pool #5			5			9				14
	Subtotals	**0**	**0**	**11**	**0**	**0**	**21**	**1**	**0**	**0**	**33**
Lasiurus blossevillii											
7/31/06	North Fork, pool #7						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**
Myotis californicus											
6/28/05	Main Fork, Sycamore Crk		1								1
8/31/06	Main Fork below Bearpaw, pool #6						1				1
7/13/02	South Fork Campground						1				1
	Subtotals	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**3**
Myotis ciliolabrum											
7/14/02	Main Fork, Ash Mountain							1			1
8/30/06	Main Fork below Bearpaw, pool #3						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**2**
Myotis evotis											
7/31/02	Marble Fork, Huckleberry Creek		1				1		2		4
8/2/02	East Fork, Mineral King						1				1
8/4/02	East Fork, Eagle Lake						1				1
8/30/06	Main Fork, below Bearpaw, pool #3						3				3
8/31/06	Main Fork, below Bearpaw, pool #6						1				1

Table 18a. Age and reproductive condition for bats captured in the Kaweah River drainage of Sequoia National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par=parous; Juv = juvenile; Unk = Unknown. (continued)

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Myotis evotis (continued)											
9/1/05	Main Fork, below Bearpaw, pool #5						1				1
9/2/06	Main Fork, Redwood Grove		1								1
	Subtotals	**0**	**2**	**0**	**0**	**0**	**8**	**0**	**2**	**0**	**12**
Myotis thysanodes											
7/31/02	Marble Fork, Huckleberry Creek				2		1				3
8/31/06	Main Fork, Redwood Grove						1				1
	Subtotals	**0**	**0**	**0**	**2**	**0**	**2**	**0**	**0**	**0**	**4**
Myotis volans											
8/31/06	Main Fork, below Bearpaw, pool #6		1		1		1	1	1		5
	Subtotals	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**5**
Myotis yumanensis											
7/31/06	North Fork, pool #7, above Yucca Creek		1			1	1	1	1		3
8/4/02	East Fork, Eagle Lake						1				1
7/14/02	Main Fork, Ash Mountain		5					9	11		25
8/30/06	Main Fork, below Bearpaw, pool #3						11				11
8/31/06	Main Fork, below Bearpaw, pool #6						8	3			11
9/1/06	Mineral King, below Bearpaw, pool #5			1			1		3		5
7/13/02	South Fork Campground						11				
	Subtotals	**0**	**6**	**1**	**0**	**0**	**33**	**13**	**15**	**0**	**69**
Parastrellas hesperus											
7/14/02	Main Fork, Ash Mountain								1		1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**
Tadarida brasiliensus											
7/14/02	Main Fork, Ash Mountain		5								5
	Subtotals	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**
	TOTALS	**0**	**15**	**12**	**3**	**1**	**72**	**16**	**19**	**0**	**138**

Table 18b. Age and reproductive condition for bats captured in the Kern River drainage of Sequoia National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par=parous; Juv = juvenile; Unk = Unknown.

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Eptesicus fuscus											
8/27/04	Junction Meadow, creek			1			1				2
8/28/04	Junction Meadow, river			2			3	2	1	1	9
8/30/04	Upper Funston Meadow at river			1							1
8/31/04	Upper Funston Meadow, side channel				1		9				10
8/24/05	Tarn, E. Upper Trail Jct. Chagoopa						1				1
8/25/05	Tarn, E. Treehouse Mdw									1	1
8/26/05	Kern, 1 km below Big Arroyo Br						7				7
8/27/05	Coyote Creek, Kern RS						1				1
	Subtotals	**0**	**0**	**4**	**1**	**0**	**22**	**2**	**1**	**2**	**32**
Lasiurus cinereus											
8/27/05	Coyote Creek, Kern RS						1				1
8/28/05	Kern RS, Meadow						2				2
	Subtotals	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**3**
Myotis californicus											
8/27/05	Coyote Creek, Kern RS							1	1		2
8/28/05	Coyote Creek, Kern RS						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**3**
Myotis evotis											
8/29/04	Rock Creek, below Kern Hot Springs						1	1			2
8/31/04	Upper Funston Meadow, side channel			2	1						3
8/31/04	Upper Funston Meadow, meadow			1							1
9/2/04	Lower Funston , Laurel Creek			1			1				2
8/22/05	Rock Creek, below Kern Hot Springs						1				1
8/24/05	Moraine Lake, Chagoopa			1							1
8/24/05	Tarn, E. Upper Trail Jct. Chagoopa		2	1	1		1				5
8/25/05	Tarn, E. Treehouse Mdw		1	1			3	2			7
8/26/05	Kern, 1 km below Big Arroyo Br				1					1	2
8/27/05	Coyote Creek, Kern RS			1			2				3
	Subtotals	**0**	**3**	**8**	**3**	**0**	**9**	**3**	**0**	**1**	**27**
Myotis lucifugus											
8/19/05	Tyndall frog ponds						1				1
	Subtotals	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**

Table 18b. Age and reproductive condition for bats captured in the Kern River drainage of Sequoia National Park. Preg = pregnant; Lact = lactating; Plact = post-lactating; Null = nulliparous; Par=parous; Juv = juvenile; Unk = Unknown. (continued)

Species & Date	Locality	Number of Bats									
		Adult Females					Adult Male	Juv Female	Juv Male	Unk	Total
		Preg	Lact	Plac	Null	Par					
Myotis volans											
8/29/04	Rock Creek, below Kern Hot Springs		1	1	1			3	1		7
8/31/04	Upper Funston Meadow, side channel				1						1
9/2/04	Lower Funston, Laurel Creek						1				1
9/22/05	Rock Creek, below Kern Hot Springs						1		1		2
9/24/05	Tarn, E. Upper Trail Jct., Chagoopa								1		1
9/27/05	Coyote Creek, Kern RS						2				2
	Subtotals	**0**	**1**	**1**	**2**	**0**	**4**	**3**	**3**	**0**	**14**
Myotis yumanensis											
8/29/04	Rock Creek, below Kern Hot Springs						2				2
8/31/04	Upper Funston Mdw, side channel						1				1
8/26/05	Kern, 1 km below Big Arroyo Br		1	1			1	2		1	6
8/28/05	Coyote Crk, Kern RS				1						1
	Subtotals	**0**	**1**	**1**	**1**	**0**	**4**	**2**	**0**	**1**	**10**
Tadarida brasiliensus											
8/28/04	Junction Meadow, river						2		1		3
8/30/04	Upper Funston Mdw at river						2				2
	Subtotals	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**1**	**0**	**5**
	TOTALS	**0**	**5**	**14**	**7**	**0**	**51**	**11**	**6**	**4**	**98**

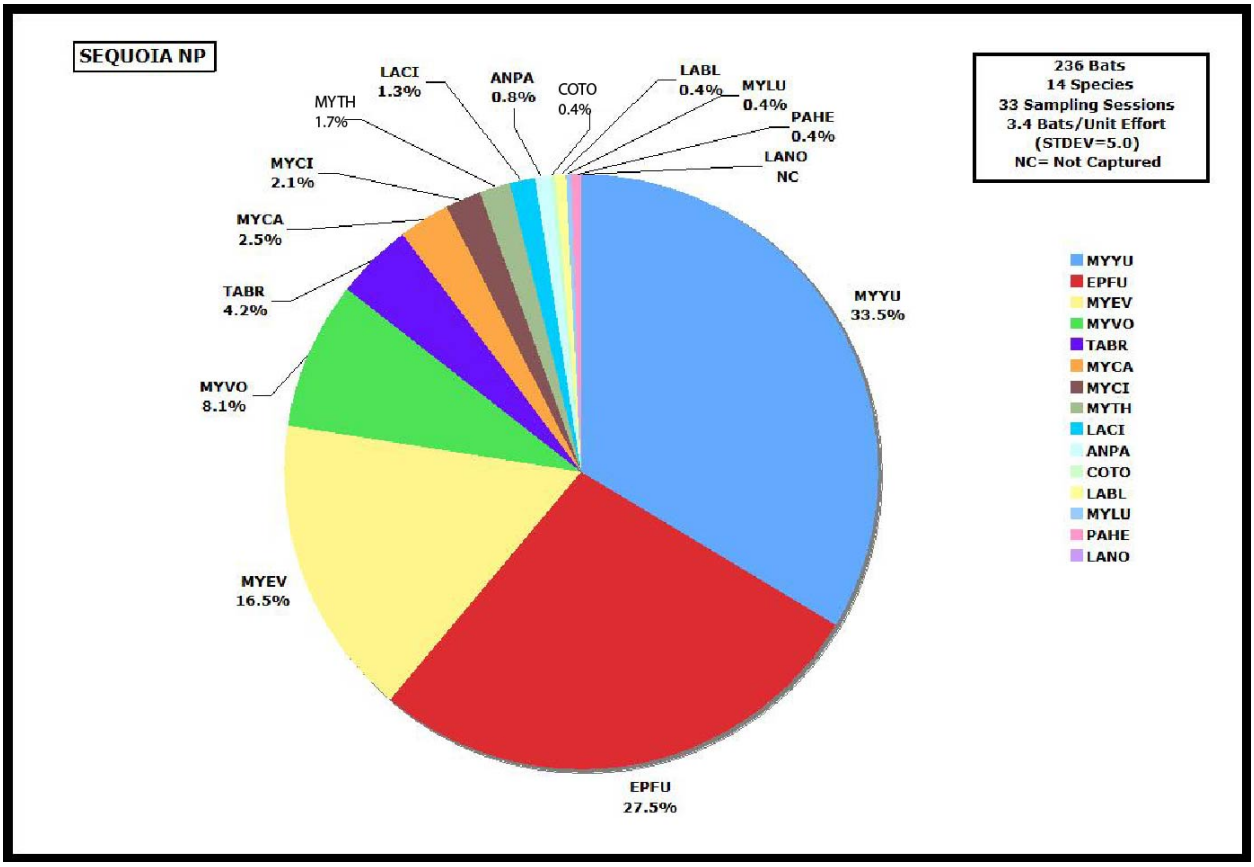


Figure 25. Relative abundance of species in net captures in Sequoia National Park.

M. yumanensis and *M. evotis* are both outliers, with *M. yumanensis* being captured more frequently than would be expected by the number of sites at which it was detected, and *M. evotis* being detected at more sites than would be expected based on number of animals captured (Figure 26). The result for *M. yumanensis* is not surprising. Given that this species often aggregates over still bodies of water to forage, when it is present it is often the dominant species captured at water sites.

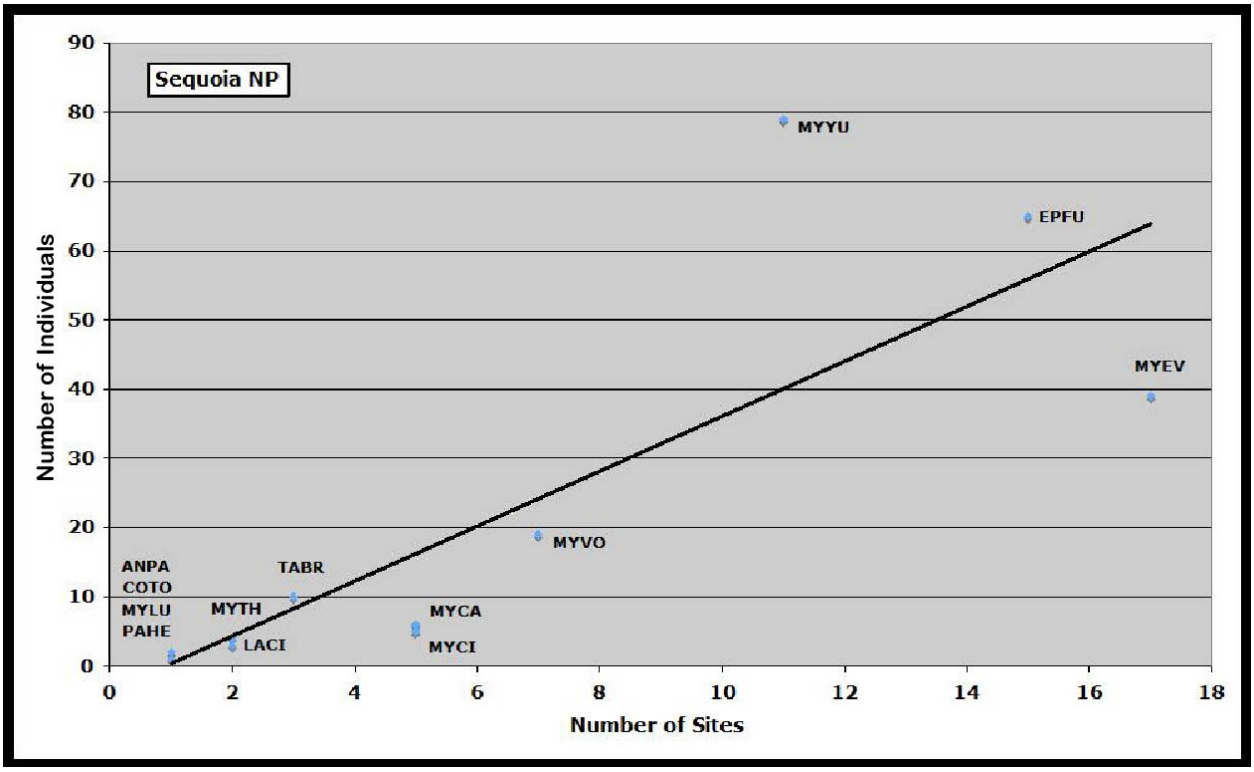


Figure 26. Number of individuals for each species plotted against the number of sites at which they were found in Sequoia National Park.

3.3.3.3. Acoustic Data

Results of our acoustic sampling are presented in Figure 27. All species sampled were detected at significantly more stations acoustically than by capture, with two species (*E. maculatum* and *E. perotis*) being detected only acoustically. The distribution of these records is discussed in the species accounts (Appendix VI) and in the discussion of sampling areas (Section 3.3.3.4. below).

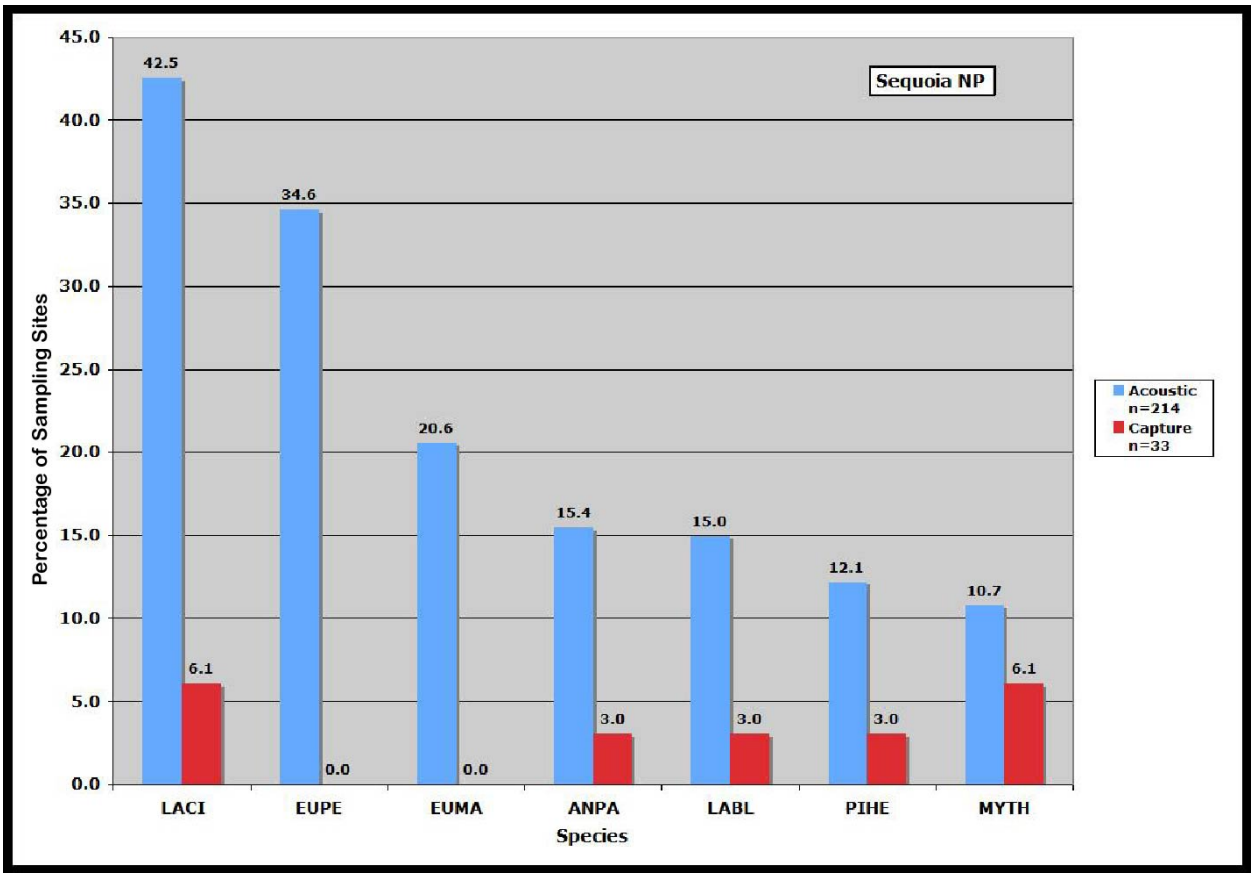


Figure 27. The percentage of sampling sites at which seven species were detected by capture and acoustic methods in Sequoia National Park. Acoustic monitoring always accompanied mist-net capture of bats, and was done at additional sites without mist-netting.

3.3.3.4. Sampling Areas

In our capture efforts in Sequoia National Park there is a striking lack of correspondance between number of bats captured per unit effort and number of species captured at particular sites (Figure 28). The highest capture rate (24.61 bats/unit effort*100) was over the South Fork Kaweah, where only two species were captured, and the most species captured (six) was at a site with a capture rate at the lower end of the specturm (4.49 bats/unit effort*100).

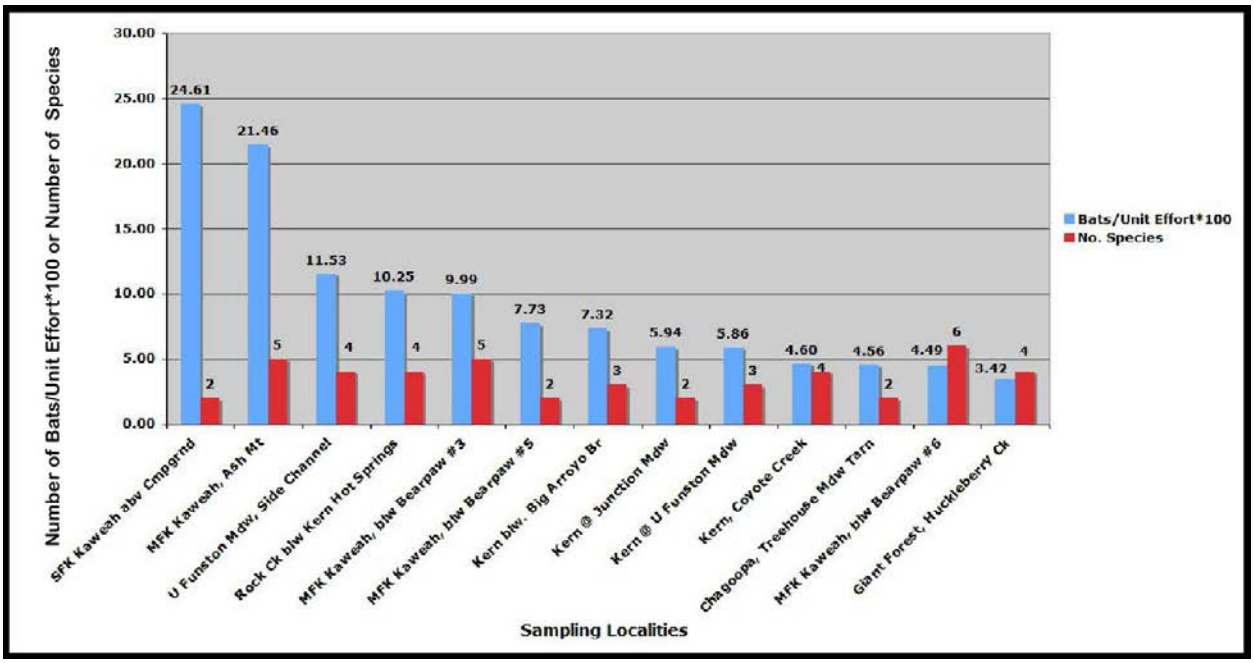


Figure 28. The number of bats captured/unit effort*100 and the number of species detected per site in Sequoia National Park, showing all sites at which more than 4 bats/unit effort*100 were captured, or at least four species were detected.

Ash Mountain. Prior to the current survey six species were known from the Ash Mountain area (Table 19). Except for one netting effort by the current investigators at Sycamore Creek in July 1995, the records were chance observations of bats associated with park structures. Although *C. townsendii* does not appear in our earlier capture records reported in Appendix V, we observed *C. townsendii* guano in two caves in the Ash Moutain area in 1991, and consider this sufficient evidence that there is a population of this species in the vicinity of Ash Mountain. Our current inventory effort brought the total number of species known from this area to fourteen.

Table 19. List of all bat species documented as occurring in the Ash Mountain area. X = Present, C = Capture, A = Acoustic. WODB=Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
A. pallidus		X	X	C	A
C. townsendii		X		X	
E. fuscus		X	X	C	C, A
E. maculatum					A
E. perotis					A
L. blossevillii					A
L. cinereus					A
M. californicus	X	X			C
M. ciliolabrum					C
M. evotis		X			
M. lucifugus		(X)*			
M. thysanodes					A
M. yumanensis		X	X		C
P. hesperus				C	C, A
T. brasiliensis		X			C, A

***** These records are likely in error as Ash Mountain is outside the known elevation range for this species.

Because the focus of this inventory effort was on less accessible areas of the park, and because we ran long-term detectors in this area, first at Sycamore Creek (May-September 2004) and later at Shepherd's Saddle (May 2004 to present), we limited our sampling here to two nights of netting (one at Sycamore Creek and one on the Middle Fork Kaweah, about one mile above the Visitor's Center). The site on the Middle Fork (Figure 29a) was one of the most productive in the park, yielding five species by capture, and an additional five (*A. pallidus*, *E. perotis*, *L. blossevillii*, *L. cinereus*, and *M. thysanodes*) acoustically (detected by one or more of four detectors placed at the river's edge and over the adjacent gravel bar) (Table 20, Pierson and Rainey 2017). Although *M. yumanensis* dominated in our capture effort over the river, it is evident from both the short-term and long-term acoustic data that several other species are also quite abundant in this area: *A. pallidus*, *E. perotis*, *L. cinereus*, and particularly *P. hesperus*. In a combined netting and acoustic effort at the waterfall on Sycamore Creek (Figure 29b) we obtained 37 *A. pallidus* detections, consistent with their apparent association with blue oak savannah (*e.g.*, Figure 29c).

Table 20. Acoustic records in Ash Mountain Area , July 12 and 14, 2002 (n=12).

Species	Number Detections	% Stations Detected
A. pallidus	12	41.67
E. perotis	62	83.33
L. blossevillii	1	8.33
L. cinereus	9	58.33
M. thysanodes	1	8.33
P. hesperus	786	100.00

a. 

b. 

c. 

Figure 29. (a) Netting site on Middle Fork Kaweah above Visitor's Center, (b) netting and acoustic site on Sycamore Creek, and (c) acoustic site in Blue Oak savannah in Ash Mountain area.

Giant Forest and Lodgepole. Prior to the current inventory 11 species were known from the Giant Forest and Lodgepole areas (Table 21). Museum records for *M. evotis* and *M. thysanodes* are from Crystal Cave, which was not surveyed in the recent effort. The earlier record for *E. maculatum* in the WODB (Appendix III) was an acoustic record from Crescent Meadow and provided by J. Koshear. The current inventory effort added four species to the known assemblage. Although there is some uncertainty about the *C. townsendii* record, we are certain this species occurs in the Middle Fork Kaweah drainage, and very likely occurs in the Marble Fork.

Table 21. List of all bat species documented as occurring in the Giant Forest and Lodgepole areas. X = Present, C = Capture, A = Acoustic. WODB=Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
A. pallidus				C	C, A
C. townsendii		(X)*	(X)*		
E. fuscus	X	X	X	C	C, A
E. maculatum		A		C, A	A
E. perotis				A	A
L. blossevillii					A
L. cinereus					A
M. californicus	X	X	X	C	
M. evotis	X	X		C	C, A
M. thysanodes	X			C	C, A
M. volans		X		C	
M. yumanensis			X		
P. hesperus					A
T. brasiliensis					A

* Refers to a record for an animal found on a truck that travelled between Ash Mt and Giant Forest. Point of origin unknown.

Because a bat inventory of the Giant Forest area had been conducted in 1995 (Pierson and Heady 1996), our efforts in this area were limited – one night of netting at Huckleberry Creek on July 31, 2002, and three nights of acoustic surveys (25 detector nights) between Giant Forest and Dorst Creek (Pierson and Rainey 2017). The acoustic surveys, using newer technology than had been available in 1995, provided important information on the distribution and relative abundance of a number of species for this area (Table 22). Most noteworthy were numerous records for *E. maculatum* (n = -118) and *E. perotis* (n = 138) on the rock bench near Huckleberry Creek (Figure 30a), and the large number of bats and high species diversity at seeps (like the one in Hazelwood area [Figure 30b]) and several wet meadows, most dramatically the one near the Tunnel Tree (Figure 30c), where we obtained 1,627 records for *T. brasiliensis* in one night. At the sparsely vegetated granite bench on Clover Ridge we obtained the first records for *L. blossevillii* for the Giant Forest area (Figure 30d). All 143 detections of *P. hesperus* were at stations with exposed rock, with 127 obtained at emergence time from a site half-way up Moro Rock.

Table 22. Summary of acoustic surveys in the Lodgepole and Giant Forest areas, July 29 – 31, 2002 (n=24).

Species	Number Detections	% Stations Detected
A. pallidus	353	41.66
E. maculatum	289	62.50
E. perotis	1,384	87.5
L. blossevillii	10	20.83
L. cinereus	206	79.17
M. thysanodes	72	62.50
P. hesperus	143	29.17
T. brasiliensis	6,035	100.00
A. pallidus	353	41.66
E. maculatum	289	62.50
E. perotis	1,384	87.5
L. blossevillii	10	20.83
L. cinereus	206	79.17
M. thysanodes	72	62.50
P. hesperus	143	29.17
T. brasiliensis	6,035	100.00

a. 

b. 

c. 

d. 

Figure 30. Four acoustic sampling sites: (a) open area adjacent to Huckleberry Creek, (b) wet meadow near Tunnel Tree, (c) a seep in the Hazelwood area, and (d) Clover Ridge above the Marble Fork, near Lodgepole.

Middle Fork Kaweah below Bearpaw Meadow and Redwood Meadow. Prior the the current study, five species were known from the Middle Fork Kaweah drainage in the vicinity of Bearpaw and Redwood Meadows. All the records were provided by J. Koshear from 1993 and 1995 surveys that included Bearpaw Ranger Station, Lower Precipice Lake, and Redwood Meadow (Koshear and Lawton 1993, Appendix III). With the current survey effort the number of species known from this area is thirteen (Table 23).

Table 23. List of all bat species documented as occurring in the Middle Fork Kaweah near Bearpaw Meadow and Redwood Meadow. X = Present, C = Capture, A = Acoustic. WODB=Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
C. townsendii					C
E. fuscus		X			C, A
E. maculatum					A
L. blossevillii					A
L. cinereus					A
M. californicus		X			C
M. ciliolabrum					C
M. evotis		X			C
M. lucifugus		C			
M. thysanodes					C
M. volans		X			C
M. yumanensis					C
T. brasiliensis					A

A reach of the Middle Fork Kaweah, above the trail between Bearpaw and Redwood Meadows, is one of the few areas in this watershed where the gradient is low enough to allow effective sampling. We sampled this area for five nights between August 29 and September 2, 2006. We conducted capture surveys for three nights (at four stations) on the river and one night (three stations) at Redwood Meadow Grove (Appendix VI). We sampled at nine different acoustic stations associated with the river for a total of 15 detector nights, plus two nights in Bearpaw Meadow and two full nights plus two partial nights in Redwood Mountain Grove (Pierson and Rainey 2017).

All three capture stations on the river were at pools (*e.g.*, Figure 31a) and among our most productive sites (Figure 28). We captured eight species during this effort, including the only *C. townsendii* captured during this project (Pierson and Rainey 2017, Appendix VI). Two additional species (*L. blossevillii* and *T. brasiliensis*) were detected acoustically at stations associated with the river. *L. blossevillii* was detected at four different locations, with the most activity on a manzanita dominated bench (Figure 31b).

We also conducted an acoustic trial, placing one detector in Redwood Meadow (surrounded by Giant Sequoia forest) (Figure 31c) and one in Little Bearpaw Meadow (surrounded by white fir dominated forest) (Figure 31d). We ran each simultaneously for two nights. Although both detectors were hassled by bears, they continued to collect some data, with the Redwood Meadow detector picking up records for three species not detected at either Little Bearpaw Meadow or at any of the river sites: *A. pallidus, E. maculatum,* and *L. cinereus*. While the data suggest that the bat fauna in Redwood habitat is more diverse than in white fir habitat, they should not be over-interpreted. The trial was only two nights, and we were unable to establish that the two detectors were operating in comparable fashion after bear interference.

a.  b. 

c.  d. 

Figure 31. (a) the most productive netting site on the Middle Fork Kaweah below Bearpaw Meadow; (b) a significant acoustic site on a manzanita terrace; (c) acoustic sites at Redwood Meadow; and (d) Little Bearpaw Meadow.

Mineral King. There were no pre-existing bat records for the Mineral King area. In the current survey, we documented 11 species for the area. Three were confirmed by capture – *E. fuscus*, *M. evotis*, and *M. yumanensis* (Appendix VI) – and eight by acoustic methods (Table 24). The taxon recognized as M40 could not be identified to species, but was known from a combination of acoustic and visual observation to include *M. lucifugus*, and could also include *M. ciliolabrum* and *M. volans.*

Sampling for this inventory effort included three nights of mist-net sampling on August 2-4, 2002, two nights on the East Fork Kaweah above the pack station (Figure 32a), and one night and one night at Eagle Lake (Figure 32b). We also conducted five nights of acoustic sampling (August 1-5, 2002), obtaining data for 32 detector nights at 29 different stations along an elevational gradient, from the cliffs near the park entrance at 1,264 m to Eagle Lake at 3060 m. We also ran a long-term, solar powered detector from May 29, 2004 to November 10, 2004.

Although capture rates were low (as would be expected for high elevaton sites), we obtained the highest known elevation record for *M. yumanensis* at Eagle Lake (Figure 32b). Although we did not capture *M. lucifugus*, by a combination of visual and acoustic observation, we were able to confirm them foraging over the river (Figure 32a).

The short-term acoustic records provided important information on bat distribution in this drainage (Table 24). In one evening of observation at the cliffs near the Entrance Station (Figure 32c), we obtained multiple records for both *E. perotis* and *P. hesperus*, confirming that both species have roosts in these cliffs. *P. hesperus* was detected at only one other station (Redwood Creek on Mineral King Road), whereas *E. perotis* was detected at 27.59% of all stations, including Eagle Lake. Although it was not detected in Mineral King Valley on the short-term detectors, it appeared *L. blossevillii* was detected at a variety of other stations on short term detectors (Pierson and Rainey 2017): Redwood Creek, the stand of black cottonwood near Tar Gap parking (Figure 32d), at both the river and in the sage habitat upslope (Figure 32a), and most significantly at boulder strewn areas at Faculty Flat rocks and at dry Highbridge Creek (no photo available). The rocks at Faculty Flat and/or Highbridge Creek were the most significant sites for *E. maculatum*, *E. perotis*, *L. blossevillii*, and *L. cinereus*.

Table 24 provides a summary of the acoustic records obtained for this area. Although it is not possible to identify the 40 kHz and 50 kHz Myotis to species, we have included these records as documentation of how prevalent these two acoustic groups were. At higher elevations, the majority of M50 are likely *M. yumanensis*, and the majority of M40 in association with water sites are likely *M. lucifugus*. A more extensive capture effort is needed in this area.

Table 24. Summary of acoustic detectors for short-term detectors in the Mineral King area, August 1-5, 2002.

Species	Number of Acoustic files	% Acoustic Stations Detected (n=29)
E. fuscus	206	48.28
E. maculatum	34	31.03
E. perotis	455	27.59
L. blossevillii	34	24.14
L. cinereus	292	44.83
M. evotis	102	75.86
M40 *(M.ciliolabrum, M. lucifugus, & M. volans)*	799	93.10
M. thysanodes	4	6.89
M50 *(M. californicus & M. yumanensis)*	790	75.86
P. hesperus	99	6.90
T. brasiliensis	2435	75.86

a.  b. 

c. 

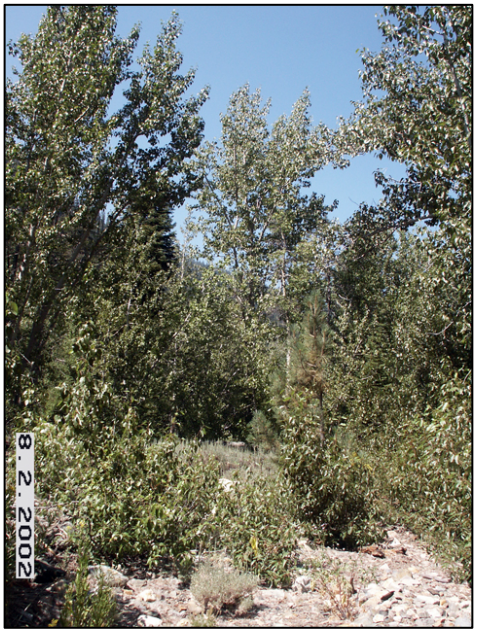
d. 

Figure 32. (a) netting site on East Fork Kaweah above Mineral King, showing sage habitat that was used for acoustic sampling; (b) netting site at Eagle Lake; (c) cliffs near Entrance Station; (d) black cottonwood habitat being used by *L. blossevillii.*

North Fork. Prior to the current survey there were records for five species from the North Fork Kaweah, all from the lower reaches of the river between Burnt Point and the confluence with Yucca Creek. Our inventory added no new species for this area.

Table 25 provides a list of the five species that have been documented for this area.

Table 25. List of all species documented as occurring in the North Fork Kaweah area. X=present, C=capture. WODB=Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
A. pallidus				C	
L. blossevillii	X	X	X		C
M. californicus		X	X		
M. volans				C	
M. yumanensis		X		C	C

Sampling for this inventory effort was limited to one night of mist-net sampling on July 31, 2006, setting nets at two sites: over the river (Figure 33) and in adjacent oak woodland. We captured a total of six bats belonging to two species, all at the water station (Pierson and Rainey 2017, Figure 33). This was one of only two stations in the park where *L. blossevillii* was captured. Intriguingly, this locality is very close to the only other for this species in the park prior to this inventory (Appendix IV), and close to the 1891 record from Three Rivers (Appendix II).

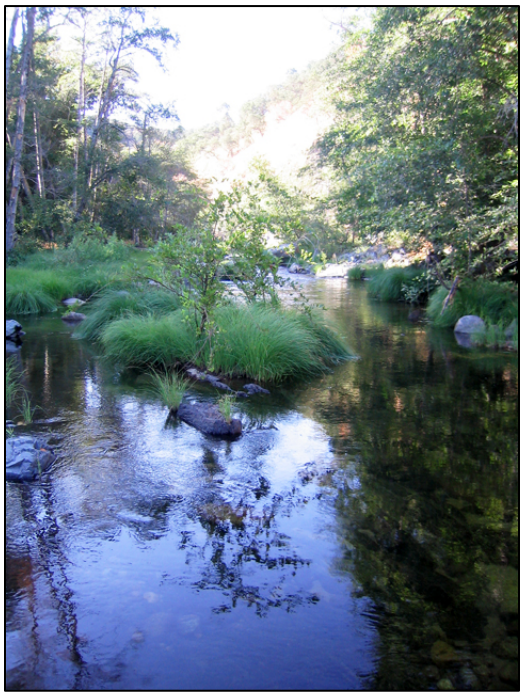


Figure 33. Netting site on the North Fork Kaweah above Yucca Creek confluence, where *L. blossevilli* was captured on July 31, 2006.

South Fork Kaweah. Prior to the current survey there were records for eight species for the South Fork Kaweah from a number of sources (Table 26), all from the vicinity of the campground and entrance station. Museum collection sampling had focused on Clough Cave (Appendix II). From 1986-1990, the ranger at South Fork Campground (T. Jeffrey) took an interest in bats and contributed a considerable number of records (Appendix III). The current investigators had sampled there in the context of a California Fish and Game status assessment for *C. townsendii* (Appendix V). The current survey added three species previously unknown for the area.

Sampling for this inventory effort was limited to one night of netting and one evening of acoustic sampling at eight stations, on July 13, 2002. While the netting effort over a pool in the river (Figure 34a) yielded the highest capture rate for any station in the park (Figure 28), this was due to the fact we captured multiple *M. yumanensis* in one small net. Our acoustic effort added three species not previously known from the area (*L. cinereus*, *M. evotis*, and *P. hesperus*) (Pierson and Rainey 2017). Most striking was the detection of *P. hesperus* at three stations, with a total of 135 accoustic records. The largest number, plus the sole record for *L. cinereus*, was at an open rocky site near the entrance station (Figure 34b).

Table 26 provides a list of all the species known to occur in this area.

Table 26. List of all bat species documented as occurring in the South Fork Kaweah area. X = Present, C = Capture, A = Acoustic. WODB=Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
A. pallidus	X	X		C	A
C. townsendii	X	X		C	
E. fuscus		X		C	A
L. cinereus					A
M. californicus		X		C	C
M. evotis					A
M. thysanodes	X	X		C	
M. volans	X	X		C	
M. yumanensis		X		C	C
P. hesperus					A
T. brasiliensis		X		C	A

a. 

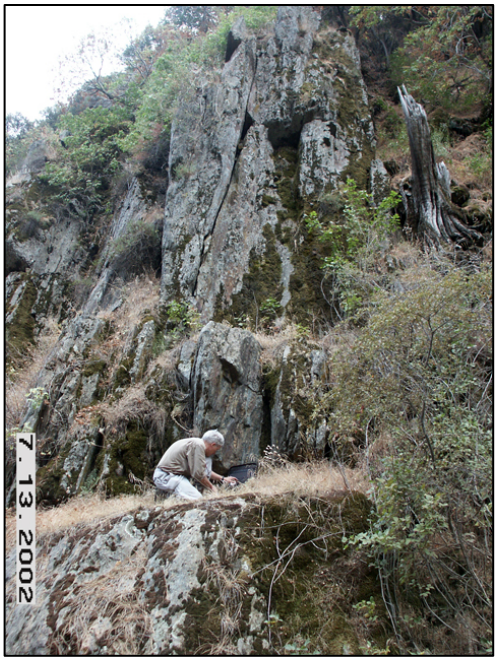
b. 

Figure 34. (a) net site on South Fork Kaweah and (b) acoustic site on road just below South Fork Campground.

Kern. Prior to the current survey there were records for only three species from the Kern drainage (Table 27). There were two specimens (*E. fuscus* and *M. evotis*) collected at Treehouse Meadow on the Chagoopa Plateau by park employee, Jim Petterson on July 14, 1988 (Appendix IV). Most other records came from a 1993 survey effort by J. Koshear, which focused on four localities (the Chagoopa Plateau [trail junction at the upper end of the plateau loop]), Junction Meadow, Kern Hot Springs, and Big Arroyo at the Kern) and added *M. yumanensis* to the species list (Appendix III) (Koshear and Lawton 1993). Our survey effort brought the total number of species known from this drainage to fourteen. Eight species were captured, five were detected only acoustically, and one (*M. lucifugus*) was identified by a combination of acoustic and visual observation.

Table 27. List of all bat species documented as occurring in the Kern drainage. X = Present, C = Capture, A = Acoustic, V/A = Visual + Acoustic. WODB=Wildlife Observation Database (Sequoia & Kings Canyon).

Species	Museum Specimen (Appendix II)	WODB (Appendix III)	Park Specimen (Appendix IV)	Prior Records – Pierson & Rainey (Appendix V)	This Study (Appendix VI & VII)
A. pallidus					A
E. fuscus		C	X		C, A
E. maculatum					A
E. perotis					A
L. blossevillii					A
L. cinereus					C, A
M. californicus					C
M. ciliolabrum					C
M. evotis		X	X		C, A
M. lucifugus					V/A
M. thysanodes					A
M. volans					C
M. yumanensis		C			C
T. brasiliensis					C, A

We took two stock supported trips into the Kern drainage, following the same basic route both times (a loop trip out of Horseshoe Meadow, going north on the high trail and returning by following the Kern River to the Kern Ranger Station and returning to Horseshoe Meadow via Trail Pass). The first trip was from August 24 to September 3, 2004 and the second from August 17-28, 2005. The first trip placed more emphasis on the Kern trench, and the second included areas not visited the first time, most particularly areas higher in the Kern drainage (*e.g.*, Tyndall Frog Ponds and a hanging meadow above Mitochondria Lake) and several sites on the Chagoopa Plateau.

Overall, we conducted mist-netting surveys on 19 nights (nine in 2004 and 10 in 2005) at 30 stations (14 in 2004 and 16 in 2005) (Pierson and Rainey 2017). Although due to the relatively high elevation of this survey, species diversity was not high at any station (the most species detected at any one station was four), six stations in the Kern were among our most productive in Sequoia National Park in terms of number of bats captured per unit effort (Figure 28). We captured a total of 98 bats belonging to eight species. The most productive station was a side channel of the Kern River at Upper Funston Meadow where we captured four *Myotis* species (Figure 35a). Other significant stations were on the main channel of the Kern River (*e.g.*, at Junction Meadow, Figure 35b). (The main channel of the river was nettable in relatively few places due to high flow). As in Devils Postpile, high elevation ponds, particularly small tarns, were important sites (*e.g.*, Treehouse Meadow Tarn where we captured 7 *M. evotis*, Figure 35c). The only capture records for *L. cinereus* and *M. californicus* in the Kern drainage came from the vicinity of the Kern Ranger Station -- Ranger Station Meadow (Figure 35d), an adjacent marshy area (*L. cinereus* and *M. californicus*), and Coyote Creek (*M. californicus*).

We typically deployed between four and six detectors in different habitat types in the vicinity of our camp and/or net sites. During the course of the two survey trips we obtained samples for 114 detector

nights at 95 different stations (Pierson and Rainey 2017). Seventeen stations were repeat sampled on two sequential nights (one station at Guyot Creek, and four stations each at Lower Crabtree Meadow, Junction Meadow, Rock Creek below Kern Ranger Station, and Upper Funston Meadow). Also, two stations at Kern Ranger Station were sampled for one night each on two sequential years. A summary of our acoustic data is presented in Table 28. Although *L. cinereus* was captured only at the Kern Ranger Station, it was detected at almost half our acoustic stations. Figures 35d-f depict some of the more interesting acoustic stations – a wet meadow at Kern Ranger Station (Figure 35d) where *A. pallidus*, *E. perotis* and *L. cinereus* were detected, Sky Parlor Meadow on the Chagoopa Plateau where both *E. maculatum* and *E. perotis* were detected (Figure 35e), and a manzanita flat below Kern Hot Springs where *A. pallidus*, *E. maculatum*, *E. perotis*, *L. blossevillii*, and *L. cinereus* were all detected (Figure 35f).

Table 28. Acoustic Records for Kern drainage, August 24 - September 4, 2004 and August 16-18, 2005.

Species	Number of Acoustic Nights Detected (n=114)	% Acoustic Nights Detected	Number of Acoustic Stations Detected (n=95)	% Acoustic Stations Detected
A. pallidus	13	11.4	11	11.6
E. maculatum	19	16.7	16	16.8
E. perotis	34	29.8	33	34.7
L. blossevillii	16	14.0	14	14.7
L. cinereus	47	41.2	45	47.3
M. thysanodes	4	3.5	4	4.2
P. hesperus	0	0.0	0	0.0

a.  b. 

c.  d. 

e.  f. 

Figure 35. (a) Side channel at Upper Funston Meadow, the most productive netting site on the Kern, (b) the Kern River at Junction Meadow, (c) a tarn near Treehouse Meadow, (d) Meadow at Kern Ranger Station, (e) acoustic site at Sky Parlor Meadow, and (f) acoustic site near Kern Hot Springs.

3.4. Bat Assemblage by River Drainage

Because our sampling focused on watersheds, we also analyzed our data by river drainage. Table 29 lists all the species documented as occurring in each drainage.

Table 29. List of species documented as occurring in the Kern, Kawaeah, Kings and San Joaquin river drainages. C = capture; A = acoustic record; A/V = acoustic + visual observation; A? = Probable, but not definitive, acoustic record; ND = Not detected; * = first record for the river drainage within park boundary.

Species	Common Name	San Joaquin	Kings	Kaweah	Kern
Antrozous pallidus	Pallid bat	**A?***	**C***	**C**	**A***
Corynorhinus townsendii	Townsend's big-eared bat	ND	ND	**C**	ND
Eptesicus fuscus	Big brown bat	**C***	**C**	**C**	**C**
Euderma maculatum	Spotted bat	**A***	**A**	**C, A**	**A***
Eumops perotis	Western mastiff bat	**A***	**A***	**A**	**A***
Lasionycteris noctivagans	Silver-haired bat	**C***	**C**	**C**	ND
Lasiurus blossevillii	Western red bat	**A?***	**A***	**C, A**	**A***
Lasiurus cinereus	Hoary bat	**C***	**C**	**A***	**C*, A***
Myotis californicus	California myotis	ND	**C**	**C**	**C***
Myotis ciliolabrum	Small-footed myotis	ND	**C***	**C***	**C***
Myotis evotis	Long-eared myotis	**C***	**C**	**C**	**C**
Myotis lucifugus	Little brown bat	**C***	**C**	**C**	**C, A/V**
Myotis thysanodes	Fringed myotis	**A?***	**C**	**C**	**A***
Myotis volans	Long-legged myotis	**C***	**C***	**C**	**C***
Myotis yumanensis	Yuma myotis	**C***	**C***	**C**	**C**
Parastrellus hesperus	Canyon bat	ND	**C***	**C**	ND
Tadarida brasiliensis	Mexican free-tailed bat	**C***	**C***	**C**	**C***

3.4.1. San Joaquin

We sampled two branches of the San Joaquin drainage, the Middle Fork in Devils Postpile National Monument and the South Fork in Kings Canyon National Park. We detected a total of ten species, eight by capture and two by acoustic sampling only (Table 29). In both branches our sampling was limited to relatively short, high elevation reaches, between 2194-2425 m along the Middle Fork and 2566-2979 m along the South Fork (with an additional sample outside the park at 2328 m).

We captured a total of 159 bats (151 inside park boundaries) (Tables 4 and 5a, Appendix VI): 111 bats belonging to eight species in 11 sampling sessions along the Middle Fork and 48 bats belonging to six species in six sampling sessions along the South Fork in Blayney Meadow (outside park boundaries), Goddard Canyon and Evolution Basin. All species captured along the South Fork were also captured on the Middle Fork. We know from acoustic records that *L. cinereus*, while not captured on the South Fork, was present (Pierson and Rainey 2017, Appendix VI – Species Account 8). *L. noctivagans* was the only species that was detected on the Middle Fork and not on the South Fork, where sampling sites were above its known elevation range (see Species Account 6 in Appendix VI). The limited species assemblage at the sites sampled for the San Joaquin drainage is most likely explained by the focus upon higher elevations.

Figure 36 graphs the relative abundance of the eight captured species, with *E. fuscus* accounting for 54.3 percent of all captures. It was also captured at more sites than any other species, although it was captured in larger numbers than would be expected based on the number of sites at which it was encountered (Figure 37). For discussion of the situation along each fork of the San Joaquin see Section 3.3.1 (Devils Postpile NM) and Section 3.3.2.4. (Goddard Canyon and Evolution Basin in Kings Canyon) above.

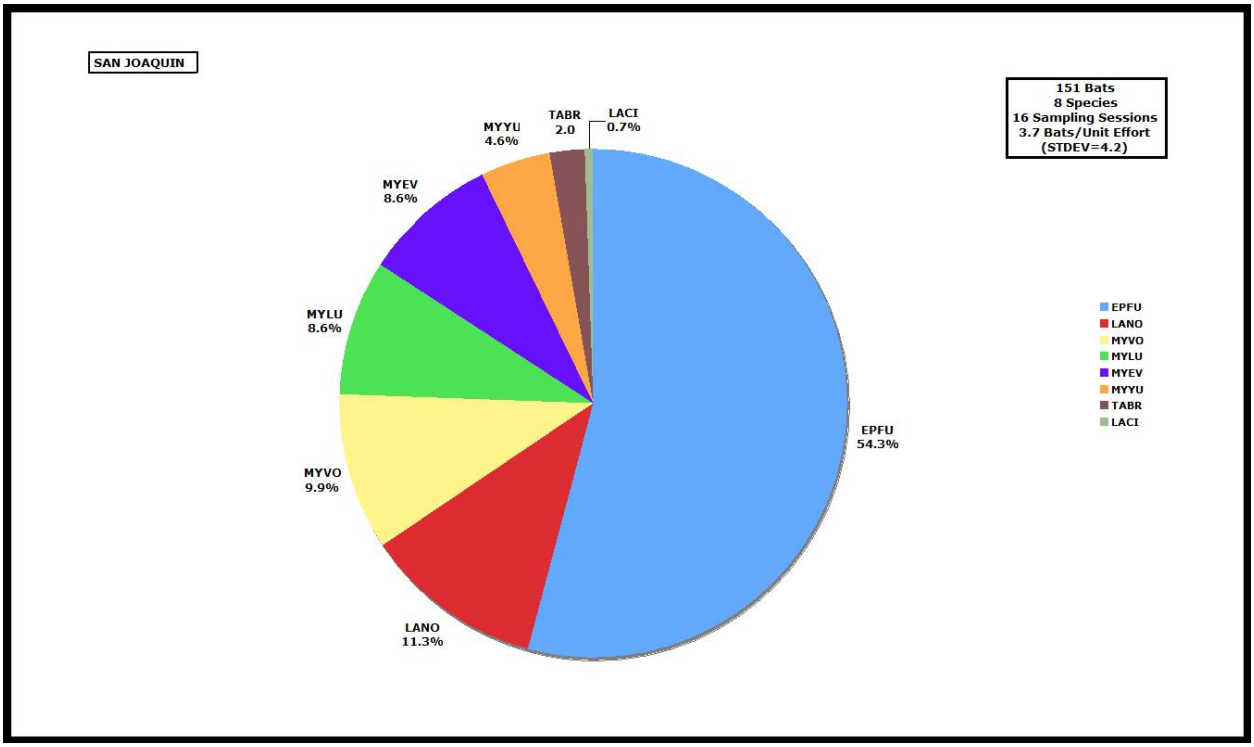


Figure 36. The relative abundance of species in net captures in the San Joaquin drainage.

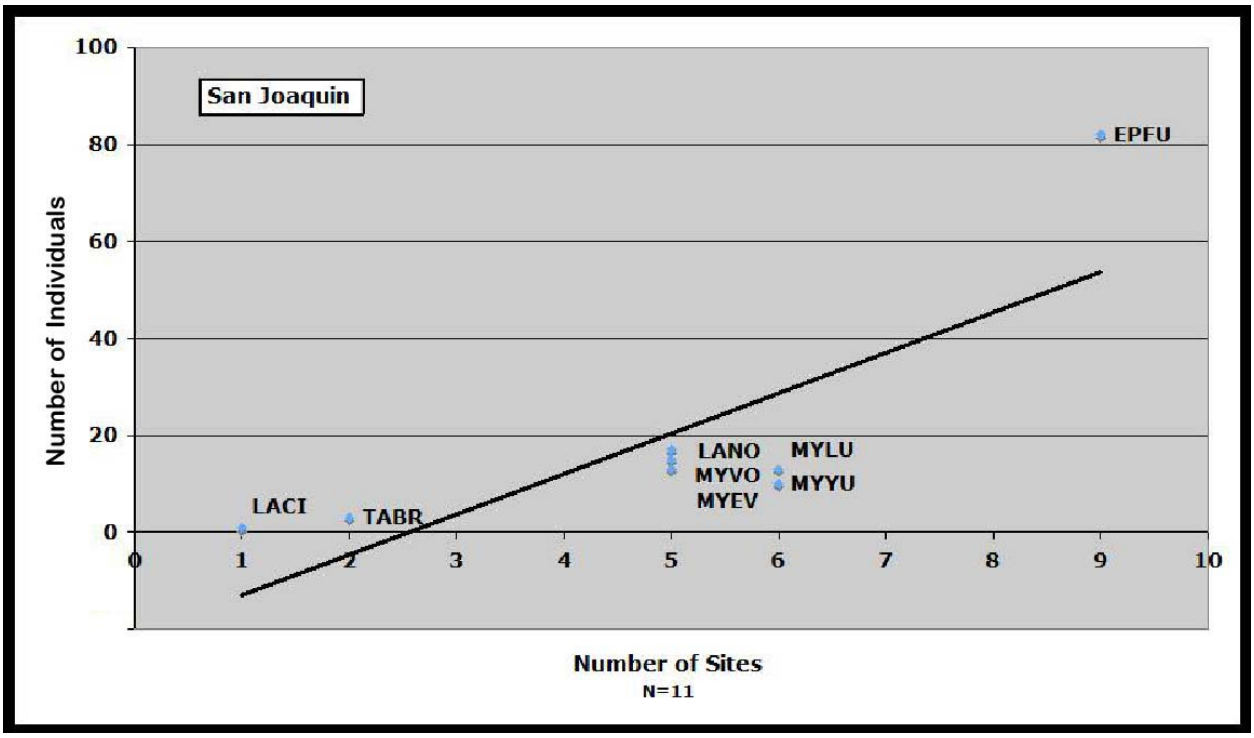


Figure 37. The number of individuals for each species plotted against the number of sites at which they were found in the San Joaquin drainage.

Figure 38 shows the relative detection rates by capture and acoustic methods for the seven species that were sampled acoustically. All sites sampled along the San Joaquin were at the upper limit or above the expected elevation range for *A. pallidus*, *M. thysanodes*, and *P. hesperus*. Thus their absence from our samples is not surprising. While *L. blossevillii* might occur during spring or fall migration, its absence during the summer season (time frame sampled) is also not surprising. *L. cinereus* was prevalent and *E. perotis* fairly widespread in both branches of the San Joaquin (Pierson and Rainey 2017, Appendix VI). Both species were detected at our highest elevation sites in McClure Meadow at ca. 2,940 m. *E. maculatum*, which has been documented at elevations greater than 3, 000 m and is often associated with wet meadows (see Species Account) was notably rare in both branches of the San Joaquin, being detected at only a few sites in Devils Postpile (none of them meadows), and only at Blayney Meadow, outside the park, along the South Fork. Given that our acoustic sampling in both Goddard Canyon and Evolution Basin focused on wet meadows, the absence of *E. maculatum* from our records is surprising and unexpected.

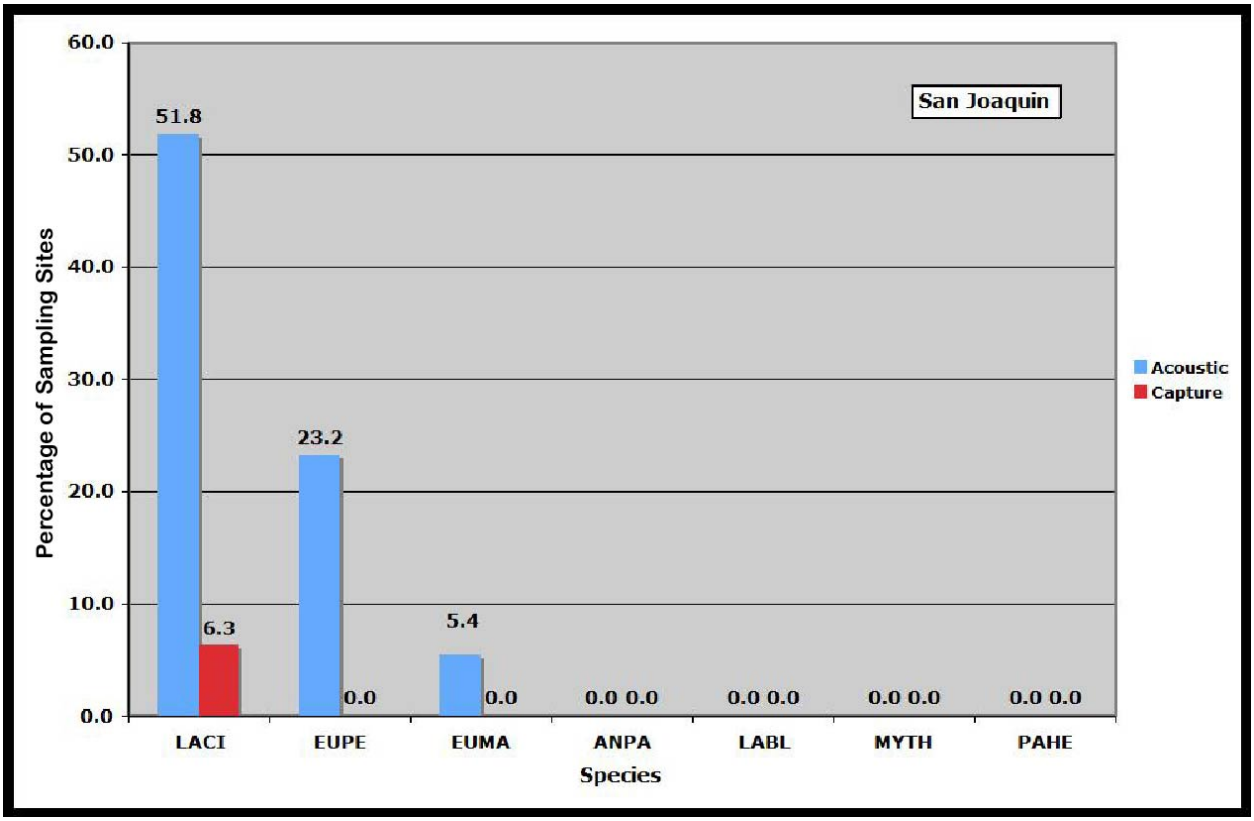


Figure 38. Comparison of the percentage of sampling sites at which seven species were detected by capture and acoustic methods in the San Joaquin drainage. Acoustic monitoring always accompanied mist-net capture of bats.

3.4.2. Kings

We sampled two branches of the Kings River drainage: the Middle Fork (Tehipite Valley, Simpson Meadow, and Dusy Basin), and the South Fork at various sites along an altitudinal transect from Cedar Grove to Rae Lakes and Sixty Lakes Basin, with a limited (acoustic only) autumn survey along Bubbs Creek and at Lake Reflection. We detected a total of 16 species, 13 by capture, and three that were detected by acoustic sampling only (Table 29). Our sampling covered an elevational range from 1,260 m (Tehipite Valley) to 3,300 m (Dusy Basin) along the Middle Fork, and 1,470 m (Cedar Grove) to 3,300 m (Sixty Lakes Basin) along the South Fork.

We captured a total of 208 bats (Table 9b). Ten species were captured along both branches of the river. Although *L. cinereus* was captured only in Cedar Grove, acoustic records document its presence from lowest to highest elevations along the Middle Fork and from Cedar Grove to Castle Dome Meadow along the South Fork (Pierson and Rainey 2017). Although *L. noctivagans* was captured only at Simpson Meadow, we expect this species also occurs along the South Fork in a comparable elevation range *(e.g.*, Paradise Valley where our sampling was limited, and from where there is an earlier record). For *A. pallidus*, both capture and acoustic records were limited to Cedar Grove. Its apparent absence from Tehipite Valley was surprising and unexpected.

Figure 39 shows the relative abundance of species captured in the Kings River drainage, where *E. fuscus* is the most frequently encountered species. It occurred at more sites and in greater numbers than any other species (Figure 40). Data for *T. brasiliensis* are biased by the capture of a "pulse" of this flock foraging species in one netting effort in Cedar Grove (Table 9b), and the relative abundance of *P. hesperus* is explained by its apparent abundance at Tehipite Valley. The results for M. volans are also biased by the fact that of the 33 individuals captured, 27 were taken at one roost site (the Fallen Monarch in Grant Grove).

Eleven of the thirteen species captured had reproductive populations in the Kings drainage. Two species (*L. cinereus* and *L. noctivagans*) were represented by adult males only. While consistent with expectations, the majority of lactating females were captured at elevations below 2,000 m, there were two striking exceptions, a lactating *E. fuscus* in Baxter Meadow at 2,882 m and a lactating *M. lucifugus* at Lower Rae Lake 3,219 m (see Appendix VI species accounts for discussion).

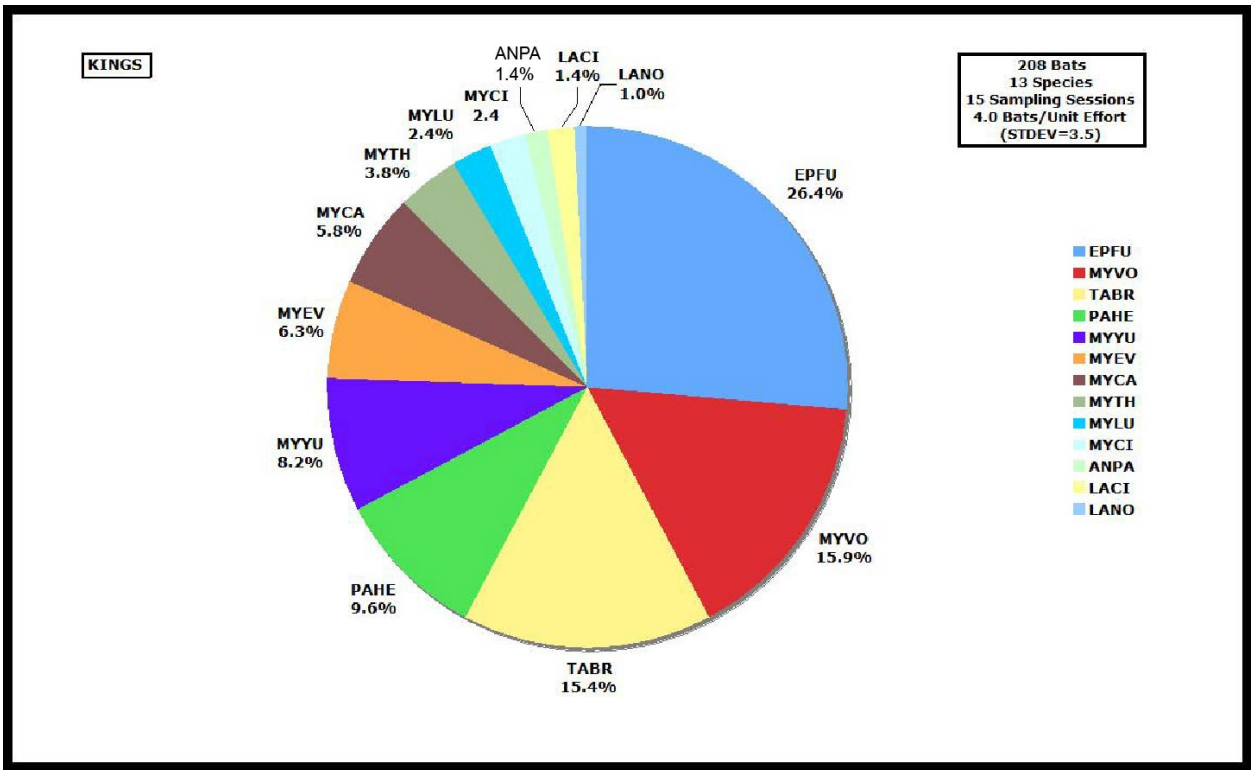


Figure 39. Relative abundance of species in net captures in the Kings drainage.

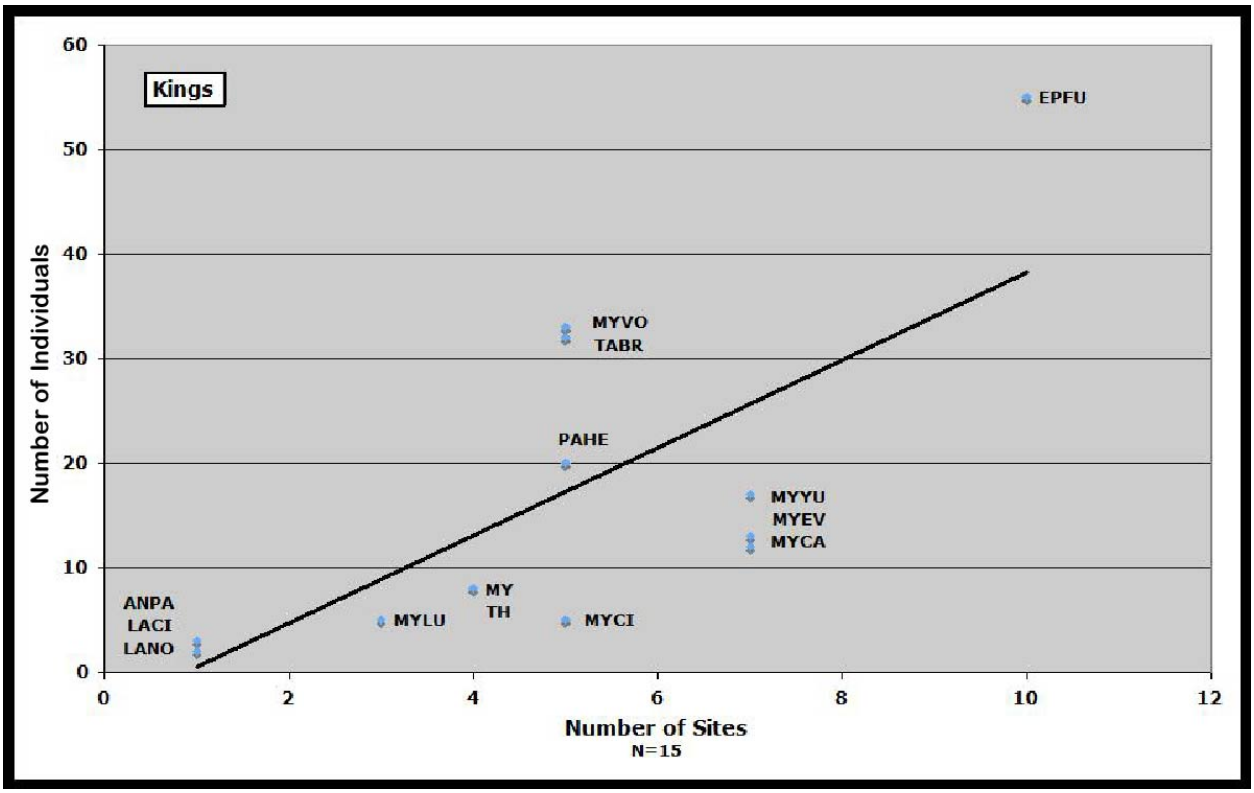


Figure 40. A scatterplot showing the number of individuals for each species plotted against the number of sites at which they were found in the Kings drainage.

Figure 41 compares the percentage of sampling sites at which seven species were detected acoustically and by capture. All seven species that were monitored acoustically were detected in the Kings drainage.

For a more detailed discussion of our findings along both branches of the Kings see Section 3.3.2.4 above.

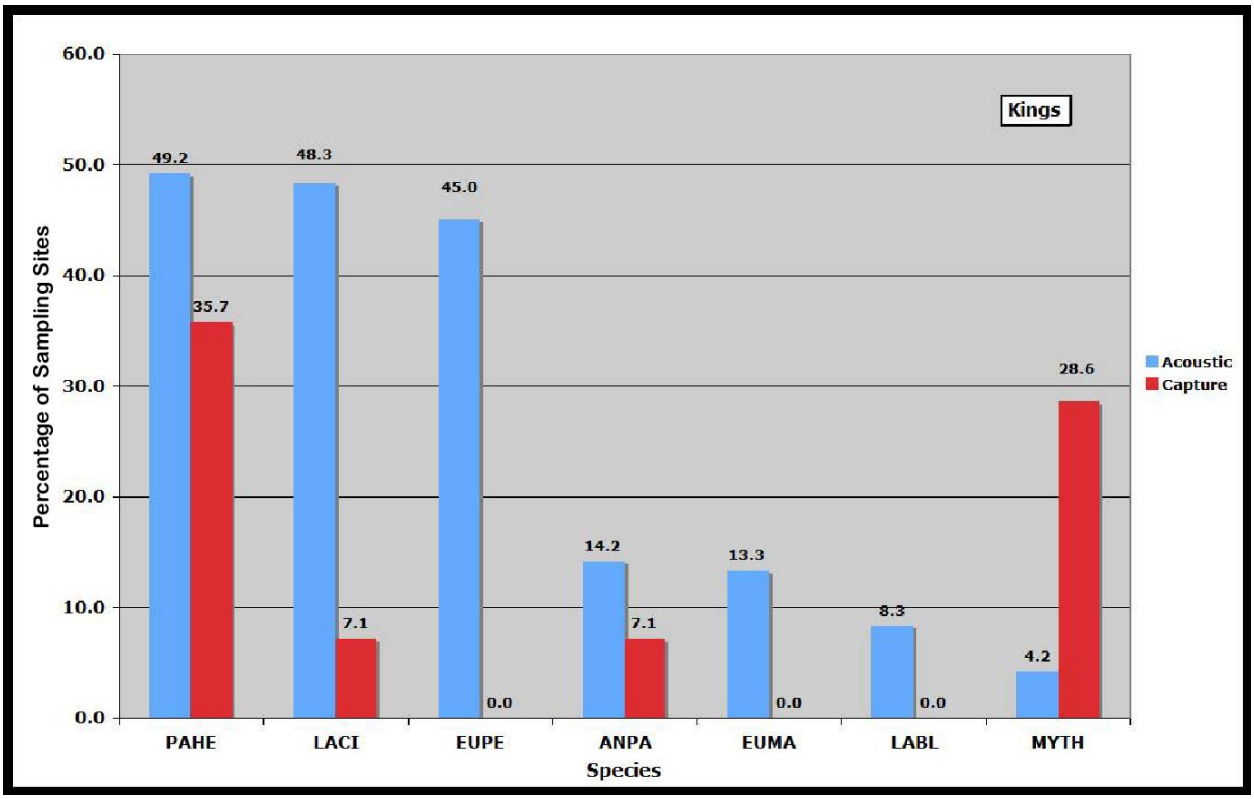


Figure 41. A bar graph comparing the percentage of sampling sites at which seven species were detected by capture and acoustic methods in the Kings drainage. Acoustic monitoring always accompanied mist-net capture of bats.

3.4.3. Kaweah

We sampled sections of all five branches of the Kaweah River drainage: the North Fork near the confluence with Yucca Creek and at Redwood Creek (one of its headwaters); the Marble Fork in the Giant Forest/Lodgepole area; the Middle Fork in the Ash Mountain area and near Bearpaw Meadow (including Redwood Meadow); the East Fork from the entrance station on the Mineral King Road to Mineral King and Eagle Lake; and the South Fork in the vicinity of the campground. This was the only drainage where we detected all 17 expected species, 14 by capture and three (*E. maculatum, E, perotis* and *L. cinereus*) only acoustically (Table 28).

We captured a total of 190 bats in this drainage, 52 in Redwood Creek in Kings Canyon (Table 9c,) and 138 in all the branches in Sequoia (Tables 18a-b) (Pierson and Rainey 2017). The Kaweah drainage was the only one where *M. yumanensis*, and not *E. fuscus*, was the most frequently captured species (Figure 42). Not only did *M. yumanensis* appear to be relatively abundant at lowest elevations (e.g., the Ash Mountain area), but it was captured at 100 % of our sampling sites that were in Sequoia National Park, and it was captured in greater numbers than expected (Figure 43). *M. thysanodes* was encountered far more frequently in this drainage than in the others, supporting the inference that this species is found preferentially in giant sequoia groves. It is nevertheless still quite rare, being found in lower numbers than expected based on the number of sites at which it was observed (Figure 43). This drainage had the only capture record for *C. townsendii* in this inventory, consistent with the pre-

existing records for this species which are all from the Kaweah drainage. While *L. noctivagans* was captured on Redwood Creek, it is not known whether it occurs elsewhere. This and prior records from this area may be the most southern localities known for this species in the Sierra Nevada.

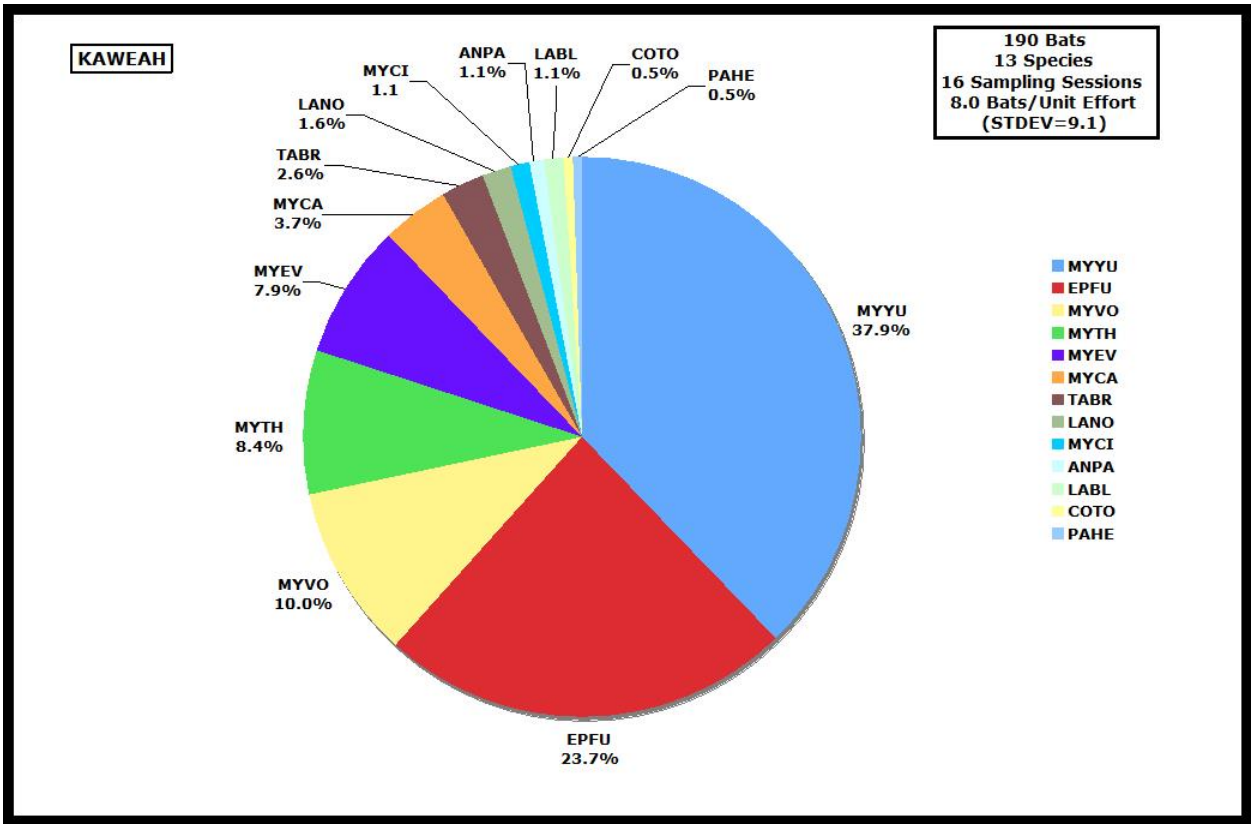


Figure 42. Relative abundance of species in net captures in the Kaweah drainage.

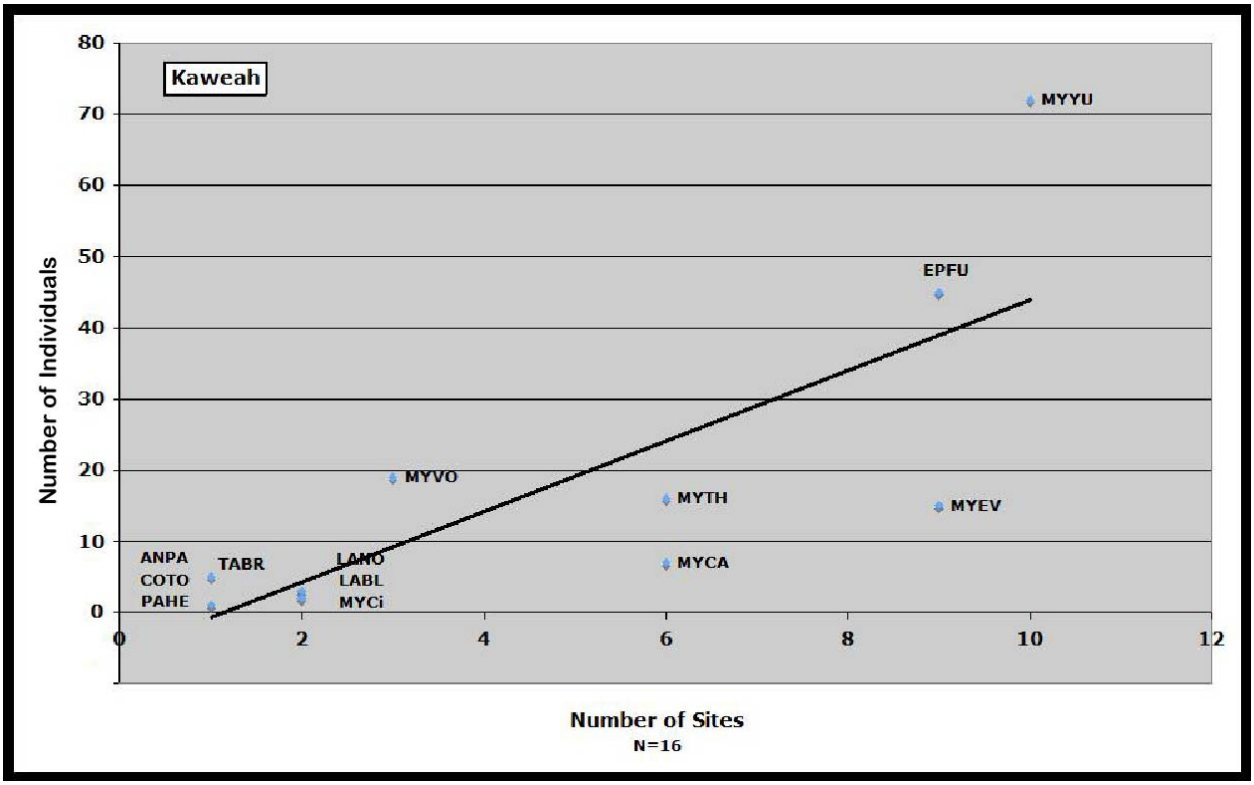


Figure 43. The number of individuals for each species plotted against the number of sites at which they were found in the Kaweah drainage.

The most striking feature of the acoustic records is that the two species that were encountered during the greatest percentage of sampling sessions were *L. cinereus* (46.6%) and *E. perotis* (39.8%) were not captured (Figure 44). Also, the third species that was not captured, *E. maculatum*, was detected during 24.6% of the sampling sessions. For all species except *M. thysanodes*, the acoustic surveys provided more information on distribution than the capture efforts.

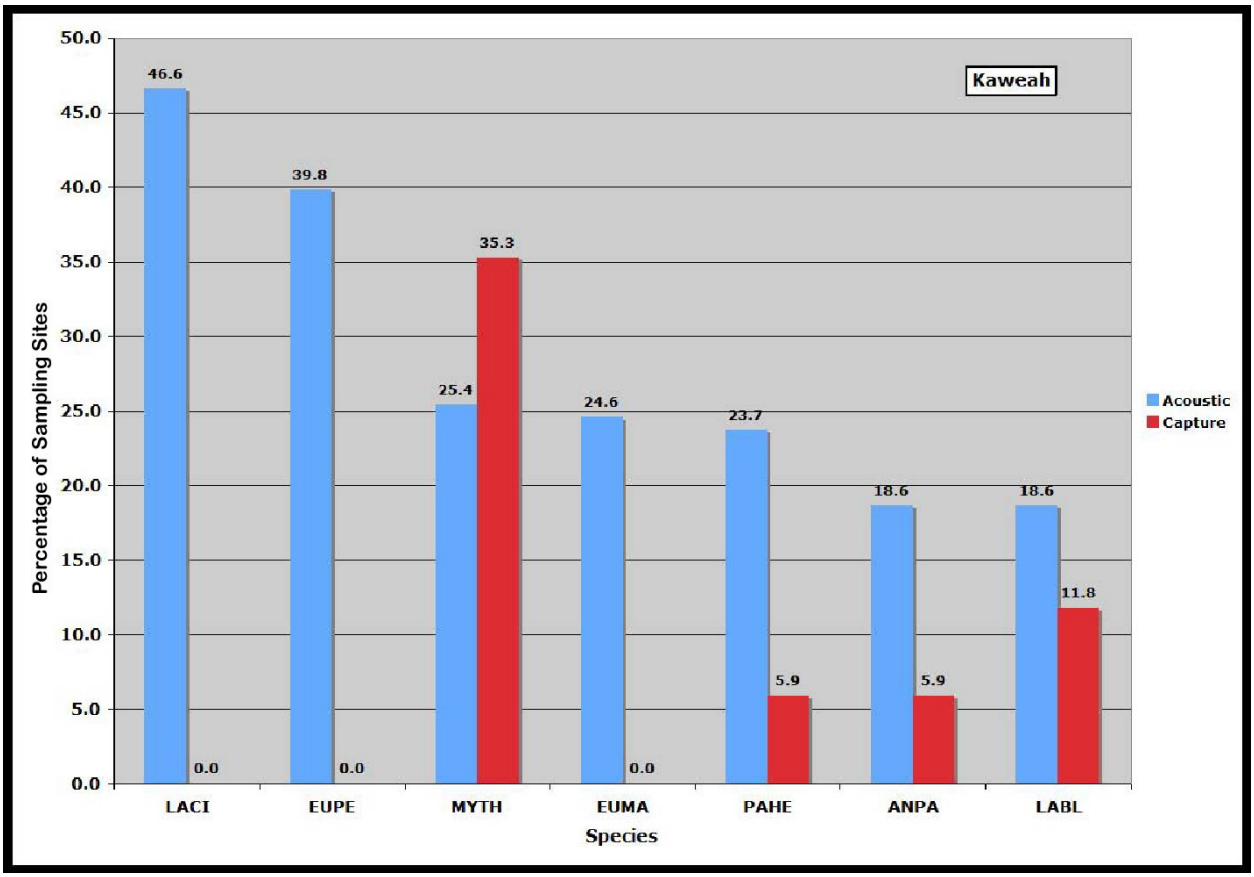


Figure 44. Comparison of the percentage of sampling sites at which seven species were detected by capture and acoustic methods in the Kaweah drainage. Acoustic monitoring always accompanied mist-net capture of bats.

For a more detailed discussion of our findings in the Kaweah drainage see Section 3.3.2.4 (Kings Canyon National Park) and Section 3.3.3.4 (Sequoia National Park).

3.4.4. Kern

Because so little was known about the Kern, we took two sampling trips into this drainage. Although a few sites were repeat sampled, we focused on different areas in the two years, focusing on sites in the Kern Trench in the first year, and adding surveys at Tyndall Frog Ponds, and area above Mitochondria Lake, and the Chagoopa Plateau in the second year (see Pierson and Rainey 2017 for link to project data). Because this entire survey ranged from mid to high elevation (1,970 m at the Kern Ranger Station to 3,372 m at Tyndall Frog Ponds), the species assemblage was more limited. We detected at total of 14 species, nine by capture and 5 by acoustic sampling only (Table 29). As in both the San Joaquin and Kings drainages, *E. fuscus* was the most frequently captured species (Figure 45). *M. evotis*, as the second most abundant species, representing 27.6 % of all captures, appears to be relatively far more abundant in the Kern drainage than in any of the other drainages. It was found from the lowest elevation at Coyote Creek to >3,000 m at two tarns on the Chagoopa Plateau. Thus it was both relatively numerous and widely distributed (Figure 46). *M. volans* was also

relatively more abundant in the Kern drainage than it was in either the Kings or Kaweah. This also may reflect a bias in its distribution towards mid to high elevation.

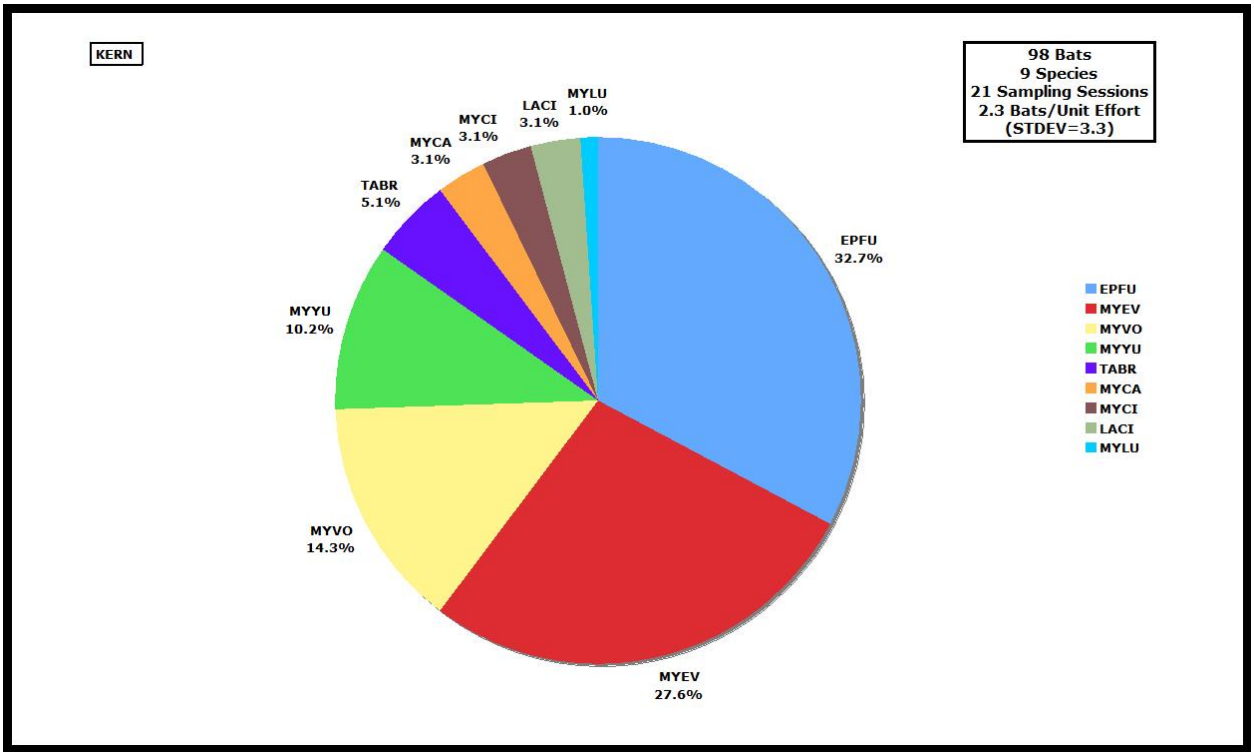


Figure 45. Relative abundance of species in net captures in the Kern drainage.

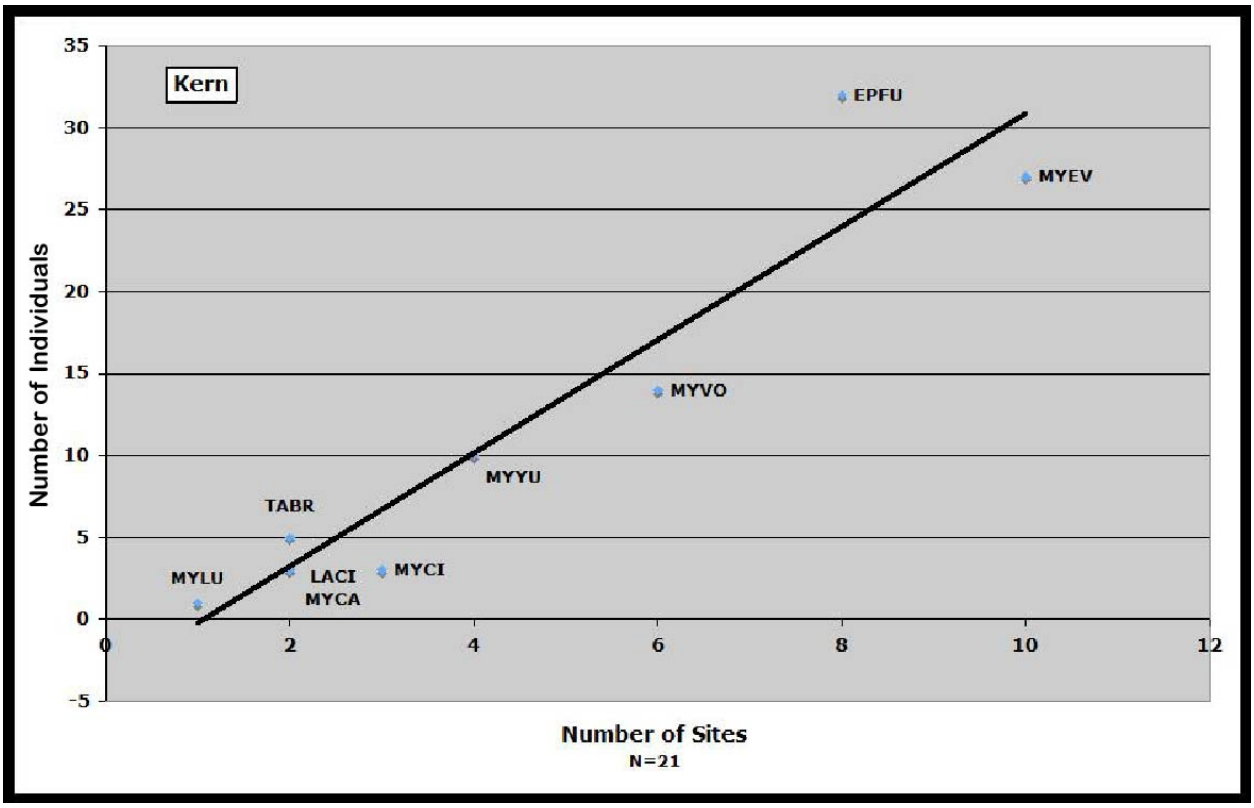


Figure 46. A scatterplot showing the number of individuals for each species plotted against the number of sites at which they were found in the Kern drainage.

Of the six species detected acoustically in the Kern drainage (with only *P. hesperus* being absent), only one, *L. cinereus*, was captured. It was captured at 9.5 % of the sites, but detected acoustically at 42.1 % of the sites (Figure 47). As was consitently true everywhere we sampled, the acoustic records gave a more comprehensive picture of distribution for most species.

3.5. Bat Assemblage by Elevation

Figure 47 depicts the summer elevation range over which each species is known to occur in Sequoia, Kings Canyon or Devils Postpile, either through prior records or records (acoustic and capture) obtained in this study. Seven of the 17 species (41.2 %) appear to be confined to elevations below 2,500 m. *A. pallidus* and *M. californicus* appear to be the most restricted, which is consistent with data collected on these species in Yosemite National Park (Pierson et al. 2001). Records for *C. townsendii*, however, are extremely limited, and this species is known to hibernate at high elevation in the White Mountains (Szewczak et al. 1998). Records suggest that the distribution for *L. noctivagans* is limited in this part of the Sierra Nevada to a fairly narrow mid-elevation band. There are several other species that were also not detected at the lowest elevations. *M. evotis* and *M. lucifugus*, in particular, appear to be mid to high elevation species.

There were a number of quite striking records at high elevation, *e.g.*, *E. perotis* at Eagle Lake and *L. cinereus* in Dusy Basin. It should be noted that these are acoustic records, indicative of foraging bats. Both the molossids (*E. perotis* and *T. brasiliensis*) and the lasiurines (both *Lasiurus* species) are open

air foragers which are capable of travelling many miles from their day roosts to forage. Radio-tracking of *E. perotis* in Yosemite National Park showed that this species, when captured in Yosemite Valley, roosted there but its foraging range extended to much higher elevation (Pierson and Rainey 1996b).



Figure 47. A floating bar graph showing the lowest and highest elevation (across all parks) for which there are records for the 17 species identified in this inventory.

Although high elevation records exist for 10 species, for most of this assemblage these records are quite rare. An examination of our capture results at water sites (our most successful sites at all elevations) shows that the number of bats captured per unit effort declines sharply with gain in elevation (Figure 48).

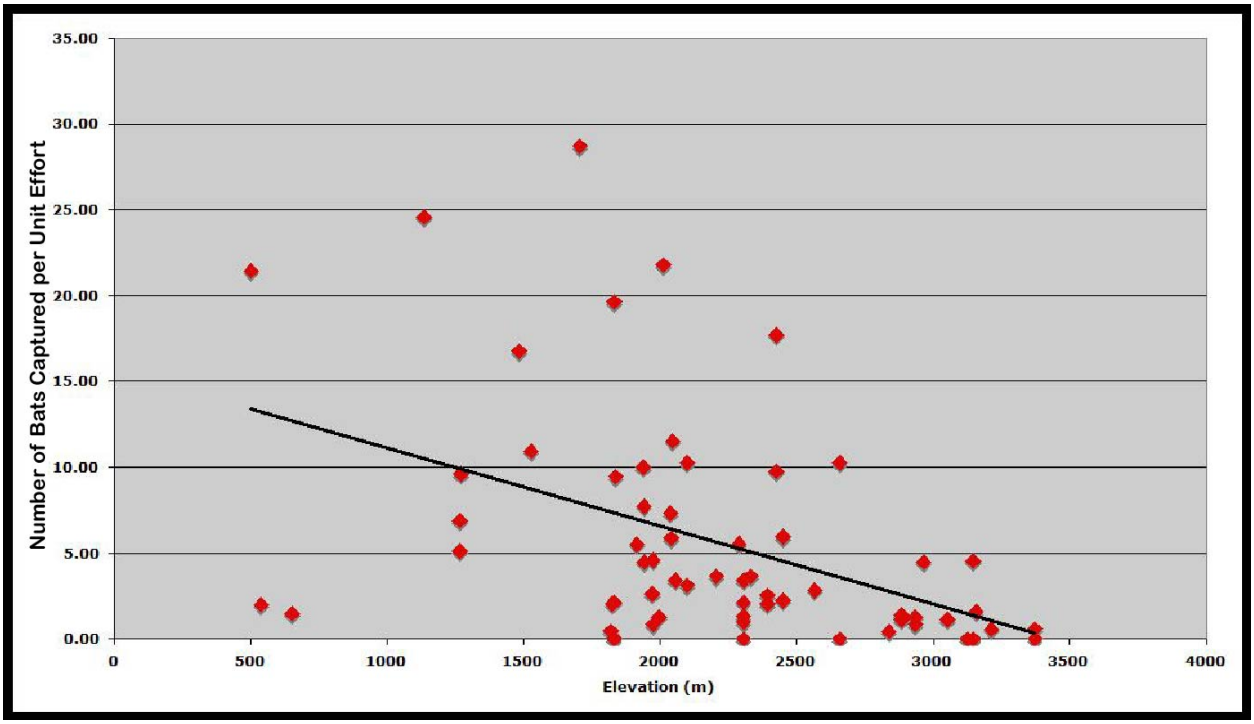
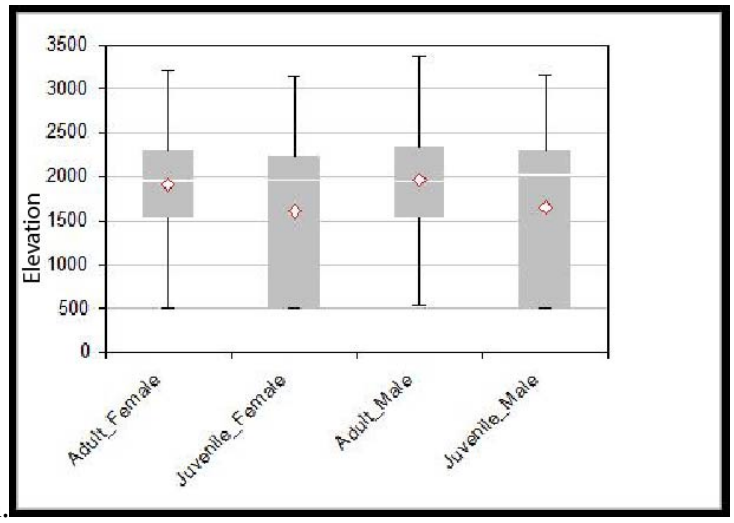


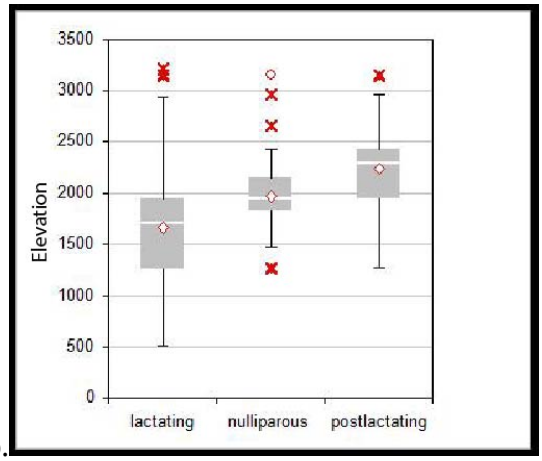
Figure 48. A scatterplot showing the number of bats captured per unit effort at water sites by elevation across all parks.

To gain a better understanding of elevational distribution we plotted our data by age, sex, and reproductive condition against elevation (Figure 50). While the median elevation value is lower for juveniles of both sexes than it is for adults of either sex, these differences are not significant (Figure 49a). When we looked at reproductive condition of adult females, even though there were outlying examples of lactating females at very high elevation, the median elevation value for lactating females in considerably lower than for nulliparous and post-lactating females (Figure 49b). Also, juveniles that were newly volant (as evidenced by open or very open epiphyseal wing joints), and would have been still dependent on their mothers, were found at much lower elevation than older juveniles (epiphyses closed and age determined by pelage and tooth wear) (Figure 49c).

a.



b.



c.

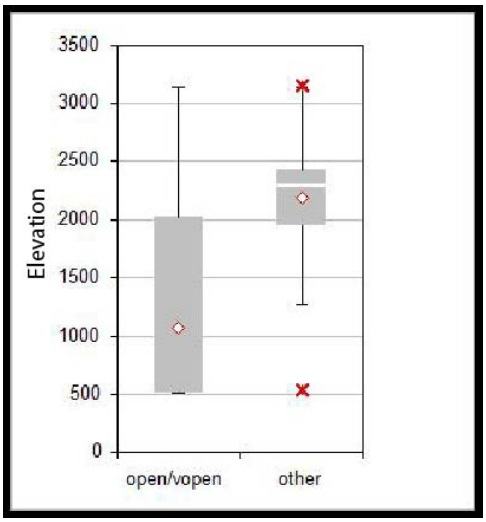


Figure 49. The distribution of capture records by elevation for (a) adults and juveniles of both sexes, (b) adult females by reproductive condition, and (c) juveniles, aged by whether they are newly volant (=open or very open epiphyses) or older juveniles with closed epiphyses. The shaded area defines the IQR (interquartile range), a range which contains the median value and 50% of the records, with 25% falling below and 25% above. The “T” lines define the Upper and Lower “Whiskers” which run to the most extreme observation up to 1.5XIQR. Observations that exceed this appear as outliers (= *).

4.0. Management Considerations

While national parks are to a large extent wildlife refuges, there are interventions that park personnel must undertake to manage the landscape, particularly to accommodate human recreational activities. All these management actions have the potential to affect bat populations. To provide a framework for the more detailed discussions provided in each species account found in Appendix VI, we conducted two ranking exercises for the bat fauna of Devils Postpile National Monument and Sequoia and Kings Canyon National Parks, one to offer a perspective on status, and the other to provide an overview of how management activities might impact individual species.

4.1. Species Status

To assess species status, we used a model first proposed by Rabinowitz (1981) that identifies seven forms of rarity based on three elements: geographic range, population size, and habitat specificity. While this model was developed for plants (Rabinowitz 1981, Rabinowitz et al. 1986), it has subsequently been used to assess rarity in mammals (Yu and Dobson 2000). Rather than consider the three parameters for the entire range of each species, we have proposed rankings based primarily on what we know of their distribution within the jurisdictions considered in this survey. For example, we considered a geographic range to be "small" if the species has a limited elevational distribution within the parks, even though its overall distribution outside the park might be considered "large." To assign these rankings we considered the combined results of our capture and acoustic efforts, plus what is known regarding the habitat needs of each species both here and elsewhere in the Sierra Nevada, particularly Yosemite National Park, where several radio-tracking efforts have yielded valuable information regarding roosting and foraging needs (e.g., Pierson and Rainey 1996b, Pierson et al. 2006a, Pierson et al., unpublished data). The proposed rankings are provided in Figure 50. Justifications are provided in the individual species accounts.

Seven species have been granted special status by other agencies or entities (Figure 50). Three are recognized as Sensitive by the Forest Service (USDA-FSS), five are considered Mammal Species of Special Concern by the California Department of Fish and Game (CDFG-MSSC), and all seven are considered High Priority by the Western Bat Working Group (WBWG). The team who worked on a draft conservation plan for the bats of California ranked all the species at a workshop in June 2007. Four of the five ranked as species of greatest conservation concern occur in Sequoia and Kings Canyon. They are (in descending ranking order): *C. townsendii* and *L. blossevillii* (tied for first), *A. pallidus*, and *M. thysanodes*. While rankings by all these parties are based largely on issues that affect these species outside park boundaries, they serve to highlight the importance of National Park Service land as potential refugia, and signal a potentially heightened sensitivity of these species to management activities within the parks.

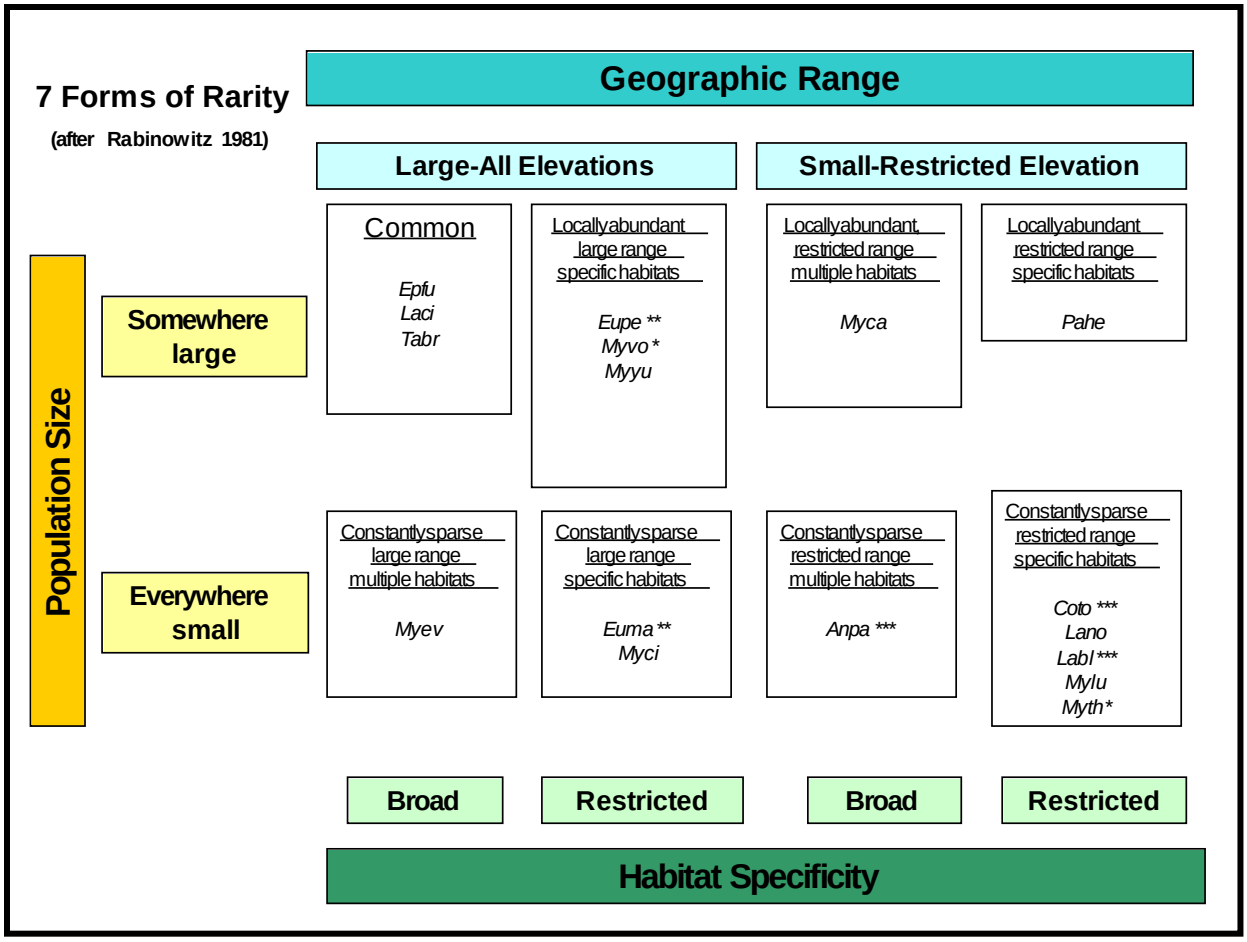


Figure 50. A proposed ranking for the 17 species of bats considered in this inventory effort, adapted from the model of Rabinowitz (1981). *= WBWG-High Priority, **= CDFG-MSSC and WBWG-High Priority, *** = USDA-FSS, CDFG-MSSC and WBWG-High Priority.

4.2. Management Issues

Bats are unique among mammals and different from many birds in that their roosting and foraging areas are often widely separated geographically (Pierson 1998). Recent radio-tracking efforts using aerial tracking have documented individual bats undergoing one-way commuting distances between day roosts and foraging areas of up to 25 km for *E. maculatum* (Chambers et al. 2006) and 40 km for *Idionycteris phyllotis* (a close relative of *E. maculatum*) (Brown and Berry 2007). To ensure the persistence of bat populations both their roosting and foraging areas need to be considered, and often separately.

Additionally, there are a number of species that undergo seasonal migrations, and thus may spend significant portions of their lives outside park jurisdiction. While management recommendations included in this document consider only issues that could potentially arise within park boundaries, it is important to recognize that national parks likely play an increasingly important role in sustaining bat populations as pressures such as urban expansion, wind farm development, and commercial timber harvest reduce habitat or increase mortality outside park jurisdiction. It is also now well

documented that both air and water quality within the parks are being compromised by factors outside the park to the detriment of wildlife and wildlife habitat (e.g., Sparling and Fellers 2009).

While many of the species have a distribution that reaches to some of the highest elevations, numbers of animals and species diversity decline with elevation. Particularly important is understanding the elevation range in which females choose to raise their young. For many species there is a gender separation with elevation, with males more likely to be found at higher elevations (Cryan et al. 2000). Reproductive females of many species seek the warmest possible habitats, and are far more likely to bear young at lower elevations, often at elevations below those found in any of the parks. Consequently, the lower elevation areas, which are often the areas most frequented by tourists (e.g., Ash Mountain, Cedar Grove, South Fork Kaweah), become differentially important.

We have provided rankings for all 17 species in three broad categories: roosting habitat, foraging habitat, and overall life history (Table 30). The purpose here is to provide some guidance to resource managers, alerting them as to which species could be affected by management actions as they relate to these various resources. The issues for individual species are addressed in the species accounts (Appendix VI).

Overall Life History

We first consider three factors that potentially affect the entire life history of a species: fire, climate change, and White Nose Syndrome (WNS).

Fire

While fire likely reduces roosting and foraging habitat in the short-term, it enhances it for many species in the longer term, particularly for species that roost in snags, under-flaking bark, or in fire-scarred basal hollows. A recent study on *Myotis septentrionalis*, an eastern long-eared species broadly analogous ecologically to *M. evotis and M. thysanodes*, found that this species was tolerant of prescribed fire, and modified both its roosting and foraging localities in response to fire (Lacki et al. 2009). Another study on *Nycticeius humeralis*, a tree-roositng species found in the eastern United States, showed that prescribed fire created habitat for this species (Boyles and Aubrey 2006).

The greatest concern with fire is for those species thought to hibernate/roost in leaf litter. Roosting in leaf litter has been documented for *L. noctivagans* (Sanborn 1953), *L. blossevillii* (D. Johnston, personal communication), and its close relatives found in the eastern U.S., the eastern red bat, *Lasiurus borealis* (Saugey et al. 1998) and the seminole bat, *Lasiurus seminolus* (Hein et al. 2007). A study on winter roost-site selection in seminole bats (*Lasiurus seminolus*), which like other *Lasiurus* species is foliage roosting, showed that on warm night bats roosted in trees, but when minimum nightly temperatures were <4°C, bats typically roosted on or near the forest floor (Hein et al. 2007). These authors recommend avoiding prescribed burns when the previous night's temperature is <4°C to avoid disturbance or direct mortality to bats roosting on or near the forest floor.

The extent to which California species engage in this behavior is unknown, but those species most likely to roost in leaf litter would be *L. blossevillii, L. cinereus*, and *L. noctivagans*. Acoustic data shows a sharp increase in the number of *L. blossevillii* and *L. cinereus* at lower elevation (e.g.,

Shepherd's Saddle) in the spring (March through mid-May), with a smaller pulse in late summer through the fall, intervals that overlap with timing of prescribed burns (Figures 7.6 and 8.6. – in respective species accounts).

Climate Change

Climate change influences the biogeography of bats, their access to food, timing of hibernation, reproduction and development, frequency and duration of torpor, and rate of energy expenditure (Sherwin et al. 2013). Climate change can be expected to alter the latitudinal and elevational distribution of a number of species (Humphries et al. 2004). Anticipated changes in the snowpack and water availability are a primary concern for the Sierra Nevada (Cayan et al. 2008). Widespread shifts in the timing and intensity of snowmelt-derived stream flow are already detectable, particularly across western mountain ranges where rising mean temperatures are affecting annual precipitation, snowpack, and stream discharge rates (Cayan et al. 2001, Christensen et al. 2004, McCabe and Clark 2005, Mote et al. 2005, Stewart et al. 2005, Knowles et al. 2006).

Data from the Sierra Nevada and Cascade ranges (Morrell and Duff 2005, Pierson et al. 2001), plus other areas with geographic relief suggest that for many bat species, males tend to dominate at higher elevations, and reproductive females prefer warmer, lower elevation areas for raising their young (Cryan et al. 2000). Thus we would expect that those species that are currently limited in their elevational distribution would expand their ranges upward. While this might benefit some species by allowing them to expand their breeding ranges, recent research in Colorado found a statistically significant decline in reproductive success in insectivorous female bats connected with higher mean monthly temperatures, lower precipitation, and lower stream discharges over a 12 year period (Adams 2009, 2010). The amount of decline depended on the severity of drought conditions (Adams 2010). It is unknown how Sierra Nevada bat populations responded to the recent 2012-2015 severe drought in California as only limited data collection on bats occurred during this time period.

Also, we know very little about requirements during the winter, hibernating season for almost any California bat species. The possibility that hibernating habitat could become limiting seems very real and has been hypothesized for *M. lucifugus* (Humphries et al. 2002). *M. lucifugus* actually provides a critical counter example to the distributional pattern outlined above. The subspecies found in the Sierra Nevada appears to be limited to elevations above 5,000 ft, and be the only species to raise their young exclusively at higher elevations. Thus, it would be our expectation that for this species both their breeding and hibernating range would shrink with global warming.

Other species that would be considered at high risk of being negatively impacted by a warming climate would be:

- *M. evotis* because, although less constrained than *M. lucifugus*, it tends to be a more high elevation species in the Sierra Nevada (Figure 48).
- *L. noctivagans* because of the apparently limited elevation band in which it occurs (Figure 48)

- *C. townsendii* because data from the Inyo and White Mountains documents this species hibernating at high elevation (Szewczak et al. 1998).

White Nose Syndrome (WNS)

White Nose Syndrome is a cold-loving fungus that has been devastating hibernating bats in caves in the eastern United States. It was first discovered in New York State in the winter of 2006, and has been rapidly expanding its range. By the winter of 2009 it had reached nine states (Gargas et al. 2009), and it has now been confirmed in bat hibernation sites in 29 states and five Canadian provinces (whitenosesyndrome.org/).

Fifteen of the seventeen species detected in this inventory are capable of hibernation (excluding the two molossids – *E. perotis* and *T. brasiliensis*). Thirteen of these (excluding *L. blossevillii* and *L. cinereus* for which cave records are exceedingly rare and atypical) could be expected to hibernate in caves. Very little, however, is known about bat hibernation behavior in California. The only species for which large hibernating aggregations are known is *C. townsendii*, and these sites are concentrated in the lava country in northern California (Pearson et al. 1952, Pierson 1988). There are isolated records of hibernation by a few animals in caves and mines for *A. pallidus*, *E. fuscus*, *L. noctivagans*, *M. ciliolabrum M. evotis*, *M. volans*, and *P. hesperus* (Barbour and Davis 1968, Marcot 1984, Pearson et. al. 1952, Szewczak et al. 1998).

The extent to which WNS could ever be an issue in the central Sierra Nevada is unknown at this time. Because the focus in this inventory was on geographic scope and on sampling bats in their foraging areas, very little emphasis was placed on roost surveys. Information on microclimate (particularly temperature and humidity) in park caves and on seasonal use patterns by bats could provide important baseline data, and help these parks be prepared should this disease reach California. A roost survey was conducted in Sequoia and Kings Canyon National Parks in 2014-2015 with funds directed at better understanding the risk of WNS for bats in national parks.

During the winter of 2014-2015, sixty caves in Sequoia and Kings Canyon National Parks were surveyed and bat echolocation activity was recorded across an elevation gradient from 700-3100m (Frick et al. in prep). The purpose of the survey was to determine winter use of caves and foraging activity to help the parks develop an appropriate monitoring and management plan. Less than 20 percent of caves (11 out of 60) has bats and nearly half of these caves housed single individuals of Townsend's big-eared bat (*Corynorhinus townsendii*). The largest aggregation of hibernating bats was less than 10 Townsend's big-eared bats. Two big brown bats (*Eptesicus fuscus*) in Crystal Cave represented the only other species found. Bat echolocation activity declined during winter months but most species were active throughout the winter, which was a severe drought year with little snowpack. These results suggest that cave habitats were not generally used for large aggregations of hibernating bats and that winter cave surveys will not be an effective management strategy for bats in Sequoia and Kings Canyon National Parks (Frick et al. in prep). Although it would be valuable to do a similar survey in a year with average snowpack to assess if roosting behavior differs from a drought year.

Roosting Habitat

We have divided roost sites into four general categories: caves (or cave analogues such as mines), cliffs or rock outcrops, trees, and human structures (other than mines).

Caves and Mines

Caves range from limestone caverns such as Crystal, Lost Soldier and Clough caves to large boulder jumbles (= talus caves) and large rock shelters (e.g., larger overhangs on resistant rock). This category would also include mines, which are cave analogues. Caves are prime roosting habitat for many bat species, particularly *C. townsendii*. Records exist for cave roosting in Sequoia for seven species (Table 30), particularly important being the documentation of a maternity roost of *M. thysanodes* in Clough Cave in 1951, and records for *C. townsendii* from multiple caves.

Potential cave management issues would be:

- Lack of information about seasonal use patterns, particularly (since WNS has reached the West) the extent to which caves in the parks are used as hibernation sites
- Impacts of visitor use and controlling visitor access
- Fire near cave entrances
- Humidity/microenvironment changes associated with climate change
- Preparing for the possibility that WNS will reach California

Cliffs and Rock Outcrops

The cliff/rock outcrop category would apply to crevice roosts, acknowledging that crevices used by bats are often inside caves and/or under large rock overhangs.

Potential management issues for bats would be:

- Highway projects that involve blasting rock
- Recreational climbing
- Tourist development in cliff areas

Tree Roosts

The tree category includes cavity roosts (such as fire-scarred basal hollows of giant sequoia, cavities created by lightning strikes, or woodpecker holes in snags), crevice roosts under loose bark, and foliage shelters used by the two *Lasiurus* species.

Potential management issues for bats would be:

- Removal of hazard trees
- New trails or any tourist development in giant seqouia groves

- Removal of large snags – particularly *P. ponderosa* or *P. lambertiana*.

Anthropogenic Structures

Human structures refer to any man-made facility other than mines, such as buildings, bridges, or towers.

Potential management issues for bats would be:

- Renovation or demolition of human–made structures

Foraging Habitat

For foraging habitat we have ranked species according to the four categories that we sampled acoustically for this inventory (Section 2.3): water sites, meadows/scrub, rock, and forest/forest edge.

Water

Water sites include all surface water, from lakes to small ponds or flooded meadows, and from rivers to small creeks. It is important to realize that bats use water sites for both drinking and foraging. Thus even those species that appear to forage primarily on terrestrial insects (particularly *A. pallidus, C. townsendii, E. maculatum, E. perotis, L. cinereus,* and *T. brasiliensis*) do come to water sources to drink. Thus water quality issues are important to all the bat species. The degree to which different bat species rely on aquatic emergent insects varies greatly, with *M. lucifugus* and *M. yumanensis* appearing to be the most aquatic dependent of the species in the Sierra Nevada (Pierson et al., unpublished data). Nevertheless, many of the species that are more opportunistic in their foraging, will feed predominantly in riparian zones where they can take both aquatic emergent insects and terrestrial prey associated with riparian vegetation (e.g., *E. fuscus, L. noctivagans, M. evotis, M. thysanodes*) (Rainey and Pierson 1996, Pierson and Rainey 1997).

Potential management issues for bats would be:

- Any management action or natural phenomenon that could alter prey diversity and abundance in water sources, or compromise water quality.

- Any management action that would alter water flow (e.g., dam installation or removal).

Meadow/scrub

The meadow category refers to open areas such as wet or dry meadows, manzanita and sagebrush scrub, and chaparral.

Potential management issues for bats would be:

- Any management action or natural phenomenon that could alter prey diversity and abundance in these habitats

- Stock use of meadows

- Tourist activities related to meadows

Rocks

The rock category refers to sparsely vegetated talus slopes and rock benches, and the gravel bars and flood plains associated with the rivers.

Potential management issues for bats would be:

- Any management action or natural phenomenon that changes the configuration of these rock features

Forest

The last category includes forest edge, and forest habitats ranging from the most open (e.g., blue oak savannah or foxtail pine) to fairly cluttered (e.g., understory of canyon live oak).

Potential management issues for bats would be:

- Prescribed burns
- Selective removal of hazard trees
- Tree removal for tourist development

Table 30. Rankings for bat species for various factors affecting their life histories. Rankings for roosting and foragaing describe the extent to which this species relies of a particular feature; rankings for climate change, fire and White Nose Syndrome (WNS) define the expected or potential impact on the species. 3 = heavily; 2 = moderately; 1 = minimally; 0 = not at all; U = unknown. * = Records exist for this roost use in Sequoia or Kings Canyon.

	ROOSTING				FORAGING				OVERALL LIFE HISTORY		
Species	**Caves/ Mines**	**Cliffs/ Rocks**	**Trees**	**Human Structures**	**Water Sites**	**Meadows**	**Rock**	**Forest/ Forest Edge**	**Climate Change**	**Fire**	**WNS**
A. pallidus	2*	2	3*	3*	1	3	2	3	2	2	2
C. townsendii	3*	U	U	3	1	3	2	3	3	2	2
E. fuscus	1*	2	2*	2	2	2	1	2	2	2	2
E. maculatum	U	3	0	0	1	3	2	3	2	1	1
E. perotis	0	3*	0	0	1	3	3	2	2	1	1
L. noctivagans	0	0	3	0	2	1	1	2	2	3	1
L. blossevillii	0	0	3	0	1	3	1	1	2	3	1
L. cinereus	0	0	3	0	1	3	2	1	2	3	1
M. californicus	1	2	2*	2	2	1	1	3	2	2	2
M. ciliolabrum	1	3	U	1	2	1	3	3	2	1	2
M. evotis	2*	2	2*	2*	2	1	1	3	3	2	2
M. lucifugus	U	3	U	U	3	1	1	1	3	1	3
M. thysanodes	3*	2	3*	1*	2	2	1	3	2	2	2
M. volans	2*	U	3*	U	2	1	1	3	2	2	2
M. yumanensis	2*	U	2*	3	3	1	1	1	2	1	2
P. hesperus	1	3*	0	U	2	3	3	1	2	1	2
T. brasiliensis	1	3	0	3	1	3	2	1	2	1	1

5.0 Recommendations for Long-term Monitoring

Long-term efforts to quantitatively monitor bat populations (typically in response to inferences of decline) began with experimental and then systematic individual marking and mass counting of largely inactive bats aggregated in north temperate winter cave and mine hibernacula. Evidence of injury to both individuals and populations from banding and winter disturbance led to dramatic reduction of these efforts in the 1950s and 1960s. Dusk emergence counts from caves and mines have also been employed with improving accuracy to follow active season abundance. However, both these approaches function best with predictably and persistently occupied aggregated roost sites. Some bats in California form large aggregations (notably *T. brasiliensis*), but such sites aren't currently identified in Sierra Nevada Network parks. Large to moderate winter hibernating aggregations are unknown statewide for most species (*C. townsendii* in lava caves in northern California being a notable exception). Many species are non-colonial or occupy only cryptic or inaccessible roost sites in the warm season (e.g., tree hollows, cliff crevices) that often require capture and radio-telemetry to localize.

An alternative approach to monitoring bat activity exploits the fact that most microbats rely at least partly on echolocation for prey detection and orientation and many emit intense ultrasound pulses

every second when in flight. The re-discovery of this sensory mode via then novel instruments is a few decades old, but rapidly advancing technology has made available efficient and cost effective acoustic detector systems that can monitor bat community activity by recording echolocation calls. With single instruments, it is not currently possible to efficiently discriminate between multiple bats and single bats when obtaining repeated calls of the same. Consequently the activity data (partitioned into species or acoustically similar species groups) provide an index (rather than a count of individuals) as a basis for following population trends in both time and space. This approach has been widely employed for both inventory and monitoring for several years in a number of European countries. The Bat Conservation Trust (2008) in the U.K. manages a geographically extensive annual program of statistically designed walking detector transects by trained volunteers to maintain distribution maps and monitor trends in activity by species. The initial program has led to several allied efforts including driven vehicle transects for roadside bats and walking surveys along waterways for bats specializing on skimming emergent aquatic insects (e.g., Roche et al. 2009, http://www.bats.org.uk/nbmp_tutorials_waterway/index.htm). Training programs (and equipment grants) for these techniques have extended these methods widely in Eastern Europe and less extensively to other areas of the Old World.

A complementary approach currently more widely used in North America and Australia, but also expanding in Europe associated with wind energy impact assessment, involves extended deployments (multiple days to years) of unattended ultrasound detection and recording equipment (e.g., Duchamp et al. 2006, Fischer et al. 2009, Hein et al. 2009). This approach has been employed on NPS lands for both inventory (e.g., Johnson and Gates 2008, this study) and evaluating the approach for long-term monitoring (Gorresen et al. 2008). We have recently completed an evaluation of this approach to monitoring in Yosemite with USGS support and found that, at low to moderate elevation sites (below 1400 m there), reasonable levels (10-15% at 0.05 alpha) of year to year activity change could be identified for the more commonly detected species with twelve currently available systems monitoring roughly 200 nights/year. This model is detailed in Rainey et al. (2009).

More recently, a multiagency group has developed a program to conduct standardized monitoring of bat species across multiple taxa in North America (Loeb et al. 2015). The North American Bat Monitoring Program (NABat) provides the biological, administrative, and statistical structure for coordinated bat population monitoring to support regional and rangewide inferences about changes in the distributions and abundances of bat populations. Bats face current and emerging threats, including habitat loss and fragmentation, white-nose syndrome, wind energy development, and climate change. This program provides guidance for monitoring bats from local to rangewide scales to promote effective conservation decisionmaking and would be an important starting point for a park or network-scale bat monitoring program.

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Glossary of Terms

Calcar: also known as the calcaneum, is the name given to a spur of cartilage arising from inner side of ankle and running along part of outer interfemoral membrane in bats. This is to help spread the interfemoral membrane, which is part of the wing membrane between the tail and the hind legs. This membrane can form a basket or pouch to help catch and hold insects captured in flight

Microbats: constitute the now outdated suborder Microchiroptera within the order Chiroptera (bats). Bats were once differentiated into Megachiroptera and Microchiroptera, based on their size; but available molecular evidence has now shown this to be incorrect, the horseshoe bats being included in Yinpterochiroptera with the fruit bats and others. Most species which were termed Microchiroptera are now referred to as the Yangochiroptera.

Molossids: members of the **Molossidae family**, also referred to as **free-tailed bats**. They are a family of bats within the order Chiroptera. They consist of many strong flying forms with relatively long and narrow wings. Another common name for some members of this group, and indeed a few species from other families, is mastiff bat. The western mastiff bat, Eumops perotis, a large species from the southwestern United States and Mexico with wings over 0.5 m (1.6 ft) across, is perhaps one of the best known with this name.

The family's common name is derived from a length of "free" tail, projecting beyond the end of the uropatagium – the membrane that connects the base of the tail to the hind legs. The tail is usually best seen when resting. A special ring of cartilage slides up or down the tail vertebrae by muscular action to stretch or retract the tail membrane. This gives many species a degree of fine tuning in their flight maneuvers to rival their day-flying ecological equivalents, such as swifts, swallows, and martins. As a result, these animals include the fastest-flying of all bat species.

Noctuids: The Noctuidae or owlet moths are a family of robustly built moths that includes more than 35,000 known species out of possibly 100,000 total, in more than 4,200 genera. They constitute the largest family in the Lepidoptera. Their distribution is worldwide, with about 1,450 species found in Europe. Most have drab forewings, although some have brightly colored hindwings. The overwhelming majority of noctuids fly at night and are almost invariably strongly attracted to light. Many are also attracted to sugar and nectar-rich flowers.

Some members of the family are preyed upon by bats. However, many Noctuidae species have tiny organs in their ears that respond to bat echolocation calls, sending their wing muscles into spasm and causing the moths to dart erratically. This aids the moths in evading the bats.

The Noctuidae are also remarkable for containing an extraordinary number of species whose caterpillars are able to feed on certain poisonous plants without harm. These foodplants — namely Solanaceae (e.g., *Nicotiana*) and Fabaceae (e.g., *Sophora*) — contain chemicals that would kill most insects trying to feed on them.

Orthopterans - The Orthoptera order of insects includes the grasshoppers, crickets, cave crickets, Jerusalem crickets, katydids, weta, lubber, *Acrida*, and locusts.

More than 27,000 species are distributed worldwide. Many insects in this order have paurometabolous or incomplete metamorphosis, and produce sound (known as a stridulation) by rubbing their wings against each other or their legs, the wings or legs containing rows of corrugated bumps. The tympanum or ear is located in the front tibia in crickets, mole crickets, and katydids, and on the first abdominal segment in the grasshoppers and locusts. These organisms use vibrations to locate other individuals.

Rostrum: skull component of bats.

Tragus: a fleshy projection which covers the entrance of the ear. Because each species of bat has a different shaped tragus, this is a good way to identify them.

Uropatagium: the membrane that extends between the thighs of a bat and commonly includes the tail.

Appendix I. Museum Collection Records

Table I-1. Museum collections reviewed for records from Sequoia and Kings Canyon National Parks and Devils Postpile National Monument. Specimens were not examined except at Sequoia National Park. SSC=the only records obtained were those for species of special concern.

Institution Abbrev.	Institution	SSC Only	ALL
AMNH	American Museum of Natural History	X	
CAS	California Academy of Sciences		X
CM	Carnegie Museum of Natural History, Pittsburgh		X
CPSU	California Polytechnic State University, San Luis Obispo	X	
CPSUP	California Polytechnic State University, Pomona	X	
CSUC	California State University, Chico		X
CSUF	California State University, Fresno		
CSUH	California State University, Humboldt		X
CSULB	California State University, Long Beach	X	
CSUN	California State University, Northridge		X
CU	Cornell University, Ithaca, NY	X	
DEVA	Death Valley National Monument	X	
FMNH	Field Museum of Natural History, Chicago		X
KU	University of Kansas		X
LACM	Los Angeles County Museum		X
LSUMZ	Louisiana State University Museum of Zoology		X
MCZ	Museum of Comparative Zoology, Harvard		X
MLZ	Moore Laboratory of Zoology, Occidental College		X
MSB	University of New Mexico		X
MSU	Michigan State University, East Lansing		X
MVZ	Museum of Vertebrate Zoology, University of California, Berkeley		X
PSM	University of Puget Sound	X	
ROM	Royal Ontario Museum, Toronto		X
SBMNH	Santa Barbara Museum of Natural History		X
SDNHM	San Diego Natural History Museum	X	
SDSU	San Diego State University		X
SEQNP	Sequoia National Park		X
TCWC	Texas A & M		X
TTU	Texas Tech University	X	
UA	University of Arizona		X
UCLA	University of California, Los Angeles		X
UCSB	University of California, Santa Barbara		X
UIMNH	University of Illinois Museum of Natural History		X
UM	University of Michigan		X
UMZ	Museum of Zoology, University of Michigan, Ann Arbor	X	
USNM	United States National Museum, Washington, DC		X
UW-WSM	University of Washington-Washington State Museum	X	
WFB	UC Davis	X	
YPM	Yale University	X	

Appendix II. Museum Records for Bats

Table II-1. Museum records for bats by species from 39 museum collections (see Appendix I).

M-Code	CAT_NO	genus	Species	Sex	Age	Repro-duction	County	Location	Spec_Locality	Latitude	Longitude	Elev (m)	Date	Remarks
Within Park Boundaries														
LACM	22894	ANTROZOUS	PALLIDUS	F			TUL	Sequoia National Park	Clough Cave, Pigeon Creek	36.35023	-118.76151	1141	21-Oct-1950	
LACM	22895	ANTROZOUS	PALLIDUS	M			TUL	Sequoia National Park	Clough Cave, Pigeon Creek	36.35023	-118.76151	1141	21-Oct-1950	
CSUN	476	CORYNORHINUS	TOWNSENDII	M			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
MVZ	114836	EPTESICUS	FUSCUS	U			TUL	General Grant National Park	Big Baldy Ridge	36.6858	-118.87810	2302	16-Apr-1951	
MVZ	24818	EPTESICUS	FUSCUS	M			FRE	Kings Canyon National Park	Kings River Canyon, Kenawyers Site	36.79367	-118.57958	1536	10-Sep-1916	
MVZ	24819	EPTESICUS	FUSCUS	M			FRE	Kings Canyon National Park	Kings River Canyon, Kenawyers Site	36.79367	-118.57958	1536	16-Sep-1916	
MVZ	24820	EPTESICUS	FUSCUS	M			FRE	Kings Canyon National Park	Kings River Canyon, Kenawyers Site	36.79367	-118.57958	1536	13-Sep-1916	
MVZ	24821	EPTESICUS	FUSCUS	M			FRE	Kings Canyon National Park	Kings River Canyon, Kenawyers Site	36.79367	-118.57958	1536	11-Sep-1916	
SBMNH	VB56-73	EPTESICUS	FUSCUS	M			TUL	Sequoia National Park	Paradise Camp (Sunset Rock??)	36.57524	-118.77367	1956	1-Sep-1956	
SBMNH	VB 56-1	EPTESICUS	FUSCUS	M			TUL	Sequoia National Park	Giant Forest Village	36.56669	-118.76453	1979	2-Aug-1956	
CAS	16721	EUDERMA	MACULATUM	U			FRE	Kings Canyon National Park	Wilsonia	36.73472	-118.95474	2017	20-Jun-1975	
MVZ	70368	MYOTIS	CALIFORNICUS	M			TUL	Sequoia National Park	Ash Mt. C.C.C. Camp	36.489923	-118.82395	507	5-May-1935	

Table II-1. Museum records for bats by species from 39 museum collections (see Appendix I). (continued)

M-Code	CAT_NO	genus	Species	Sex	Age	Repro-duction	County	Location	Spec_Locality	Latitude	Longitude	Elev (m)	Date	Remarks
MVZ	108985	MYOTIS	CALIFORNICUS	F			FRE	Kings Canyon National Park	Cedar Grove	36.7875	-118.66040		8-May-1942	
SBMNH	VB54-40	MYOTIS	CALIFORNICUS	F			TUL	Sequoia National Park	Colony Mill Ranger Station	36.55236	-118.81109	1653	8-Aug-1954	
SBMNH	VB54-41	MYOTIS	CALIFORNICUS	M	J		TUL	Sequoia National Park	Colony Mill Ranger Station	36.55236	-118.81109	1653	8-Aug-1954	
SBMNH	VB55-14	MYOTIS	CALIFORNICUS	M			TUL	Sequoia National Park	Colony Mill Ranger Station	36.55236	-118.81109	1653	25-Jul-1955	
SBMNH	VB55-15	MYOTIS	CALIFORNICUS	M	J		TUL	Sequoia National Park	Colony Mill Ranger Station	36.55236	-118.81109	1653	25-Jul-1955	
SBMNH	VB55-16	MYOTIS	CALIFORNICUS				TUL	Sequoia National Park	Colony Mill Ranger Station	36.55236	-118.81109	1653	25-Jul-1955	
SBMNH	VB54-33	MYOTIS	CALIFORNICUS	M			TUL	Sequoia National Park	Giant Forest Highland	36.56669	-118.76453	1979	31-Jul-1955	
SBMNH	VB54-42	MYOTIS	CALIFORNICUS	M			TUL	Sequoia National Park	Giant Forest Highland	36.56669	-118.76453	1979	10-Aug-1954	
SBMNH	VB55-111	MYOTIS	CALIFORNICUS	F			TUL	Sequoia National Park	Giant Forest Highland	36.56669	-118.76453	1979	22-Aug-1955	
CAS	3666	MYOTIS	CALIFORNICUS	M			TUL	Sequoia National Park	Huckleberry Meadow	36.55833	-118.75241	2061	24-Mar-1905	
CAS	3667	MYOTIS	CALIFORNICUS	F			TUL	Sequoia National Park	Huckleberry Meadow	36.55833	-118.75241	2061	24-Mar-1905	
SBMNH	VB54-71	MYOTIS	CALIFORNICUS	F			TUL	Sequoia National Park	Colony Mill Ranger Station	36.55236	-118.81109	1653	18-Aug-1954	
SBMNH	VB-55-12	MYOTIS	EVOTIS	M			TUL	Sequoia National Park	Crystal Cave, Curtain Room	36.58941	-118.82502	1397	23-Jul-1955	
SBMNH	VB-54-1	MYOTIS	EVOTIS	F			TUL	Sequoia National Park	Giant Forest Highland	36.56669	-118.76453	1979	25-Jun-1954	
SBMNH	VB-56-2	MYOTIS	EVOTIS	M			TUL	Sequoia National Park	Giant Forest Highland	36.56669	-118.76453	1979	6-Aug-1956	
CM	83561	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	

CM	83562	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	494	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	

Table II-1. Museum records for bats by species from 39 museum collections (see Appendix I). (continued)

M-Code	CAT_NO	genus	Species	Sex	Age	Repro-duction	County	Location	Spec_Locality	Latitude	Longitude	Elev (m)	Date	Remarks
CSUN	495	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	496	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	497	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	498	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	499	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	500	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	501	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	502	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	503	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	504	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CSUN	505	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
CU	6199	MYOTIS	THYSANODES				TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	
SBMNH	VB-D1	MYOTIS	THYSANODES	F	A	Preg	TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	8-May-1950	
SBMNH	VB-D3	MYOTIS	THYSANODES	F	A	Preg	TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	8-May-1950	
SBMNH	VB-MT-2	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Crystal Cave, Big Room	36.58941	-118.82502	1397	ND	
SBMNH	VB-MT-3	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Crystal Cave, Big Room	36.58941	-118.82502	1397	ND	
SBMNH	VB-MT-4	MYOTIS	THYSANODES	F			TUL	Sequoia National Park	Crystal Cave, Big Room	36.58941	-118.82502	1397	ND	
MVZ	17791	MYOTIS	VOLANS	M			INY	Kings Canyon National Park	Kearsarge Pass	36.77328	-118.37654	3574	2-Jul-1912	

CSUN	531	MYOTIS	VOLANS	F			TUL	Sequoia National Park	Clough Cave	36.35023	-118.76151	1141	5-May-1951	

Table II-1. Museum records for bats by species from 39 museum collections (see Appendix I). (continued)

M-Code	CAT_NO	genus	Species	Sex	Age	Repro-duction	County	Location	Spec_Locality	Latitude	Longitude	Elev (m)	Date	Remarks
MVZ	114835	PARASTRELLUS	HESPERUS	U			TUL	General Grant National Park	Big Baldy Ridge	36.6858	-118.87810	2302	16-Aug-1951	Jerram L. Brown
Relevant Records from Outside Park Boundaries														
MCZ	11751	EPTESICUS	FUSCUS	M			TUL	Mt Whitney	Mirror or Lower Boy Scout Lake??	36.57095	-118.26293	3354	19-Jul-1915	Allen 1919; coordinates for Mirror Lake
MVZ	24814	EPTESICUS	FUSCUS	M			FRE	Hume		36.78726	-118.91261	1588	19-Aug-1916	
MVZ	24815	EPTESICUS	FUSCUS	F			FRE	Hume		36.78726	-118.91261	1588	21-Aug-1916	
MVZ	24816	EPTESICUS	FUSCUS	M			FRE	Hume		36.78726	-118.91261	1588	21-Aug-1916	
MVZ	24817	EPTESICUS	FUSCUS	M			FRE	Hume		36.78726	-118.91261	1588	19-Aug-1916	
MVZ	25331	EPTESICUS	FUSCUS	F			FRE	Hume		36.78726	-118.91261	1588	22-Aug-1916	
MVZ	107940	EPTESICUS	FUSCUS	M			MAD	San Joaquin River	12 mi WNW Mammoth P.O.	37.70748	-119.12547	2574	22-Aug-1940	
MVZ	84260	EPTESICUS	FUSCUS	M			TUL	Whitaker's Forest	10 mi NE Badger	36.63924	-118.93899	1438	28-Jun-1938	
MVZ	16350	EPTESICUS	FUSCUS	M			TUL	Whitney Meadow		36.43413	-118.26710	2964	9-Aug-1911	
MCZ	11751	EPTESICUS	FUSCUS	M			TUL	Mt Whitney	Mirror or Lower Boy Scout Lake??	36.57095	-118.26293	3354	19-Jul-1915	Allen 1919; coordinates for Mirror Lake
MVZ	24814	EPTESICUS	FUSCUS	M			FRE	Hume		36.78726	-118.91261	1588	19-Aug-1916	
USNM	31177	LASIURUS	BLOSSEVILLII	M			TUL		Three Rivers	36.44713	-118.90111	252	16-Sep-1891	Grinnell 1918
MVZ	84261	LASIURUS	CINEREUS	M			TUL	Highway 6 mi NE Badger		36.67445	-118.91711	2964	23-Jun-1938	
MVZ	84259	MYOTIS	CALIFORNICUS	F			TUL	Highway 6 mi NE Badger		36.67445	-118.91711	2964	23-Jun-1938	
MVZ	84258	MYOTIS	CALIFORNICUS	M			TUL	Whitaker's Forest	10 mi NE Badger	36.63924	-118.93899	1438	25-Jun-1938	

Table II-1. Museum records for bats by species from 39 museum collections (see Appendix I). (continued)

M-Code	CAT_NO	genus	Species	Sex	Age	Repro-duction	County	Location	Spec_Locality	Latitude	Longitude	Elev (m)	Date	Remarks
FMNH	13297	MYOTIS	EVOTIS	M			TUL		Mt Whitney, Long Canyon, Jordan Hot Springs	36.22944	-118.30657	1968	17-Jul-1903	Eliot 1904
MVZ	54905	MYOTIS	EVOTIS	M			TUL	nr. General Grant NP	0.25 mi SW Big Stump Fox Farm				23-Jun-1932	Henry S. Fitch (#451)
MCZ	11747	MYOTIS	LUCIFUGUS	M			TUL	Mt Whitney	Mirror or Lower Boy Scout Lake??	36.57095	-118.26293	3354	14-Jul-1915	Allen 1919; coordinates for Mirror Lake
MVZ	72443	MYOTIS	LUCIFUGUS	M			TUL	Kern River	Little Lake	36.30723	-118.40368	1873	21-May-1934	
FMNH	13301	MYOTIS	VOLANS	M			TUL		Mt Whitney, Long Canyon, Jordan Hot Springs	36.22944	-118.30657	1968	28-Jul-1903	Eliot 1904
FMNH	13321	MYOTIS	VOLANS	M			TUL		Mt Whitney, Long Canyon, Jordan Hot Springs	36.22944	-118.30657	1968	01-Aug-1903	Eliot 1904
FMNH	13322	MYOTIS	VOLANS	M			TUL		Mt Whitney, Long Canyon, Jordan Hot Springs	36.22944	-118.30657	1968	01-Aug-1903	Eliot 1904
FMNH	13325	MYOTIS	VOLANS	F			TUL		Mt Whitney, Long Canyon, Jordan Hot Springs	36.22944	-118.30657	1968	28-Jul-1903	Eliot 1904
FMNH	13336	MYOTIS	VOLANS	F			TUL		Mt Whitney, Long Canyon, Jordan Hot Springs	36.22944	-118.30657	1968	02-Jul-1903	Eliot 1904
MCZ	11749	MYOTIS	VOLANS	M			TUL	Mt Whitney	Mirror or Lower Boy Scout Lake??	36.57095	-118.26293	3354	19-Jul-1915	Allen 1919; coordinates for Mirror Lake

Table II-1. Museum records for bats by species from 39 museum collections (see Appendix I). (continued)

M-Code	CAT_NO	genus	Species	Sex	Age	Repro-duction	County	Location	Spec_Locality	Latitude	Longitude	Elev (m)	Date	Remarks
MCZ	11750	MYOTIS	VOLANS	M			TUL	Mt Whitney	Mirror or Lower Boy Scout Lake??	36.57095	-118.26293	3354	17-Jul-1915	Allen 1919; coordinates for Mirror Lake
MVZ	17788	MYOTIS	VOLANS	F			INY		Little Onion Valley	36.78302	-118.31238	2286	3-Jun-1912	
MVZ	17789	MYOTIS	VOLANS	F			INY		Little Onion Valley	36.78302	-118.31238	2286	3-Jun-1912	
MVZ	17790	MYOTIS	VOLANS	M			INY		Little Onion Valley	36.78302	-118.31238	2286	3-Jun-1912	
MCZ	11748	MYOTIS	YUMANENSIS	M			TUL	Mt Whitney	Mirror or Lower Boy Scout Lake??	36.57095	-118.26293	3354	16-Jul-1916	Allen 1919; coordinates for Mirror Lake

Appendix III. Wildlife Observation Database Bat Records for Sequoia and Kings Canyon National Parks

Note: The observations in the following table are derived from Sequoia and Kings Canyon National Parks' wildlife observation database, which is a mixture of visual observations and trap records. The keys to the species codes and vegetation types are at the end of this appendix.

Table III-1. Bat observations from Sequoia and Kings Canyon National Parks Wildlife Observation Database, provided by David Graber.

Record #	RECNUM	Species Code	Corrected	Year	Month	Day	UTME	UTMN	PREC	Locality	Vegetation Type	Observer
45136	45299	ANPA		1980	6	1	335000	4039000	4	Ash Mountain	71140	GraberD
41904	42053	ANPA		1984	6	29	336000	4040000	4	Ash Mtn Research	71140	NorrisL
44960	45123	ANPA		1987	7	2	336000	4040000	4	Ash Mt.	71140	HedleyB
44123	44279	ANPA		1987	7	20	341000	4024000	4	South Fork CG	76000	JeffreyT
45041	45204	ANPA	MYEV	1988	7	14	369000	4040000	4	Chagoopa Trhouse	86100	PettersonJ
45058	45221	ANPA	MYEV*	1988	7	18	369000	4042000	4	Outlet GoldfoxLk	36100	PettersonJ
46303	46468	ANPA		1988	7	27	341000	4024000	4	South Fork CG	76000	JeffreyT
51454	51625	ANPA		1992	6	1	336000	4040000	4	AshMtnRC	71140	GraberD
52919	53103	ANPA		1995	7	13	335000	4040000	4	Sycamore Creek	76100	PiersonE
60102	60351	ANPA		2001	1	5	337000	4040000	4	KaweahCave		ObergE
49120	49285	COTO		1949	12	0	342000	4023000	4	SoldiersCave	95000	SuptMonthRpt.
43418	43571	COTO		1986	1	24	342000	4024000	4	Clough Cave	81300	PiersonE
43419	43572	COTO		1986	1	27	342000	4042000	6	Clough Cave	0	RaineyW
44167	44323	COTO		1987	5	12	341000	4024000	4	Clough Cave	76000	JeffreyT
44168	44324	COTO		1987	6	1	341000	4024000	4	Clough Cave	76000	JeffreyT
44169	44325	COTO		1987	6	8	341000	4024000	4	Clough Cave	76000	JeffreyT
44170	44326	COTO		1987	6	9	341000	4024000	4	Clough Cave	76000	JeffreyT
44171	44327	COTO		1987	6	10	341000	4024000	4	Clough Cave	76000	JeffreyT
44172	44328	COTO		1987	7	6	341000	4024000	4	Clough Cave	76000	JeffreyT
44173	44329	COTO		1987	9	8	341000	4024000	4	Clough Cave	76000	JeffreyT
44174	44330	COTO		1987	9	14	341000	4024000	4	Clough Cave	76000	JeffreyT
44175	44331	COTO		1987	9	21	341000	4024000	4	Clough Cave	76000	JeffreyT
46265	46430	COTO		1988	6	12	341000	4024000	4	Clough Cave	76000	JeffreyT

Table III-1. Bat observations from Sequoia and Kings Canyon National Parks Wildlife Observation Database, provided by David Graber. (continued)

Record #	RECNUM	Species Code	Corrected	Year	Month	Day	UTME	UTMN	PREC	Locality	Vegetation Type	Observer
46293	46458	COTO		1988	7	14	341000	4024000	4	Clough Cave	76000	JeffreyT
46357	46522	COTO		1988	9	13	341000	4024000	4	Clough Cave	76000	JeffreyT
46358	46523	COTO		1988	9	18	341000	4024000	4	Clough Cave	76000	JeffreyT
45477	45642	COTO		1988	10	5	336000	4041000	4	Fry's Pt/NNE AM	95000	PeacheyW
47368	47533	COTO		1988	10	21	344000	4047000	4	CrstMdw, see memo	0	EsperanzaA
46624	46789	COTO		1989	5	14	341000	4024000	4	CloughCave	76100	JeffreyT
46640	46805	COTO		1989	5	28	341000	4024000	4	CloughCave	76100	JeffreyT
46639	46804	COTO		1989	6	9	341000	4024000	4	S.F.Campground	76100	JeffreyT
46664	46829	COTO		1989	7	16	341000	4024000	4	CloughCave	76100	JeffreyT
49549	49714	COTO		1990	9	3	341000	4024000	4	CloughCave	95000	JeffreyT
42127	42276	EPFU		1916	9	0	353000	4072000	6	Kings River Cany	0	DixonJ
42128	42277	EPFU		1933	7	6	342000	4048000	4	Round Mdw G F	0	DixonJ
42129	42278	EPFU		1942	7	24	342000	4114000	6	Goddard	0	DixonJ
42130	42279	EPFU		1942	7	25	347000	4116000	4	Colby Mdw EvolCr	0	DixonJ
42131	42280	EPFU		1951	4	0	338000	4054000	5	Big Baldy Ridge	0	BrownJ
42132	42281	EPFU		1966	4	20	342000	4024000	4	Clough Cave	0	GraterR
44040	44195	EPFU		1980	5	23	359000	4073000	6	Hotel Creek Trl.	84230	NorrisL
42133	42282	EPFU		1981	7	28	363000	4079000	4	ParadiseVa KingR	0	EasterlaD
45026	45189	EPFU		1988	6	12	334000	4040000	4	SycamoreSpring	76000	PettersonJ
45031	45194	EPFU		1988	6	29	329000	4064000	4	N.end Redwd Cr.	84250	PettersonJ
46302	46467	EPFU		1988	7	27	341000	4024000	4	South Fork CG	76000	JeffreyT
47285	47450	EPFU		1988	8	10	371000	4069000	4	Junction Meadow	84230	WarnerJ
45125	45288	EPFU		1988	8	18	336000	4050000	4	Cascade Creek	36100	PettersonJ
47679	47844	EPFU		1989	6	30	359000	4064000	4	Roaring River Tr	76200	PettersonJ

Table III-1. Bat observations from Sequoia and Kings Canyon National Parks Wildlife Observation Database, provided by David Graber. (continued)

Record #	RECNUM	Species Code	Corrected	Year	Month	Day	UTME	UTMN	PREC	Locality	Vegetation Type	Observer
47699	47864	EPFU		1989	7	2	359000	4064000	4	Roaring River Tr	76000	PettersonJ
59788	60028	EPFU		1993	8	17	374000	4038000	4	KernHotSprings	84230	KoshearJ
59787	60027	EPFU		1993	8	18	369000	4039000	4	ChagoopaPlateau	45220	KoshearJ
59789	60029	EPFU		1993	8	20	374000	4034000	4	BgArroyo/KernRvr	84230	KoshearJ
59791	60031	EPFU		1993	8	21	373000	4049000	4	JunctionMdw/Kern	85210	KoshearJ
59792	60033	EPFU		1993	8	21	373000	4049000	4	JunctionMdw/Kern	85210	KoshearJ
59793	60035	EPFU		1993	8	21	373000	4049000	4	JunctionMdw/Kern	85210	KoshearJ
59794	60037	EPFU		1993	8	21	373000	4049000	4	JunctionMdw/Kern	85210	KoshearJ
59795	60039	EPFU		1993	8	24	370000	4069000	4	JunctionMdwBubbs	45100	KoshearJ
59796	60041	EPFU		1993	8	24	370000	4069000	4	JunctionMdwBubbs	45100	KoshearJ
59797	60043	EPFU		1993	8	24	370000	4069000	4	JunctionMdwBubbs	45100	KoshearJ
59798	60045	EPFU		1993	8	24	370000	4069000	4	JunctionMdwBubbs	45100	KoshearJ
59799	60047	EPFU		1993	8	24	370000	4069000	4	JunctionMdwBubbs	45100	KoshearJ
59321	59557	EPFU		1994	7	18	363000	4078000	4	LwrParadiseVlly	84230	KoshearJ
59323	59559	EPFU		1994	7	22	359000	4103000	4	GrouseMeadow	45100	KoshearJ
59324	59560	EPFU		1994	7	23	355000	4092000	4	SimpsonMeadow	76200	KoshearJ
59327	59563	EPFU		1994	7	26	344000	4047000	4	CrescentMeadow	84250	KoshearJ
52920	53104	EPFU		1995	7	13	335000	4040000	4	Sycamore Creek	76100	PiersonE
59388	59624	EPFU		1995	7	24	346000	4047000	4	CrescentMeadow	84250	KoshearJ
59389	59625	EPFU		1995	7	26	355000	4048000	4	BearpawRS	84230	KoshearJ
59390	59626	EPFU		1995	7	27	355000	4048000	4	BearpawRS	84230	KoshearJ
59391	59627	EPFU		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
59392	59629	EPFU		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
59395	59632	EPFU		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ

Table III-1. Bat observations from Sequoia and Kings Canyon National Parks Wildlife Observation Database, provided by David Graber. (continued)

Record #	RECNUM	Species Code	Corrected	Year	Month	Day	UTME	UTMN	PREC	Locality	Vegetation Type	Observer
59399	59636	EPFU		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
53663	53877	EPFU		1996	7	6	552000	4048000	4	Bearpaw RS	84230	KoshearJ
51933	52113	EUMA		1975	6	20	325000	4067000	4	Wilsonia	84230	StockingS
59322	59558	EUMA		1994	7	22	359000	4103000	4	GrouseMeadow	45100	KoshearJ
59325	59561	EUMA		1994	7	23	355000	4092000	4	SimpsonMeadow	76200	KoshearJ
59326	59562	EUMA		1994	7	26	344000	4047000	4	CrescentMeadow	84250	KoshearJ
45132	45295	LABL		1988	8	21	330000	4050000	4	No.Fk.-Burnt Pt.	76000	PettersonJ
42470	42622	LACI		1973	6	24	351000	4073000	4	Cedar Gr Campgr	0	SchmoldtD
42471	42623	LANO		1981	7	28	363000	4079000	4	ParadiseVa Kin R	0	EasterlaD
45032	45195	LANO		1988	6	29	329000	4064000	4	N.end Redwd. Cr.	84250	PettersonJ
43021	43174	MYCA		1916	9	9	351000	4073000	5	Cedar Grove	0	DixonJ
43022	43175	MYCA		1933	7	6	342000	4048000	4	Giant Forest	0	DixonJ
43023	43176	MYCA		1935	5	0	336000	4040000	6	Ash Mtn	0	CarrisonL
43024	43177	MYCA		1977	0	0	345000	4052000	4	Lodgepole Resi	0	HolserB
43025	43178	MYCA		1986	8	28	342000	4024000	4	South Fork Cg	81300	PiersonD
43026	43179	MYCA		1986	8	28	342000	4024000	4	South Fork Cgr	62100	JeffreyT
44137	44293	MYCA		1987	6	9	341000	4024000	4	South Fork CG	76000	JeffreyT
44138	44294	MYCA		1987	7	16	341000	4024000	4	Ladybug Trail	76000	JeffreyT
45010	45173	MYCA		1988	5	22	343000	4024000	4	S.Fk.KaweaLadyTr	71100	PettersonJ
45017	45180	MYCA		1988	5	27	330000	4046000	4	N. Fk. Kaweah	76000	PettersonJ
46278	46443	MYCA		1988	6	29	341000	4024000	4	Ladybug Trail	76000	JeffreyT
46305	46470	MYCA		1988	7	27	341000	4024000	4	South Fork CG	76000	JeffreyT
51750	51929	MYCA		1992	4	10	366000	4040000	4	AshMtnHdqrtsFMO	99999	WernerH
52923	53107	MYCA		1995	6	27	342000	4048000	4	Giant Forest	84250	PiersonE

59396	59633	MYCA		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ

Table III-1. Bat observations from Sequoia and Kings Canyon National Parks Wildlife Observation Database, provided by David Graber. (continued)

Record #	RECNUM	Species Code	Corrected	Year	Month	Day	UTME	UTMN	PREC	Locality	Vegetation Type	Observer
53680	53894	MYCA		1996	10	2	336000	4040000	4	A.Mtn. Hdqts.	71140	GraberD
58864	59098	MYCA		2000	6		351000	4073000	4	CedarGroveResid	84210	SessionsR
43027	43180	MYEV		1935	3	12	336000	4040000	4	Ash Mtn HQ	71140	DixonJ
44866	45029	MYEV		1987	8	4	325000	4068000	4	Grant Grove Vill	84230	DurniakC
52921	53105	MYEV		1995	7	13	341000	4048000	4	Giant Forest Lod	84250	PiersonE
59393	59630	MYEV		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
59394	59631	MYEV		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
59397	59634	MYEV		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
59402	59639	MYEV		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
58257	58488	MYEV		1999	7	8	351000	4073000	4	CedarGroveVC	84210	SessionsR
58208	58436	MYEV		1999	9	2	351000	4073000	4	CedarGroveAmp	84210	SessionsR
60003	60252	MYEV		2000	8	4	325000	4068000	4	GrantGroveVC	84230	NolteL
46108	46273	MYLU		1965	7	12	355000	4072000	4	Kings River	0	StockingS
46109	46274	MYLU		1966	7	20	349000	4074000	4	LewisCrCedarGrov	0	StockingS
46127	46292	MYLU		1988	6	29	326000	4069000	4	Panoramic Point	85310	SampsonD
45140	45303	MYLU	MYYU	1988	7	6	338000	4041000	4	Middle Fk. Kawea	76000	PettersonJ
45139	45302	MYLU	MYYU	1988	8	17	338000	4041000	4	Middle Fk. Kawea	76000	PettersonJ
50257	50422	MYLU		1991	1	9	336000	4040000	4	AshMtHQTRS	0	MasonD
59785	60023	MYLU		1993	8	17	370000	4047000	4	LwrPrecipiceLake	45210	KoshearJ
59786	60025	MYLU		1993	8	17	370000	4047000	4	LwrPrecipiceLake	45210	KoshearJ
52659	52842	MYLU		1994	6	15	351000	4073000	4	InsideCGVC	1000	SchulmanM
59400	59637	MYLU		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
59163	59398	MYLU		2000	5	24	351000	4073000	4	CedarGroveVC	84210	SessionsR
59729	59967	MYLU		2000	6	3	336000	4040000	4	AshMountainHQ	71140	LaberM

Table III-1. Bat observations from Sequoia and Kings Canyon National Parks Wildlife Observation Database, provided by David Graber. (continued)

Record #	RECNUM	Species Code	Corrected	Year	Month	Day	UTME	UTMN	PREC	Locality	Vegetation Type	Observer
59302	59538	MYLU		2000	6	9	324000	4068000	4	FallenMonarch	84250	O'BrienK
58433	58664	MYLU		2001	7	7	341000	4043000	4	BucheyeFlat/Camp	71100	HerreraF
44139	44295	MYTH		1987	6	9	341000	4024000	4	Clough Cave	76000	JeffreyT
59800	60048	MYTH		1993	8	24	370000	4069000	4	JunctionMdwBubbs	45100	KoshearJ
59801	60049	MYTH		1993	8	26	349000	4074000	4	CGBridgeLewisCrk	84210	KoshearJ
44140	44296	MYVO		1987	6	9	341000	4024000	4	Clough Cave	76000	JeffreyT
52924	53108	MYVO		1995	6	27	342000	4048000	4	Giant Forest	84250	PiersonE
59398	59635	MYVO		1995	7	28	353000	4044000	4	RedwoodMeadow	84250	KoshearJ
43028	43181	MYYU		1986	8	28	342000	4024000	4	South Fork Cg	81300	PiersonD
43029	43182	MYYU		1986	8	28	342000	4024000	4	South Fork Cgr	62100	JeffreyT
44141	44297	MYYU		1987	6	9	341000	4024000	4	Clough Cave	76000	JeffreyT
44142	44298	MYYU		1987	7	16	341000	4024000	4	Ladybug Trail	76000	JeffreyT
46248	46413	MYYU		1988	5	22	341000	4024000	4	Ladybug Trail	76000	JeffreyT
46279	46444	MYYU		1988	6	29	341000	4024000	4	Ladybug Trail	76000	JeffreyT
46304	46469	MYYU		1988	7	27	341000	4024000	4	South Fork CG	76000	JeffreyT
45138	45301	MYYU		1988	8	17	338000	4041000	4	Middle Fk. Kawea	76000	PettersonJ
45126	45289	MYYU	MYCA	1988	8	18	336000	4050000	4	Cascade Creek	36100	PettersonJ
45131	45294	MYYU		1988	8	21	330000	4050000	4	No.Fk.-Burnt Pt	76000	PettersonJ
59790	60030	MYYU		1993	8	20	374000	4034000	4	BgArroyo/KernRvr	84230	KoshearJ
43659	43813	TABR		1933	9	6	338000	4041000	5	KaweahRvr AshMtn	0	DixonJ
43660	43814	TABR		1966	9	9	336000	4040000	4	Ash Mountain	71140	GraterR
43661	43815	TABR		1984	8	2	339000	4042000	4	Potwisha Bridge	0	SanMiguelG
43662	43816	TABR		1984	8	2	339000	4042000	6	Potwisha Bridge	0	NorrisL
46301	46466	TABR		1988	7	27	341000	4024000	4	South Fork CG	76000	JeffreyT
49956	50121	TABR		1990	10	2	336000	4040000	4	AMResearch	71140	Strkee
49957	50122	TABR		1990	10	2	336000	4040000	4	AMResearch	71140	StephensonN

*There is no specimen for this record, but it is unlikely to be *A. pallidus*, and likely to be a *M. evotis.*

Table III-2. Bat species code key.

Scientific Name	Four-letter Code	Common Name
Antrozous pallidus	ANPA	Pallid bat
Corynorhinus townsendii	COTO	Townsend's big-eared bat
Eptesicus fuscus	EPFU	Big brown bat
Euderma maculatum	EUMA	Spotted bat
Eumops perotis	EUPE	Western mastiff bat
Lasionycteris noctivagans	LANO	Silver-haired bat
Lasiurus blossevillii	LABL	Western red bat
Lasiurus cinereus	LACI	Hoary bat
Myotis californicus	MYCA	California myotis
Myotis ciliolabrum	MYCI	Small-footed myotis
Myotis evotis	MYEV	Long-eared myotis
Myotis lucifugus	MYLU	Little brown bat
Myotis thysanodes	MYTH	Fringed myotis
Myotis volans	MYVO	Long-legged myotis
Myotis yumanensis	MYYU	Yuma myotis
Parastrellus hesperus	PAHE	Canyon bat
Tadarida brasiliensis	TABR	Mexican free-tailed bat

Table III-3. Vegetation type code key. The descriptions of these vegetation types follow the table.

COMMUNITY TYPE	CODE
SCRUB AND CHAPARRAL	30000
Montane/Alpine Riparian Scrub	36100
Mixed Chaparral	37110
Chamise Chaparral	37200
Montane Chaparral	37500
MEADOW AND HERB COMMUNITY	
Montane Meadow	45100
Subalpine/Alpine Meadow	45200
(Wet Subalpine/Alpine Meadow)	45210
(Dry Subalpine/Alpine Meadow)	45220
WOODLAND	
Oak Woodland	71100
Black Oak Woodland	71120
Blue Oak Woodland	71140
Canyon Live Oak Woodland	71160
So. Sierra Foothill Riparian Woodland	76100
Cottonwood Riparian Woodland	76200
BROADLEAVED UPLAND FOREST	
Oak Forest	81300
Canyon Live Oak Forest	81320
Interior Live Oak Forest	81330
Black Oak Forest	81340
Mixed North Slope Forest	81500
Aspen Forest	81900
LOWER MONTANE CONIFEROUS FOREST	
Westside Ponderosa Pine Forest	84210
Sierran Mixed Coniferous Forest	84230
Sierran White Fir Forest	84240
Bigtree (Giant Sequoia) Forest	84250

Table III-3. Vegetation type code key.

COMMUNITY TYPE	CODE
UPPER MONTANE CONIFEROUS FOREST	
Jeffrey Pine-Fir Forest	85210
Red Fir Forest	85310
SUBALPINE CONIFEROUS FOREST	
Lodgepole Pine Forest	86100
Mixed Subalpine Conifer Forest	86200
Whitebark Pine/Lodgepole Forest	86220
Lodgepole Pine/Foxtail Pine Forest	86230
Foxtail Pine Forest	86300
Whitebark Pine Forest	86600
ALPINE	
Alpine Boulder/Rock Field	91000
Sierra Nevada Fell Field	91120
Wet Alpine Talus and Scree	91210
Dry Alpine Talus and Scree	91220
Low Angle Rock Slabs & Ledges	91230
Cliffs/Barren Rock Outcrops	95000
Alpine Glacier	10300
MISSING DATA, UNKNOWN	99999

Vegetation Type Descriptions

(adapted from Holland 1986 by S. Haultain, 1992, Sequoia & Kings Canyon National Parks)

Code: 30000

Community Name: Scrub and Chaparral

Description: Communities dominated by woody broad-leaved shrubs with limited understory, occurring at all elevations of both parks. This is a very broad classification which includes many different species.

Code: 36100

Community Name: Montane/Alpine Riparian Scrub

Description: Open to dense, broadleafed, winter-deciduous shrubby riparian thickets usually dominated by any of several willow species (Salix sp.), alder (Alnus sp.) or Pacific Dogwood. This is a catch-all community which includes a bewildering array of cover species! Site Factors: Relatively fine-textured alluvial soils along fairly low-gradient reaches of snowmelt-fed streams. Often occurs as a thin scrubby corridor through Montane or Subalpine and Alpine Meadows. Above 6000' elevation.

Code: 37000

Community Name: Chaparral

Description: Woody, broad-leaved sclerophyllus shrubs, forming dense, impenetrable stands in foothill to montane areas. Often found on drier slopes; understory usually sparse in herbaceous species. May be found in forest openings, or forming mosaics within other communities.

Code: 37110

Community Name: Northern Mixed Chaparral

Description: Broad-leaved, sclerophyllous (thick-leaved) shrubs, 2-4 m tall, forming dense, often impenetrable vegetation dominated by Chamise (Adenostoma fasciculatum), and any one of several species of manzanita (Arctostaphlyos spp.), buckbrush (Ceanothus spp.) and Scrub Oak (Quercus dumosa). Usually little or no understory vegetation; often considerable accumulation of leaf litter.

Site Factors: Found on dry, rocky, often steep slopes with little soil. Slopes are often north-facing in SEKI. Often adjacent to, but on rockier soils than Oak Woodland. Found below 5000' elevation.
Characteristic Associated Species: Aesculus californica, Arctostaphylos viscida, Ceanothus cuneatus, Cercocarpus betuloides, Eriodictyon californicum, Fraxinus dipetala, Fremontia californica, Rhamnus crocea, Toxicodendron diversilobum.

Typical SEKI Locations: Found on north-facing slopes in the Middle Fork, Marble Fork and North Fork drainages of the Kaweah. Typical in the lower Middle Fork of the Kaweah on the south side of the river.

Code: 37200
Community Name: Chamise Chaparral
Description: A 1-3 m tall chaparral overwhelmingly dominated by Chamise (Adenostoma fasciculatum). Associated species contribute little to cover. Mature stands are densely interwoven with very little herbaceous understory or litter.

Site Factors: On dry, rocky, often steep slopes with little soil; interspersed with mixed chaparral and oak woodland/forest. Typically found below 4000'on south and west facing slopes.
Characteristic Associated Species: Arctostaphylos viscida, Ceanothus cuneatus, Eriodictyon californicum, Lotus scoparius, Quercus dumosa, Yucca whipplei.

Typical SEKI Locations: Abundant in the Middle Fork, Marble Fork and North Fork of the Kaweah drainages. A good type locality is Elk Creek, near Potwisha.

Code: 37500
Community Name: Montane Chaparral
Description: A dense, heterogeneous, thick-leaved thicket dominated by Mountain Whitethorn (Ceanothus cuneatus), Chinquapin (Chrysolepis sempervirens) and any of several species of manzanita (Arctostaphylos) or buckbrush (Ceanothus). Understories typically are very sparse except in the few years immediately following fire. Most plants are under 5 feet tall. Canopies usually are not quite closed.

Site Factors: Steep, usually south-facing slopes in the coniferous forest zones. Much of the annual precipitation comes as snow, leading to shorter growing seasons than in lower elevation chaparrals. Typically between 4,000 and 11,000 feet.
Characteristic Associated Species: Arctostaphylos nevadensis, A. patula, Artemisia tridentata, Ceanothus cordulatus, C. leucodermis, Cercocarpus betuloides, Holodiscus discolor, Prunus emarginata. Typical SEKI Locations: Slopes and burned areas of Cedar Grove; Park Ridge at Grant Grove; upper Clover Creek near Lodgepole; south facing slopes in Mineral King Valley.

Code: 40000
Community Name: Grasslands, Meadows, and other herb communities
Description: Open areas dominated by grasses, sedges and other herbaceous perennials.

Code: 45000
Community Name: Meadows
Description: Open areas, often flat, of more or less permanently moist soils which support a dense herbaceous cover which can vary from .5 to 2 meters high. Found largely from the coniferous forest upward.

Code: 45100
Community Name: Montane Meadow
Description: Dense growth of sedges and other perennial herbs, usually from 0.5-1 m high, but with some taller herbs to 2 m. Main growth period from late spring through summer (summer only at higher elevations); flowering mostly in summer; dormant in winter (from fall through spring at higher elevations).

Site Factors: On fine-textured, more or less permanently moist or wet soils. Adjacent forest or scrub are on coarser, better drained soils. Often a successional stage in the filling of lakebeds with soil, and characterized by young trees encroaching from the margins. Scattered within montane forests between 5000 to 9000 feet.

Characteristic Associated Species: Camassia leichtlinii, Carex spp., Dodecatheon jeffreyi, Heracleum lanatum, Juncus nevadensis, Lupinus polyphyllus ssp. superbus, Pteridium aquilinum, Veratrum californicum.
Typical SEKI Locations: All Sequoia groves, Zumwalt Meadow in Cedar Grove, Junction Meadow in Bubbs Creek, Long Meadow at Wolverton.

Code: 45200
Community Name: Subalpine and Alpine Meadow

Code: 45210
Community Name: Wet Subalpine or Alpine Meadow
Description: Open areas within the Subalpine Forest or above treeline where a rich flora of grasses, sedges, rushes, and forbs form low (typically under 0.5 m), dense, often matted vegetation.
Site Factors: Wet Meadows remain saturated throughout the growing season. Growing season limited by snow. 9-11,000' elevation.

Characteristic Associated Species: Calamagrostis breweri, Cardamine breweri, Carex exserta, C. rostrata, C. scopulorum, Deschampsia caespitosa, Eleocharis pauciflora, Juncus nevadensis, J. orthophyllus, Mimulus primuloides, Oryzopsis kingii, Senecio scorzonella, Triglochin palustris, Trisetum spicatum, Trisetum spicatum, Veratrum californicum.

Typical SEKI Locations: McClure Meadow, Crabtree Meadow

Code: 45220
Community Name: Dry Subalpine or Alpine Meadow
Description: Open areas within the Subalpine Forest or above treeline where a rich flora of grasses, rushes, and forbs form a low (typically under 0.3 m), fairly open vegetation.
Site Factors: Dry Meadows have no capillary water available during some part of the growing season. Growing season limited by snow. Dry Meadow vegetation may form a "fairy ring" around a Wet Meadow. At 9-12,000' elevation.

Characteristic Associated Species: Achillea lanulosa, Artemisia rothrockii, Aster alpigenus, Calyptridium umbellatum, Carex exserta, Eriogonum incanum, E. ovalifolium nivale, Festuca brachyphylla, Lupinus breweri bryoides, Muhlenbergia richardsonis.

Typical SEKI Locations: Sky Parlor Meadow, Chagoopa Plateau; scattered throughout the parks.

Code: 70000
Community Name: Woodlands
Description: Community with an open canopy of deciduous or evergreen broadleaved trees.

Code: 71000
Community Name: Cismontane Woodland
Description: Woodlands found along the western slope of the Sierra Nevada.

Code: 71100
Community Name: Oak Woodland
Description: Highly variable woodland (=open canopy) dominated by any of several oak species. Understory may consist of grassland, shrubs or bare ground covered with leaf litter.

Site Factors: Dry, sunny slopes between 1000 and 7000 feet elevation.

Characteristic Associated Species: Any of the following oak species: Quercus douglasii, Q. kelloggii, Q. chrysolepis, Q. wislizenii.

Code: 71120
Community Name: Black Oak Woodland
Description: Open to dense woodlands are dominated by Black Oak (Quercus kelloggii). Shrubby understories usually are partly open, often with Birch-leaf Mountain Mahogany (Cercocarpus betuloides). Ponderosa Pine (Pinus ponderosa) is a common associate on all but the poorest sites. Ground cover is usually well developed, contributing to a good litter layer.

Site Factors: A community largely maintained by fire. Best developed between 4500' and 7000' elevation.
Characteristic Associated Species: Abies concolor, Calocedrus decurrens, Pinus jeffreyi, Quercus chrysolepis, Pteridium aquilinum, Q. wizlizenii, Umbellularia californica, Ceanothus integerrimus, Arctostaphylos viscida, Rhamnus crocea, Toxicodendron diversiloba, Chamaebatia foliolosa.

Typical SEKI Locations: Colony Mill Area; Generals Highway at 5000'.

Code: 71140
Community Name: Blue Oak Woodland
Description: A highly variable climax woodland dominated by Blue Oak (Quercus douglasii), but usually including individuals of several other oaks. Stands vary from open savannas with grassy understories (usually at lower elevations) to fairly dense woodlands with shrubby understories.

Site Factors: Well-drained soils below 3000-4000 feet.

Characteristic Associated Species: Aesculus californica, Arctostaphylos spp., Ceanothus spp., Eriodictyon californicum, Quercus dumosa, Q. kelloggii, Q. wislizenii, Rhamnus spp.. Typical SEKI Locations: Ash Mountain Area, Middle Fork Canyon.

Code: 71160
Community Name: Canyon Live Oak Woodland
Description: A broad-leaved, thick-leaved woodland dominated by Canyon Live Oak (Quercus chrysolepis). Typically forms a woodland up to 20 meters in height with little understory.

Site Factors: Dry, south facing, frequently rocky slopes with little soil development. West slope of the Sierra Nevada at elevations of 3000 to 6000 feet in SEKI.

Associated Species: Similar to Canyon Live Oak Forest, with manzanita species (Arctostaphylos sp.).

Typical SEKI Locations: Lower Copper Creek Trail, Kings Canyon; Middle Fork Trail, Sequoia.

Code: 76000
Community Name: Riparian Woodland
Description: Woodlands associated with water courses. Understory often of increased species richness due to increased water availability.

Code: 76100
Community Name: Southern Sierra Foothill Riparian Woodland
Description: A tall, open, broadleafed, winter-deciduous streamside woodland dominated by California Sycamore (Platanus racemosa) or White Alder (Alnus rhombifolia). Lianas include wild berries (Rubus sp.) and Poison Oak (Toxicodendron diversilobum).

Site Factors: Very rocky streambeds subject to seasonally high-intensity flooding, from 1500 to 5000 feet in elevation.

Characteristic Associated Species: Vitus californica, Calycanthus occidentale, Rubus leucodermis, Lonicera involucrata, Artemisia ludoviciana, Philadelphus lewisii.

Code: 76200
Community Name: Cottonwood Riparian Woodland
Description: Tall, open, broadleaved winter-deciduous riparian woodland dominated by Black Cottonwood (Populus trichocarpa) and several tree willows. Understories are usually of a variety of herbaceous species and shrubby willows.

Site Factors: Sub-irrigated and frequently overflowed lands along rivers and streams. From approximately 5,000 to 7,500 feet in SEKI.

Typical SEKI Locations: Bubb's Creek near Junction Meadow.

Code: 80000
Community Name: Forest
Description: Closed canopy of trees (as opposed to woodland, with an open canopy).

Code: 81000
Community Name: Broadleaved Upland Forest
Description: A closed canopy community composed of broadleaved evergreen or deciduous trees found in the middle latitudes of the Sierra Nevada. Variable understory.

Code: 81300
Community Name: Oak Forest
Description: A highly variable closed canopy community dominated by one of several oak species. Understory may consist of grassland, shrubs, bare ground covered with leaf litter, or exposed rock.

Site Factors: Often on rocky, steep slopes or in protected canyons. Found between 3000 and 7000 feet elevation.

Characteristic Associated Species: Any of the following oak species: Quercus kelloggii, Q. chrysolepis, Q. wislezenii.

Code: 81320
Community Name: Canyon Live Oak Forest
Description: Dominated by Canyon Live Oak (Quercus chrysolepis), a broadleaved, evergreen forest. Typically forms forests with little understory up to 20 m in moist sites and low, chaparral-like stands on south-facing slopes. Trees often have multiple trunks, probably due to post-fire crown-sprouting.

Site Factors: Transitional between low elevation broadleaved forests and higher elevation coniferous forests. On rocky, often steep slopes with little soil development. Typically in canyons and on north-facing slopes at relatively low elevations and on south-facing slopes at higher elevations. West slope of the Sierra Nevada at elevations of 3000 to 6000 feet in SEKI.

Characteristic Associated Species: Calocedrus decurrens, Umbellularia californica.

Typical SEKI Locations: Selected locations in Cedar Grove; General's Highway between Hospital Rock and Deer Ridge.

Code: 81340
Community Name: Black Oak Forest
Description: A persistent subclimax forest dominated by Black Oak (Quercus kelloggii), with scattered emergent Ponderosa Pine (Pinus ponderosa) in all but the poorest sites. Most stands are even-aged.
Site Factors: Fire type found on mountain slopes, benches and coves, canyon bottoms, lower sidehills and upper foothill slopes up to 8000 feet.

Characteristic Associated Species: Abies concolor, Aesculus californicus, Calocedrus decurrens, Pinus jeffreyi, P. lambertiana, Quercus chrysolepis, Umbellularia californica.

Typical SEKI Locations: Mineral King Road, north-facing slope of Deer Ridge on Generals Highway.

Code: 81500
Community Name: Mixed North Slope Forest
Description: Mesic, usually north-facing forest of moderate height with a dense canopy of both evergreen and deciduous broadleaved trees and shrubs. Overstory and understory are not clearly separate from one another. Wide variety of dominant species which can include Aesculus californica, Umbellularia californica, Prunus sp., Toxicodendron diversilobum, Fraxinus dipetala, Cercocarpus betuloides, Quercus chrysolepis. Intergrades with oak woodland and chaparral.

Site Factors: Gently sloping to steep, generally north-facing slopes with deep, well drained soils. Found at 2000 to 5000 feet on the western slope of the Sierra Nevada in SEKI. Can also occur in patches on southwest exposures.

Characteristic Species: As above; also Madia elegans, Clarkia sp., Trifolium sp., Montia perfoliata, and various annual grass species.

Code: 81900
Community Name: Aspen Forest
Description: Typically dense forests dominated by Quaking Aspen (Populus tremuloides) growing to 20 meters tall. Scrubby thickets may occur at the edges of groves, in other areas of relatively dry soil or at high altitudes. The trunks may be bent downslope near their bases or otherwise contorted in areas of heavy snowfall. The understory is sparse in dense groves, but includes a variety of small shrubs and herbaceous perennials in more open stands.

Site Factors: Along streambanks, near springs or other areas with high soil moisture between 7,000 and 9,000 feet.

Typical SEKI Locations: Mineral King Valley, Palisade Creek, Bubbs Creek.

Code: 84000
Community Name: Lower Montane Coniferous Forest
Description: A closed canopy community type dominated by coniferous trees, occurring from 5500 to 7000 feet in elevation.

Code: 84200
Community Name: Sierran Coniferous Forest

Code: 84210
Community Name: Westside Ponderosa Pine Forest
Description: An open, park-like forest of coniferous evergreens to 70 m tall, dominated by Ponderosa Pine (Pinus ponderosa). Black Oak (Quercus kelloggii) is a common associate. The understory typically is sparse, consisting of scattered chaparral shrubs and young trees. There is often considerable accumulation of needle litter and pine cones on the ground. Growth occurs mostly from late spring to midsummer and is probably limited by summer and fall drought. A fire-controlled community.

Site Factors: Often on south-facing slopes, except near lower elevational margins. Intergrades with Blue Oak Woodland and Montane Chaparral in the lower elevations and with Sierran Mixed Conifer Forest and Jeffrey Pine Forest at the higher elevations. 4500-6500' elevation; the lowest occuring montane forest type over most of its range.

Characteristic Associated Species: Abies concolor, Arctostaphylos patula, Calocedrus decurrens, Ceanothus sp., Cercocarpus betuloides, Juniperous occidentalis, Pinus jeffreyi, Chamaebatia foliolosa.

Typical SEKI Locations: Cedar Grove, Colony Mill Area.

Code: 84230
Community Name: Sierran Mixed Coniferous Forest
Description: Similar to Westside Ponderosa Pine Forest, but denser, with the crowns often touching, often slightly taller (to 75 m) and with several dominant species. White Fir (Abies concolor) and Pacific Dogwood (Cornus nuttallii) are more common on moist sites; pine (Pinus spp.) and buckbrush (Ceanothus spp.) on dry sites. Understory much as in Westside Ponderosa Pine Forest but with scattered, broadleaved shrubs and small trees, and with greater accumulation of wood on the ground.
Site Factors: Similar to Westside Ponderosa Pine Forest, but usually on moister soils. Usually on north-facing slopes near its lower elevational margin. Found in areas of greater winter snowpack than Ponderosa Pine Forest or Montane Chaparral. Intergrades with Sierran White Fir Forest on cool, moist, north-facing slopes within its

elevational range. Averaging slighter higher than Westside Ponderosa Forest at 5000-7000' elevation.

Characteristic Associated Species: Arctostaphylos patula, Calocedrus decurrens, Chrysolepis sempervirens, Ceanothus cordulatus, C. integerrimus, Pinus jeffreyi, Pinus lambertiana, Pinus ponderosa, Prunus emarginata, Quercus kelloggii, Ribes roezlii, Ribes nevadensis, Sequoiadendron gigantea.

SEKI Locations: Suwanee Creek, Halstead Creek

Code: 84240
Community Name: Sierran White Fir Forest
Description: Similar to Sierran Mixed Conifer Forest but denser, with the narrow crowns often overlapping and casting a deep shade. Typically consists of nearly pure stands of White Fir (Abies concolor), which grows to about 70 m tall. The understory is very sparse, with occasional seedlings of A. concolor, and an abundance of downed branches and needle litter. The growing season is concentrated in early and midsummer.

Site Factors: Very similar to Sierran Mixed Conifer Forest, but usually on somewhat cooler, moister sites; typically on north-facing slopes. Probably the coolest, moistest, nonriparian habitat within the Sierran Lower Montane Conifer Forest. Intergrades with and often surrounded by Sierran Mixed Conifer Forest on drier soils. At its upper limits, often intergrades broadly with Red Fir Forest. At approximately 6000-7500' elevation in SEKI.

Characteristic Associated Species: Calocedrus decurrens, Chrysolepis sempervirens, Ribes spp., Sarcodes sanguinea. Mature stands typically have little undergrowth. This usually is restricted to canopy openings that harbor Ribes roezlii, R. viscosissimum, Symphoricarpos parishii, Arctostaphylos nevadensis, A. patula, Ceanothus cordulatus.

Typical SEKI Locations: Clover Creek Area, Twin Lakes Trail.

Code: 84250
Community Name: Big Tree Forest
Description: Very similar to Sierran Mixed Conifer Forest, but lacking its drier species and with the conspicuous addition of Giant Sequoia (Sequoiadendron giganteum).

Site Factors: Very similar to the moister portion of Sierran Mixed Conifer Forest and scarcely distinct from it. Usually between 5000 and 7000'.

Characteristic Species: Abies concolor, Calocedrus decurrens, Pinus lambertiana, P. ponderosa.

Typical SEKI Locations: Giant Forest, Redwood Mountain Grove, and Grant Grove.

Code: 85000
Community Name: Upper Montane Coniferous Forest
Description: A closed canopy community type dominated by coniferous trees, occurring from 7000 to 10000 feet in elevation.

Code: 85210
Community Name: Jeffrey Pine-Fir Forest
Description: Very similar to Sierran Mixed Conifer Forest, but not quite so tall (to 60 m). Dominated by Jeffrey Pine (Pinus jeffreyi), Red Fir (Abies magnifica), and White Fir (A. concolor). The understory is open, primarily of scattered Montane Chaparral and small trees, lacking the moister components of the Sierran Mixed Conifer Forest.

Site Factors: Similar to and probably the high-elevation equivalent of Sierran Mixed Conifer Forest. On well-drained slopes, typically occurs above Sierran Mixed Conifer Forest between 7000 and 9000 feet.

Characteristic Associated Species: Ceanothus cordulatus, Chrysolepis sempervirens, P. monticola, P. contorta.
Typical SEKI Locations: Big Meadows area, Sugarloaf, Lower Big Arroyo.

Code: 85310
Community Name: Red Fir Forest
Description: Very similar to Sierran White Fir Forest but still denser, with the narrow crowns often overlapping and casting a deep shade. Typically consists of essentially pure stands of Red Fir (Abies magnifica), which grow to about 60 m tall. The understory is nearly absent, but needle itter and downed branches are abundant. Growing season is concentrated in the midsummer.

Site Factors: Similar to, and probably the high elevation equivalent of Sierran White Fir forest, but cooler and moister, often on north-facing slopes. On coarse, well-drained, but moist soils. This is the area of greatest winter snow accumulation in the Sierra Nevada, and the snow usually remains until June. At its lower elevational limit, often intergrades broadly with Sierran White Fir Forest. At 7500-9000'.

Associated Species: Chrysolepis sempervirens, Pinus contorta, Pyrola spp., Ribes spp., Sarcodes sanguinea, Symphoricarpos spp..

Typical SEKI Locations: Pear Lake Trail below the Watchtower.

Code: 86000
Community Name: Subalpine Coniferous Forest
Description: Open or closed canopy community type, usually occurring on sites with less well-developed soils, under relatively dry environmental conditions. Ranges from 9000 feet to timberline.

Code: 86100

Community Name: Lodgepole Pine Forest

Description: Dense forests of slender trees up to 40 m tall, often in nearly pure stands of Lodgepole Pine (Pinus contorta). More open stands up to 20 m tall occur on dry sites or near timberline. The understory is normally sparse, but low shrubs and perennial herbs occur abundantly in forest openings.

Site Factors: Typically occurs at elevations with long, snowy winters and cool, dry summers; colder in winter and usually drier than Red Fir Forest. At its lower limit it occupies cold, moist sites within the Upper Montane Coniferous Forest; at its upper limit it occupies dry, exposed sites at timberline. Typically found at 9000-11,000' and at lower elevations in cold air drainages.

Characteristic Associated Species: Phyllodoce breweri, Abies magnifica, Pinus monticola, Pyrola spp., and occasionally Populus tremuloides.

Typical SEKI Locations: Hockett Plateau, Twin Lakes, Rowell Meadow.

Code: 86200

Community Name: Sierran Mixed Subalpine Coniferous Forest

Description: Open coniferous forest of Western White Pine (Pinus monticola), Lodgepole Pine (Pinus contorta), Whitebark Pine (Pinus albicaulis), Red Fir (Abies magnifica), and Foxtail Pine (P. balfouriana) (south of the Kings/Kern Divide). The understory is normally sparse in these stands, but low shrubs and perennial herbs occur more abundantly in forest openings. Found at 9-10,000 feet in SEKI).

Site Factors: See Lodgepole Pine Forest.

SEKI Locations: Upper Soda Creek Canyon (SEQU), Upper East Creek drainage (KICA).

Code: 86220

Community Name: Whitebark Pine-Lodgepole Pine Forest

Description: An open or clumped timberline forest to about 70 m tall, dominated by Whitebark Pine (Pinus albicaulis) and Lodgepole Pine (P. contorta). Several other conifers may occur in some stands. Clumps of trees occur in localized soil accumulations among rocky ridges and outcrops. Shrub canopies are usually low and sparse.

Site Factors: Cold, stony sites with poor, usually granitic soils. 9,500-11,500'.

Characteristic Associated Species: Abies concolor, A. magnifica, Artemisia rothrockii, Eriogonum spp., Juniperus occidentalis, Leptodactylon pungens, Pinus albicaulis, P. balfouriana, P. jeffreyi, Populus tremuloides, Potentilla fruticosa, Ribes spp.

Typical SEKI Locations: Common in the higher elevations north of the Kern Headwaters.

Code: 86230
Community Name: Lodgepole Pine-Foxtail Pine Forest
Description:
Site Factors:
Characteristic Associated Species:
Typical SEKI Locations:

Code: 86300
Community Name: Foxtail Pine Forest
Description: Open forest to 20 m tall, dominated by Foxtail Pine (Pinus balfouriana), often in nearly pure stands. The understory is sparse, with scattered low shrubs and cushion plants. Much of the rocky ground is barren.

Factors: Best developed on dry, rocky sites, between 9,500-11,500'.

Characteristic Associated Species: Artmeisia rothrockii, Eriogonum spp., Pinus albicaulis, P. contorta, Primula suffructescens.

Typical SEKI Locations: Upper Chagoopa Plateau, Upper Rock Creek, Bighorn Plateau.

Code: 86600
Community Name: Whitebark Pine Forest
Description: These open forests are dominated by Whitebark Pine (Pinus albicaulis), with other subalpine trees present only in small quantities. The trees seldom exceed 50', and often are wind-pruned into grotesquely gnarled, picturesque krummholz.

Site Factors: Shallow rocky soil at the alpine timberline. Extremely short growing season. Above 9,500'.

Characteristic Associated Species: Carex congdonii, Draba spp., Eriogonum spp., and other alpine herbaceous species.

Typical SEKI Locations: Kern Headwaters, Dusy Basin.

Code: 90000
Community Name: Alpine Habitats
Description: Sparse plant communities composed mainly of herbs and small shrubs which are limited in size by harsh environmental conditions and/or rocky substrate. These are typical of the colder, higher (subalpine to alpine) areas of both parks but can also be found in the elevations on steep rocky slopes.

Code: 91000
Community Name: Alpine Boulder and Rock Field
Description: Alpine plant communities found on rock substrate which varies in structure from open granite slabs to broken talus and scree slopes.

Code: 91120

Community Name: Sierra Nevada Fell-Field

Description: Perennial herbs or dwarf shrubs less than 0.5 m tall, including "cushion plants". Forms a low turf on favorable sites but more often scattered among the rocks and gravel.

Site Factors: Similar to Subalpine Forest but above treeline and colder. The substrate is rocky, usually flat, with little soil formation and excellent drainage. Often referred to as "alpine pavement". Usually occurs above Foxtail Pine Forest (above 11,500').

Characteristic Associated Species: Aquilegia pubescens, Carex exserta, Draba spp., Epilobium obcordatum, Oxyria digyna, Penstemon davidsonii, Polemonium eximum, Primula suffrutescens.

Typical SEKI Locations: Tablelands, Darwin Bench, Wright Lakes Basin, Rock Creek Basin.

Code: 91210

Community Name: Wet Alpine Talus and Scree

Description: Similar to Dry Alpine Talus and Scree but plant cover sometimes up to 100% in isolated scattered patches as a result of moist conditions. Mesic grass and sedge species common in alpine meadows are found here in small clumps.

Site Factors: Similar to Dry Alpine Talus and Scree Slope, but usually found in the course of a natural drainage or fed by melting waters of perennial snow fields. Found at all elevations in the parks, but only talus slopes above 6000 feet are treated in this community type.

Characteristic Associated Species: Carex spp., Calamagrostis breweri, Dodecatheon alpinum, D. redolens, Heuchera rubescens, Primula suffructescens, Ivesia pygmaea, Antennaria alpina, Lewisia pygmaea.

Typical SEKI Locations: More common on north and northeast facing slopes.

Code: 91220

Community Name: Dry Alpine Talus and Scree Slope

Description: Moderate to fairly steep slopes of broken, unstable angular rock extending downward from below cliff faces to valley floors. Depending on the degree of weathering, slopes can consist of very large sharp angular boulders to sandy gravels and fine silts. Low-growing shrubs, densely tufted bunch-grasses and sedges, and other herbaceous perennials that are common on more stable, dry abitats at similar elevations are found here. Often unexpectedly rich in plant species, although cover is usually sparse.

Site Factors: On steep slopes (15-45 degrees), commonly underneath cliffs where mass-wasting and frost action are the dominant erosional processes. Found at all elevations in the parks, but only talus slopes above 6000 feet are treated in this community type.

Characteristic Associated Species: Trisetum spicatum, Sitanion hystrix, Festuca brachyphylla, Eriogonum ovalifolium var. nivale, Phacelia frigida, Juncus parryi, Oxyria digyna, Carex helleri, Carex congdonii, Calamagrostis purpurascens.

Typical SEKI Locations: Ubiquitous in the high Sierra Nevada.

Code: 91230
Community Name: Low Angle Rock Slabs and Ledges
Description: A rich plant community of mostly compact herbaceous perennials and densely tufted sedge, rush, and grass species growing in well-drained gravel filled crevices and on top of terraces. Large mats or clumps of vegetation occur on more protected sites with abundant moisture, but more commonly the jointed nature of the rock produces a linear pattern of growth.

Site Factors: Large areas of stable, low-angle rock slabs. From mixed coniferous forest to alpine environments on solid rock substrate with little or no soil development above 7000 feet.

Characteristic Associated Species: Carex helleri, C. breweri, C. straminiformes, Phyllodoce breweri, Agrostis sp., Calamagrostis sp., Poa sp., Juncus parryi, J. drummondii, Penstemon newberryi, Vaccinium nivictum, Epilobium obcordatum, Mimulus tilingii, Primula suffrutescens.

Typical SEKI Locations: Tablelands, Little Baldy, Dusy Basin.

Code: 95000
Community Name: Cliffs and Barren Rock Outcrops
Description: Steep to vertical rock outcrops which can be found at all elevations of SEKI. Can be fractured; a number of plant species can be found in the cracks, including herbs, shrubs and trees. Plant growth is limited by lack of moisture.

Site Factors: Steep exposed bedrock outcrops with little or no soil development; usually very dry. Found at all elevations but usually in the montane and higher elevations.

Typical SEKI Locations: Ash Peaks, Angel Wings, North Dome, Grand Sentinal.

Code: 99999
Community Name: Missing Data, Unknown
Description: Insufficient data to assign any one of the community types listed above. Rather than "second guessing" an observer, this number is assigned as a placeholder.

Literature Cited

Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California. Department of Fish and Game, Sacramento, California.

Appendix IV. Specimen Collection for Sequoia National Park

Elizabeth D. Pierson reviewed and made corrections to this specimen collection, July 2008.

Table IV-1. Specimen collection for Sequoia National Park, with corrections by Elizabeth D. Pierson.

Sci. Name	Corrected Identification	Record # (SEKI Wildlife Observation Database)	RECNUM (SEKI Wildlife Observation Database)	Locality (Eldredge-Museum Specimens)	Locality (SEKI Wildlife Observation Database or speciment tag)	Location	Elevation	Description	Catalog Number	Collection Date	Accession Number	NOTES (E.D. Pierson)
Antrozous pallidus		NA	NA	ASH MTN	Ash Mt (specimen tag)	AMB BIO 2 C		Study skin, male. Wingspread 13 inches. H.E.Basey 14AUG1968	SEKI 3541	8/14/1968	SEKI-00321	Juvenile Male; not in Wildlife Observation Database
Antrozous pallidus	Myotis evotis[a]	45041	45204	CHAGOOPA PLATEAU, CR W OF CHAGOOPA CR	Chagoopa Treehouse (SEKI WODB)	AMB BIO 2 C	10400'	Study skin & skull, adult female skull fragmented in posterior cranial area, hole in right "wing" membrane prepared by Jim Petterson	SEKI 8310	7/14/1988	SEKI-00690	
Eptesicus fuscus		NA	NA	WOLVERTON	Wolverton (specimen tag)	AMB BIO 2 C		Study skin with skull and lower jaw, male. Wingspan 12.75 inches H.E.Basey 30JUL1967, 145. Road kill. No jaw located 10DEC1993.	SEKI 3504	7/30/1967	SEKI-00292	Adult; prepared by A. Ringgold; not in Wildlife Observation Database
Eptesicus fuscus		45125	45288	CASCADE CR, BELOW CRYSTAL CAVE	Cascade Creek (SEKI WODB)	AMB BIO 2 C	4400'	skin & skull, adult male. prepared by Jim Petterson	SEKI 8307	8/18/1988	SEKI-00690	
Eptesicus fuscus		45031	45194	REDWOOD MT GROVE, REDWOOD CR	N. end Redwood Creek (SEKI WODB)	AMB BIO 2 C	6400'	skin & skull, adult male missing fur ventrally, right lower area prepared by Jim Petterson	SEKI 8309	6/29/1988	SEKI-00690	
Eptesicus fuscus		NA	NA	CHAGOOPA PLATEAU, CR W OF CHAGOOPA CR	Chagoopa Plateau (specimen tag)	AMB BIO 2 C	10400'	Study skin and skull, adult male both zygomatic arches broken prepared by Jim Petterson	SEKI 8312	7/14/1988	SEKI-00690	Not in Wildlife Observation Database
Eptesicus fuscus		45026	45189	SYCAMORE SPRING	Sycamore Spring	AMB BIO 2 C	2800'	Study skull only, male, testes descended	SEKI 8353	6/12/1988	SEKI-00690	

Table IV-1. Specimen collection for Sequoia National Park, with corrections by Elizabeth D. Pierson. (continued)

Sci. Name	Corrected Identification	Record # (SEKI Wildlife Observation Database)	RECNUM (SEKI Wildlife Observation Database)	Locality (Eldredge-Museum Specimens)	Locality (SEKI Wildlife Observation Database or speciment tag)	Location	Elevation	Description	Catalog Number	Collection Date	Accession Number	NOTES (E.D. Pierson)
Lasionycteris noctivagans		45032	45195	REDWOOD MT GROVE, REDWOOD CR	N. end Redwood Creek (SEKI WODB)	AMB BIO 2 C	6400'	skin & skull, adult male left zygomatic arch broken, balding in lower right ventral area prepared by Jim Petterson	SEKI 8311	6/29/1988	SEKI-00690	
Lasiurus borealis	Lasiurus blossevillii[b]	45132	45295	NORTH FORK KAWEAH RIVER	No. Fk.-Burnt Pt. (SEKI WODB)	AMB BIO 2 C	2400'	Study skin & skull, adult female. prepared by Jim Petterson	SEKI 8308	8/21/1988	SEKI-00690	Nulliparous
Myotis californicus		45017	45180	NORTH FORK KAWEAH RIVER	N. Fk. Kaweah (SEKI WODB)	AMB BIO 2 B		Study skin and skull zygomatic arches broken. prepared by Jim Petterson	SEKI 8355	5/27/1988	SEKI-00690	Adult
Myotis lucifugus	Myotis volans[a]	NA	NA	REDWOOD MT GROVE, REDWOOD CR	Redwood Mt. Grove (SEKI WODB)	AMB BIO 2 B	6400'	Study skin & skull, sdult female left zygomatic arch broken prepared by Jim Petterson	SEKI 8314	6/29/1988	SEKI-00690	FA=39.72 mm;keeled clacar; Tibia=20.86 mm; not in Wildlife Observation Database
Myotis lucifugus	Myotis yumanensis[a]	45139	45302	MIDDLE FORK KAWEAH RIVER	Middle Fork Kaweah (SEKI WODB)	AMB BIO 2 B		Study skin & skull, adult female right zygomatic arch broken prepared by Jim Petterson	SEKI 8356	8/17/1988	SEKI-00690	FA=34.18 mm; fur not glossy
Myotis lucifugus	Myotis yumanensis[a]	45140	45303	MIDDLE FORK KAWEAH RIVER	Middle Fork Kaweah (SEKI WODB)	AMB BIO 2 B		Study skin & skull, adult male right membrane split at 4th digit prepared by Jim Petterson	SEKI 8357	7/6/1988	SEKI-00690	FA=33.35 mm

Table IV-1. Specimen collection for Sequoia National Park, with corrections by Elizabeth D. Pierson. (continued)

Sci. Name	Corrected Identification	Record # (SEKI Wildlife Observation Database)	RECNUM (SEKI Wildlife Observation Database)	Locality (Eldredge-Museum Specimens)	Locality (SEKI Wildlife Observation Database or speciment tag)	Location	Elevation	Description	Catalog Number	Collection Date	Accession Number	NOTES (E.D. Pierson)
Myotis lucifugus	Myotis volans[a]	NA	NA	REDWOOD CR	Redwood Creek (SEKI WODB)	AMB BIO 2 B		Study skin & skull, adult female zygomatic arches broken prepared by Jim Petterson	SEKI 8358	6/28/1988	SEKI-00690	FA = 40.08 mm; Tibia = 20.67 mm; not in Wildlife Observation Database
Myotis yumanensis		45126	45289	CASCADE CR, BELOW CRYSTAL CAVE	Cascade Creek (SEKI WODB)	AMB BIO 2 B	4400'	Study skin & skull, adult male prepared by Jim Petterson	SEKI 8313	8/18/1988	SEKI-00690	FA = 33.79 mm; no keel on calcar; big feet
Myotis yumanensis	Myotis californicus[a]	45126	45289	CASCADE CR, BELOW CRYSTAL CAVE	Cascade Creek (SEKI WODB)	AMB BIO 2 B	4400'	Study skin & skull, adult male right zygomatic arch broken. prepared by Jim Petterson	SEKI 8316	8/18/1988	SEKI-00690	FA = 31.15 mm; keeled calcar; small feet; One record in Wildlife Observation Database for two MYYU; two specimens in collection identified as MYYU from Cascade Crk; one misidentified and is M. californicus
Myotis yumanensis		45138	45301	MIDDLE FORK KAWEAH RIVER	Middle Fork Kaweah (SEKI WODB)	AMB BIO 2 B		Study skin & skull, adult male skin slipped right dorsal and ventral areas, zygomatic arches broken prepared by Jim Petterson	SEKI 8354	8/17/1988	SEKI-00690	FA=32/93 mm; no keel on calcar; big feet

Table IV-1. Specimen collection for Sequoia National Park, with corrections by Elizabeth D. Pierson. (continued)

Sci. Name	Corrected Identification	Record # (SEKI Wildlife Observation Database)	RECNUM (SEKI Wildlife Observation Database)	Locality (Eldredge-Museum Specimens)	Locality (SEKI Wildlife Observation Database or speciment tag)	Location	Elevation	Description	Catalog Number	Collection Date	Accession Number	NOTES (E.D. Pierson)
Plecotus townsendii	Corynorhinus townsendii[b]	47368	47533	BETWEEN ASH MTN & GIANT FOREST FOUND IN NPS TRUCK	Crescent Meadow, see Memo (SEKI WODB)	AMB BIO 2 C	4800'	skin, adult male tail wire exposed prepared by Jim Petterson	SEKI 8315	10/21/1988	SEKI-00690	Dates match, localities do not match; Collector A. Esperanza
Myotis thysanodes		59801	60049	Hwy 180 Bridge, Cedar Grove (specimen tag)	CGBridge Lewis Creek (SEKI WODB)			Study skin & skull, Adult female; FA = 40 mmp	None	8/26/1993	None	Specimen in collection, but not in database; not accessioned; Collector J. Koshear

[a] = correction for misidentification

[b] = accepted name change

Appendix V. Prior Bat Records for Sequoia National Park

Table V-1. Bat records for Sequoia National Park collected by E. Pierson and W. Rainey prior to this study. C= capture, AC = acoustic, V = visual, DR = day roost, NR = night roost, FOR = foraging area. Reproductive status codes: EPSP= Epididymis sperm visible; LAC = lactating; NON = non-reproductive; NUL = nulliparous; PAR =parous; Plac = post-lactating; P3 = Pregnant, level 3 (very pregnant); SC=Scrotal.

Genus	Species	Observation Type	Site Type	Year	Observation Date	Sex	Age	Reproduction Status	Site Locality	Site Name	Latitude	Longitude	Elev (m)
Antrozous	pallidus	C	FOR	1988	07/27/88	M			SFK Kaweah Campgrnd	Trail below Br., Campground	36.34992	-118.76331	1114
Corynorhinus	townsendii	C	DR	1987	06/09/87	M	A		SFK Kaweah Campgrnd	Clough Cave	36.35023	-118.76151	1141
Eptesicus	fuscus	C	FOR	1988	07/27/88	M	A	SC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Eptesicus	fuscus	C	FOR	1988	07/27/88	M	A	SC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Myotis	californicus	C	FOR	1988	07/27/88	M	A	SC	SFK Kaweah Campgrnd	Lady Bug Trail	36.34977	-118.76162	1-118
Myotis	thysanodes	C	DR	1987	06/09/87	M	A		SFK Kaweah Campgrnd	Clough Cave	36.35023	-118.76151	1141
Myotis	volans	C	DR	1987	06/09/87	M	A		SFK Kaweah Campgrnd	Clough Cave	36.35023	-118.76151	1141
Myotis	volans	C	DR	1987	06/09/87	M	A		SFK Kaweah Campgrnd	Clough Cave	36.35023	-118.76151	1141
Myotis	yumanensis	C	DR	1987	06/09/87	M	A		SFK Kaweah Campgrnd	Clough Cave	36.35023	-118.76151	1141
Myotis	yumanensis	C	FOR	1988	07/27/88	M	A	NON	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	F	A	LAC	SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Tadarida	brasiliensis	C	FOR	1988	07/27/88	M	J		SFK Kaweah Campgrnd	Across River, SFK Kaweah	36.35061	-118.76373	1115
Antrozous	pallidus	C	NR?	1995	10/06/95	F	A	PLAC	Giant Forest	D5,D26, Crescent Mdw Rd	36.56038	-118.77246	1981

Table V-1. Bat records for Sequoia National Park collected by E. Pierson and W. Rainey prior to this study. C= capture, AC = acoustic, V = visual, DR = day roost, NR = night roost, FOR = foraging area. (continued)

Genus	Species	Observation Type	Site Type	Year	Observation Date	Sex	Age	Reproduction Status	Site Locality	Site Name	Latitude	Longitude	Elev (m)
Antrozous	pallidus	C	NR?	1995	10/06/95	M	A		Giant Forest	D5,D26, Crescent Mdw Rd	36.56038	-118.77246	1981
Antrozous	pallidus	C	NR	1995	09/11/95	M	A	SC	Giant Forest	Round Mdw. Trees	36.56737	-118.76840	1950
Antrozous	pallidus	C	NR	1995	09/11/95	M	A	SC	Giant Forest	Round Mdw. Trees	36.56737	-118.76840	1950
Antrozous	pallidus	C	NR	1995	09/11/95	M	A	SC	Giant Forest	Round Mdw. Trees	36.56737	-118.76840	1950
Antrozous	pallidus	C	FOR	1995	09/13/95	M	A	SC	Giant Forest	Sunset Rock	36.57524	-118.77367	1953
Antrozous	pallidus	C	FOR	1995	08/30/95	M	A		Giant Forest	Nr. Burnt Twins, Crescent Mdw	36.55843	-118.76870	2000
Antrozous	pallidus	C	FOR	1995	08/30/95	M	A		Giant Forest	Nr. Burnt Twins, Crescent Mdw	36.55843	-118.76870	2000
Eptesicus	fuscus	C	NR	1995	09/11/95	M	A	NON	Giant Forest	Round Mdw. Trees	36.56737	-118.76840	1950
Eptesicus	fuscus	C	FOR	1995	07/27/95	M	A		Giant Forest	General's Highway, Sec 31	36.57152	-118.76386	2034
Eptesicus	fuscus	C	FOR	1995	07/27/95	M	A		Giant Forest	General's Highway, Sec 31	36.57152	-118.76386	2034
Eptesicus	fuscus	C	FOR	1995	07/27/95	F	A	NUL	Giant Forest	General's Highway, Sec 31	36.57152	-118.76386	2034
Euderma	maculatum	C	FOR	1995	09/13/95	F	A	PLAC	Giant Forest	Sunset Rock	36.57524	-118.77367	1953
Eumops	perotis	AC	FOR	1995	06/27/95	U	U		Giant Forest	Hazelwood Nature Tr.	36.56488	-118.76477	1962
Eumops	perotis	AC	FOR	1995	09/13/95				Giant Forest	Sunset Rock	36.57524	-118.77367	1953
Myotis	californicus	C	FOR	1995	06/27/95	M	A		Giant Forest	Hazelwood Nature Tr.	36.56488	-118.76477	1962
Myotis	californicus	C	NR?	1995	09/12/95	M	A	SC	Giant Forest	L28, SE6, Crescent Mdw Rd	36.55843	-118.76870	2000
Myotis	californicus	C	FOR	1995	09/13/95	M	A	SC	Giant Forest	Sunset Rock	36.57524	-118.77367	1953
Myotis	californicus	C	FOR	1995	09/13/95	M	A		Giant Forest	Sunset Rock	36.57524	-118.77367	1953
Myotis	evotis	C	DR	1995	08/19/95	F	A		Giant Forest	Giant Forest Lodge, Cabin 91	36.56815	-118.76604	1965
Myotis	evotis	V	DR	1995	08/28/95	M	A		Giant Forest	Giant Forest Lodge, Restaurant	36.56581	-118.76552	1957
Myotis	evotis	C	DR	1995	09/14/95	M	J		Giant Forest	Giant Forest Lodge, Dispensary	36.66690	-118.76513	1972
Myotis	evotis	V	DR	1995	08/21/95	F	A		Giant Forest	Giant Forest, Pinewood Trailer	36.57382	-118.76477	2008

Table V-1. Bat records for Sequoia National Park collected by E. Pierson and W. Rainey prior to this study. C= capture, AC = acoustic, V = visual, DR = day roost, NR = night roost, FOR = foraging area. (continued)

Genus	Species	Observation Type	Site Type	Year	Observation Date	Sex	Age	Reproduction Status	Site Locality	Site Name	Latitude	Longitude	Elev (m)
Myotis	evotis	C	DR	1995	09/14/95	M	J		Giant Forest	Giant Forest, Kaweah Motel	36.56561	-118.77276	1966
Myotis	evotis	C	NR?	1995	09/12/95	F	A	null	Giant Forest	L30, SE6, Crescent Mdw Rd	36.55843	-118.76870	2000
Myotis	evotis	C	FOR	1995	09/13/95	F	A	LAC	Giant Forest	Sunset Rock	36.57524	-118.77367	1953
Myotis	thysanodes	C	NR?	1995	09/12/95	M	A	SC	Giant Forest	L28, SE6, Crescent Mdw Rd	36.55843	-118.76870	2000
Myotis	thysanodes	C	FOR	1995	09/13/95	M	A	EPSP	Giant Forest	Sunset Rock	36.57524	-118.77367	1953
Myotis	thysanodes	C	FOR	1995	09/13/95	F	A	PLAC	Giant Forest	Sunset Rock	36.57524	-118.77367	1953
Myotis	volans	C	FOR	1995	06/27/95	M	A		Giant Forest	Hazelwood Nature Tr.	36.56488	-118.76477	1962
Antrozous	pallidus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Antrozous	pallidus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Antrozous	pallidus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Antrozous	pallidus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Antrozous	pallidus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Antrozous	pallidus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510

Table V-1. Bat records for Sequoia National Park collected by E. Pierson and W. Rainey prior to this study. C= capture, AC = acoustic, V = visual, DR = day roost, NR = night roost, FOR = foraging area. (continued)

Genus	Species	Observation Type	Site Type	Year	Observation Date	Sex	Age	Reproduction Status	Site Locality	Site Name	Latitude	Longitude	Elev (m)
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Eptesicus	fuscus	C	FOR	1995	07/13/95	M	A		Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Parastrellus	hesperus	C	FOR	1995	07/13/95	F	A	LAC	Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Parastrellus	hesperus	C	FOR	1995	07/13/95	F	A	P3	Ash Mountain	Sycamore Creek	36.48770	-118.84446	510
Antrozous	pallidus	C	FOR	1996	09/19/96	M	A	SC	NFK Kaweah	200 m up fr. Yucca Ck	36.54697	-118.89764	538
Myotis	volans	C	FOR	1996	09/19/96	F	A	PLAC	NFK Kaweah	200 m up fr. Yucca Ck	36.54697	-118.89764	538
Myotis	yumanensis	C	FOR	1996	09/19/96	M	A	NON	NFK Kaweah	200 m up fr. Yucca Ck	36.54697	-118.89764	538

Appendix VI. Bat Species Accounts

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1. *Antrozous pallidus*, Pallid Bat

1.1. Identification

Antrozous pallidus is a morphologically distinctive bat (Figure 1.1). It is pale (blonde to tan) with large ears, a blunt pig-like snout, and a characteristic skunk-like odor. It is relatively large, with a forearm of 48-60 mm.



Figure 1.1 Photograph of *A. pallidus*. (Credit: Keith Paul, USFWS).

It has a distinctive echolocation call that allows it to be identified acoustically. Particularly diagnostic is the social “directive” call (Figure 1.2).

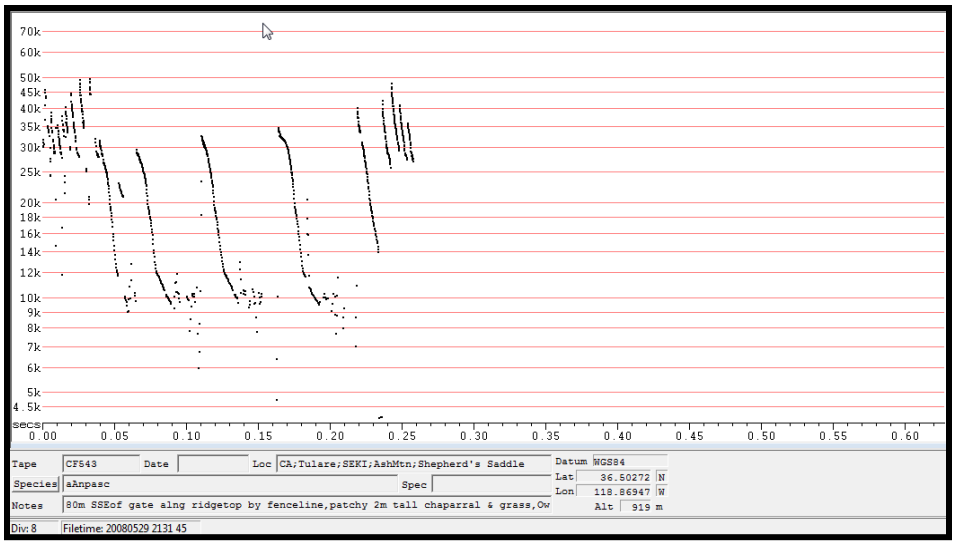


Figure 1.2.Echolocation call of *A. pallidus*, showing an audible social component. Shepherd’s Saddle, Sequoia National Park, May 29, 2008.

1.2. Distribution

Geographic Range

A. pallidus is distributed from southern British Columbia and Montana to central Mexico, and east to Texas, Oklahoma and Kansas. An isolated population also occurs on Cuba (Hermanson and O'Shea 1983). In California it is widely distributed, but concentrated at lower elevations, and with the majority of records below 2,000 m.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for *A. pallidus* are mapped in Figure 1.3, and detailed in Table 1.1 through 1.4. All records for *A. pallidus* collected prior to this study were from Sequoia National Park, and the Kaweah drainage (Tables 1.1, 1.2, and 1.3). There are two records in Los Angeles County Museum (LACM) from Clough Cave and one in the Park collection from Ash Mountain (Appendices II & IV, Table 1.1). There are also eight records in the park Wildlife Observation Database (WODB), six from the vicinity of Ash Mountain and two from South Fork Campground (Appendix III, Table 1.2). Two additional records in the park database for the Chagoopa Plateau are in error. The specimen from the Chagoopa Treehouse was misidentified, and when inspected by the current investigators, was identified as *Myotis evotis*. Although there is no specimen for the Goldfox Lake record, it was collected by the same investigator, and because it is outside the expected elevation range for *A. pallidus*, it should be assumed that this record is also an error.

During earlier studies in Sequoia National Park, we obtained records for this species at Sycamore Creek, South Fork Campground, North Fork of the Kaweah near Yucca Creek, and at multiple sites in the vicinity of Giant Forest (Appendix V, Table 1.3; Pierson and Heady 1996).

During the current inventory effort, we obtained capture records in Giant Forest and the first capture records for Kings Canyon in Cedar Grove (Appendix VI, Table 1.3). In our acoustic surveys we obtained records in Kings Canyon at a number of sites in Cedar Grove and two in the Redwood Creek giant sequoia grove. In Sequoia National Park, *A. pallidus* was detected from lower elevation sites (e.g., Ash Mountain, Sycamore Creek, and South Fork Ranger Station) to sites in excess of 2000 m in Giant Forest and Lodgepole. We also detected *A. pallidus* in two areas in the Kern Trench – a manzanita/ponderosa pine stand near Kern Hot Springs and at multiple sites in the vicinity of the Kern Ranger Station (Table 1.4). There is also a museum record (CSUH#2485) for *A. pallidus* from Lower Peppermint Campground, farther south in the Kern drainage.

Overall, *A. pallidus* was relatively rare in net captures and acoustic detections. We obtained no definitive records from Devils Postpile National Monument and detected it at relatively few sites in Kings Canyon and Sequoia National Parks (Figures 1.4 and 1.5). The greatest number of detections per night was in the blue oak savannah at Sycamore Creek and in the open ponderosa parkland in Cedar Grove (Table 1.4). *A. pallidus* seemed widely distributed, although uncommon, in Giant Forest, and rare in the Redwood Mountain Grove. This discrepancy could be explained by the fact that all detections in Giant Forest were in or near relatively open rocky areas. More surprising was the total absence of any *A. pallidus* detections in 22 acoustic sampling nights in Tehipite Valley,

where there appeared to be suitable habitat (oak woodland, ponderosa parkland, rock benches, manzanita scrub).

Sequoia and Kings Canyon records range from 510 to 2,164 m in elevation, with the highest elevation record being on the manzanita flat just south of Kern Hot Springs (and just above the bridge crossing of the Kern River). This elevation range is consistent with published accounts suggesting this species is most commonly found below 2,000 m (Barbour and Davis 1969). The highest elevation record for *A. pallidus* in Yosemite National Park is 1864 m (Pierson et al. unpublished data). All sites in Devils Postpile were greater than 2,200 m, and thus above the known elevation range for this species.

Table 1.1. Museum records for *A. pallidus* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/ Age	MUS ID	REC NUM	Collector
SQNP	MFK Kaweah	Ash Mt RC	36.48985	-118.82811	509	14-Aug-68	MJ	SEKI-3541*	NA	Basey, H.E.
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	21-Oct-50	FU	LACM-22894		NA
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	21-Oct-50	MU	LACM-22895		NA

* Not in museum database or WODB

Table 1.2. Records for *A. pallidus* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
SQNP	MFK Kaweah	Ash Mountain	36.48985	-118.82811	509	1-Jun-80	45299	Graber, D.
SQNP	MFK Kaweah	Ash Mtn Research	36.48985	-118.82811	509	29-Jun-84	42053	Norris, L.
SQNP	MFK Kaweah	Ash Mt.	36.48985	-118.82811	509	2-Jul-87	45123	Hedley, B.
SQNP	SFK Kaweah	South Fk Cmpgrnd	36.34992	-118.76331	1114	20-Jul-87	44279	Jeffrey, T.
SQNP	MFK Kaweah	Ash Mtn Research	36.48985	-118.82811	509	1-Jun-92	51625	Graber, D.
SQNP	MFK Kaweah	Kaweah Cave	36.49332	-118.81994	563	5-Jan-01	60351	Oberg, E.
SQNP	MFK Kaweah	South Fk Cmpgrnd	36.48985	-118.82811	509	1-Jun-92	46468[a]	Jeffrey,T.

[a] Record provided with more detail in Pierson and Rainey capture records (Table 1.3.)

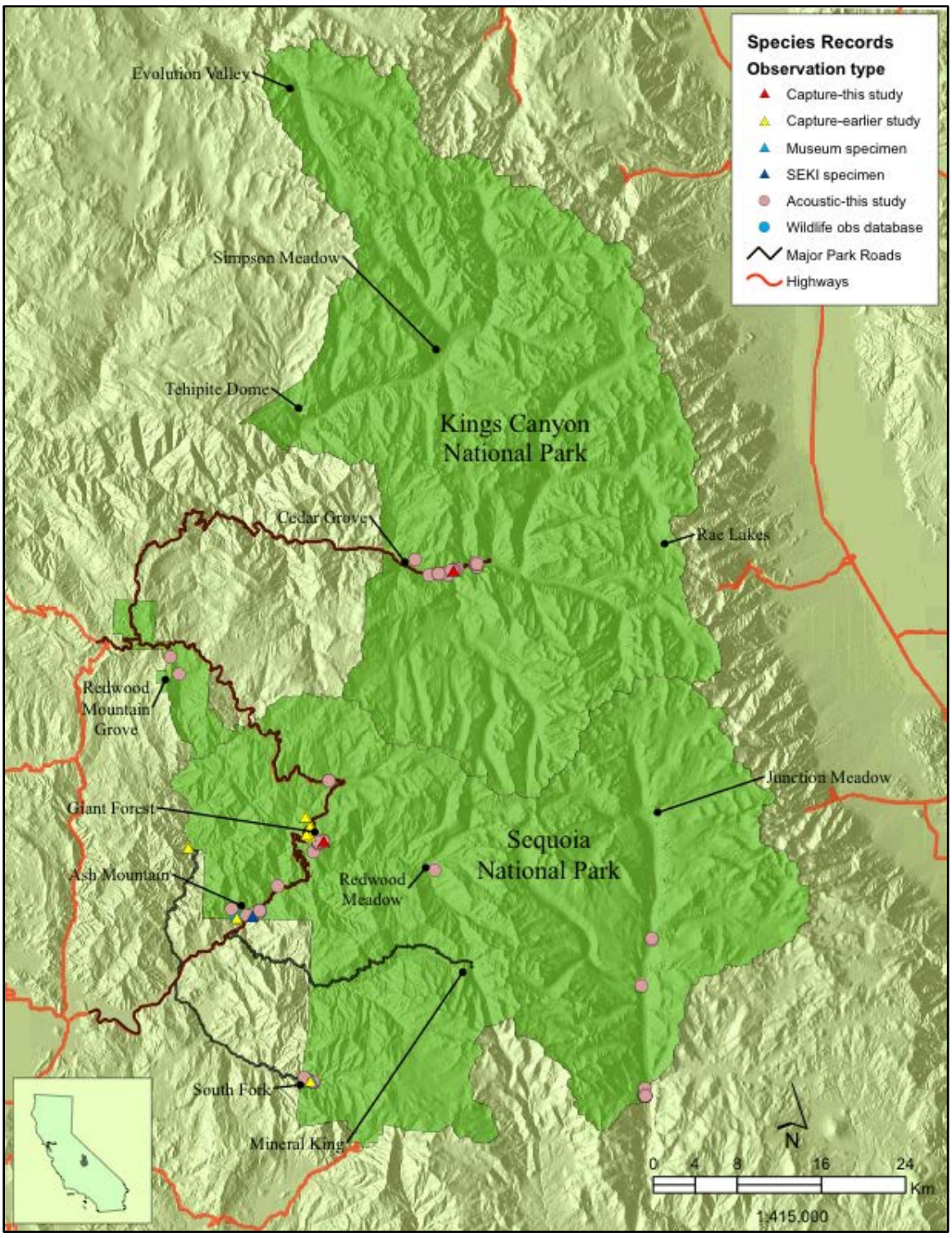


Figure 1.3. Map showing known distribution of *A. pallidus* (pallid bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 1.3. Capture records for *Antrozous pallidus* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
KCNP	SFK Kings	Cedar Grove, River side channel	36.78673	-118.62043	1483	11-Jul-02		3								3
SQNP	Marble Kaweah	Giant Forest, Huckleberry Ck	36.55432	-118.75354	2054	31-Jul-02						2				2
						TOTALS	**0**	**3**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**5**
EARLIER STUDIES																
SQNP	NFK Kaweah	Pool #7, abv Yucca Ck[a]	36.54697	-118.89764	538	19-Sep-96						1				1
SQNP	Marble Kaweah	Giant Forest, nr. Burnt Twins[b]	36.55843	-118.76870	2000	30-Aug-95						2				2
SQNP	Marble Kaweah	Giant Forest, Trees, Round Mdw[b]	36.56737	-118.76840	1950	11-Sep-95						3				3
SQNP	Marble Kaweah	Giant Forest, Sunset Rock[b]	36.57524	-118.77367	1953	13-Sep-95						1				1
SQNP	Marble Kaweah	Giant Forest, Crescent Mdw Rd[b]	36.56038	-118.77246	1981	6-Oct-95			1			1				2
SQNP	MFK Kaweah	Sycamore Creek, Ash Mountain[b]	36.48770	-118.84446	510	13-Jul-95						6				6
SQNP	SFK Kaweah	Trail blw Bridge, Campground[a,c]	36.34992	-118.76331	1114	27-Jul-88						1				1
						TOTALS	**0**	**0**	**1**	**0**	**0**	**15**	**0**	**0**	**0**	**16**

[a] E.D. Pierson, under permit by the park

[b] Pierson and Heady 1996

[c] Also appears as REC NUM 46468 in WODB (Table 1.2)

Table 1.4. Acoustic records for *A. pallidus* obtained in this study. "X" = Present, files not counted.

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	SFK Kings	Cedar Grove	Cliff base @ Zumwalt Mdw Pkg	36.79421	-118.59793	1540	9-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Sidebar River, W Roaring R Xing	36.78251	-118.62710	1471	9-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin	36.78374	-118.63663	1469	9-Jul-02	14
KCNP	SFK Kings	Cedar Grove	Service Rd, betw Knapp & Cedar Grv	36.78274	-118.64697	1461	9-Jul-02	3
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,NW crnr	36.79158	-118.59697	1520	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,N edge	36.79237	-118.59704	1539	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, talus slope	36.79048	-118.59558	1534	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	E Knapp's cabin	36.78374	-118.63663	1469	10-Jul-02	14
KCNP	SFK Kings	Cedar Grove	River just E. Knapp's cabin	36.78369	-118.63337	1467	10-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Talus at E end of River Rd	36.78809	-118.61687	1494	10-Jul-02	3
KCNP	SFK Kings	Cedar Grove	N river @ Zumwalt Mdw	36.79301	-118.59547	1524	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	River Rd, 1st turnout	36.78715	-118.61978	1477	11-Jul-02	16
KCNP	SFK Kings	Cedar Grove	Island, betw River and side channel	36.78645	-118.62046	1482	11-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Roadside, diagonal up road	36.78692	-118.62274	1470	11-Jul-02	18
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	23-Jul-04	X
KCNP	NFK Kaweah	Redwood Mt. Grove	Redwood Ck	36.69395	-118.91100	1955	1-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	2-Jul-05	1
SQNP	Marble Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	29-Jul-02	1
SQNP	Marble Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	30-Jul-02	1
SQNP	Marble Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-02	3
SQNP	Marble Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55227	-118.75893	2007	30-Jul-02	11
SQNP	Marble Kaweah	Giant Forest	Moro Rock, first rest area, 1/2 to top	36.54554	-118.76456	2003	30-Jul-02	4
SQNP	Marble Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, SEGI burn	36.55215	-118.75900	2013	31-Jul-02	2
SQNP	Marble Kaweah	Giant Forest	Huckleberry Rock, bare rock below Rd	36.55355	-118.75900	2059	31-Jul-02	5

Table 1.4. Acoustic records for *A. pallidus* obtained in this study. "X" = Present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Marble Kaweah	Giant Forest	Huckleberry Rock at edge of seep blw rd	36.55391	-118.75900	2072	30-Jul-98	5
SQNP	Marble Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-98	2
SQNP	Marble Kaweah	Giant Forest	Mdw at Tunnel Tree	36.55376	-118.75900	2036	30-Jul-98	1
SQNP	MFK Kaweah	Ash Mt	Marble Fork	36.51569	-118.80184	635	12-Jul-02	2
SQNP	MFK Kaweah	Ash Mt	Alder Creek, below road	36.49268	-118.82482	542	12-Jul-02	7
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr. - Farther East on dirt rd	36.49004	-118.83413	512	14-Jul-02	1
SQNP	MFK Kaweah	Ash Mt	gravel bar 30 m abv abve net site	36.49390	-118.82068	501	14-Jul-02	1
SQNP	MFK Kaweah	Ash Mt	gravel bar dwn fr net site	36.49429	-118.82032	499	14-Jul-02	1
SQNP	MFK Kaweah	Sycamore Creek	Abv Falls, Net site	36.49552	-118.85029	646	28-Jun-05	37
SQNP	MFK Kaweah	Redwood Meadow	Redwood Meadow Creek	36.53188	-118.63554	1839	31-Aug-06	X
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Rock face, above entrance road	36.35282	-118.76980	1080	13-Jul-02	6
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	River edge, above footbridge, nr. net site	36.34955	-118.75966	1134	13-Jul-02	3
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	River edge above footbridge	36.34962	-118.76013	1130	13-Jul-02	1
SQNP	Kern	Kern Hot Springs	Bench, S. of Rock Ck	36.47541	-118.40348	2164	29-Aug-04	X
SQNP	Kern	Kern Hot Springs	Manzanita 50 m blw trail xing Rock Ck	36.47652	-118.40383	2097	22-Aug-05	1
SQNP	Kern	Kern Ranger Station	Log, upslope Ranger Station	36.34254	-118.40972	1970	3-Sep-04	X
SQNP	Kern	Kern Ranger Station	Coyote CK, nr. Trail Xing	36.34210	-118.40840	1966	3-Sep-04	X
SQNP	Kern	Kern Ranger Station	Pasture at RS	36.34251	-118.40843	1964	3-Sep-04	X
SQNP	Kern	Kern Trench	Talus, 1 km blw Big Arroyo Br	36.43590	-118.41373	2037	26-Aug-05	1
SQNP	Kern	Kern Ranger Station	Log, upslope RS	36.34254	-118.40972	1970	27-Aug-05	1
SQNP	Kern	Kern Ranger Station	Marsh, trail Xing	36.34200	-118.40837	1973	27-Aug-05	5
SQNP	Kern	Kern Ranger Station	Near Ck Xing	36.34210	-118.40840	1989	27-Aug-05	4
SQNP	Kern	Kern Ranger Station	Pasture, RS	36.34251	-118.40843	1976	27-Aug-05	8
SQNP	Kern	Kern Ranger Station	Ponderosa snag	36.34833	-118.40833	1979	27-Aug-05	2
SQNP	Kern	Kern Ranger Station	Pasture RS 1	36.34266	-118.40793	1960	28-Aug-05	11
SQNP	Kern	Kern Ranger Station	Pasture Center	36.34251	-118.40810	1960	28-Aug-05	8
					TOTAL SAMPLING SESSIONS			52

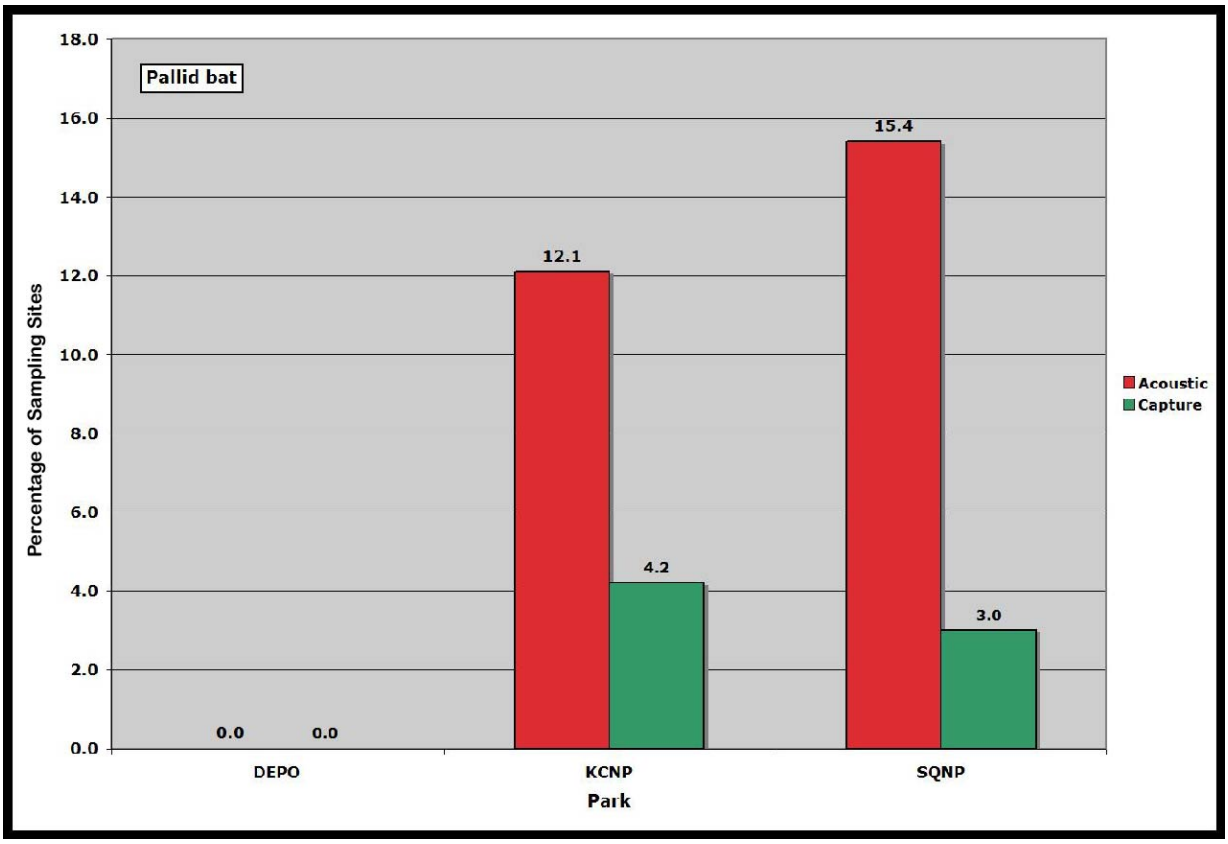


Figure 1.4. A bar graph comparing capture and acoustic records by park as measured by the percentage of sampling sites at which *A. pallidus* was detected.

The combination of capture and acoustic efforts yielded records in all the river drainages except the San Joaquin, where all sampling sites were above the known elevation range for this species (Figure 1.5). The discrepancies among the drainages in detection rates in these graphs have not been corrected for elevation. If we make that correction, and include only those sites below 2,164 m (the highest elevation at which *A. pallidu*s was detected), this species is still detected acoustically at only 16.9% of sites in Kings Canyon and 27.9% sites in Sequoia. If we look by drainage, detection rates are 17.9% of sites in the Kings, 25.3 % of sites in the Kaweah, and 27.1 % of sites in the Kern.

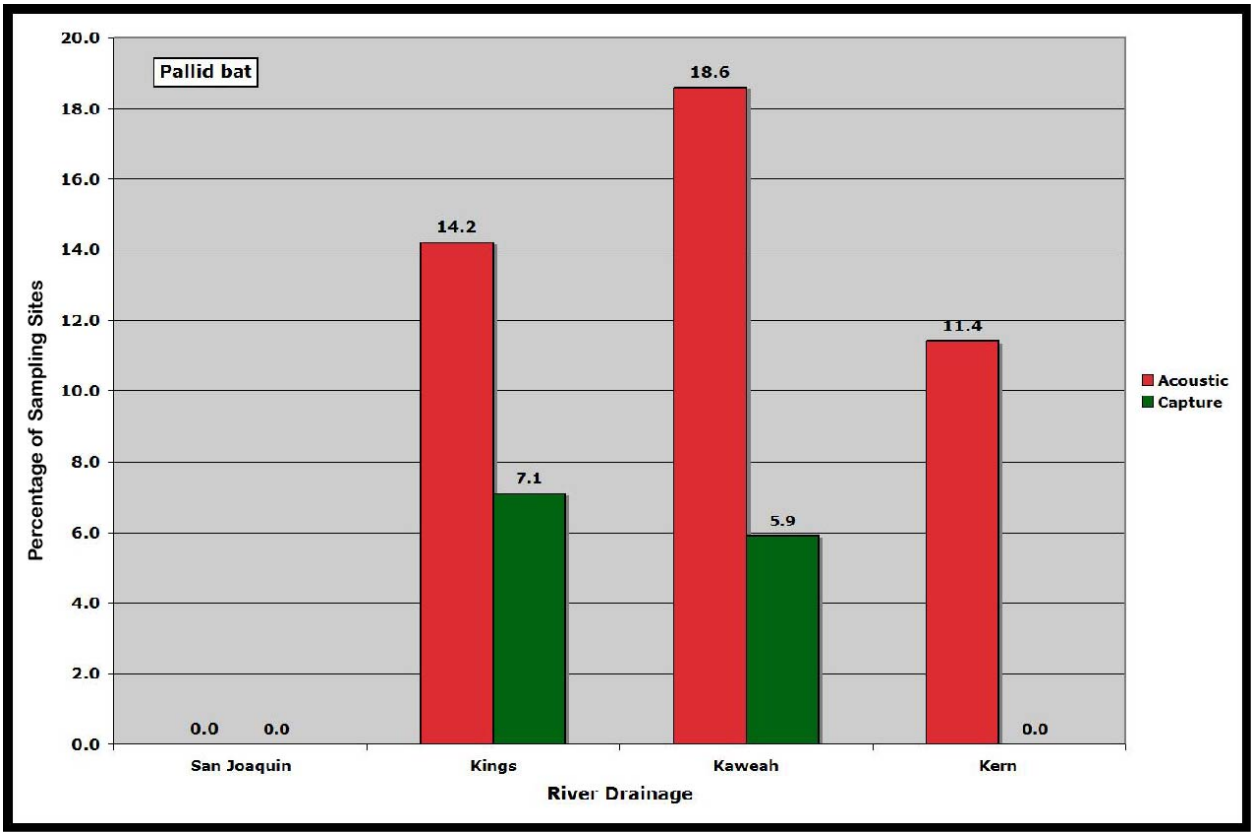


Figure 1.5. A bar graph comparing capture and acoustic records by river drainage as measured by the percentage of sampling sites at which *A. pallidus* was detected.

Of the 21 *A. pallidus* we captured in this and earlier studies, only four were females (three lactating females in Cedar Grove, and one post-lactating female in Giant Forest) (Table 1.3). Seventeen (81%) were adult males. This strongly suggests that lactation and raising of young occur only at the lowest elevations within the parks, indicating that Cedar Grove and the Ash Mountain areas are both critical for this species in these parks.

1.3. Habitat Associations

Vegetative Communities

Throughout its geographic range *A. pallidus* occurs in a number of habitats ranging from rocky arid deserts to grasslands into mid-elevation coniferous forests. Within Sequoia and Kings Canyon, this species is most associated with oak habitat (both low elevation blue oak woodland and mid-elevation black oak), mixed deciduous forest (particularly ponderosa pine dominated stands), and giant sequoia groves (see also Pierson and Heady 1996).

Roosting

This species is quite versatile in its choice of roosting sites, and has been documented using tree hollows (both oak and ponderosa pine), rock crevices, caves, abandoned mines, and other anthropogenic structures such as buildings and bridges (Barbour and Davis 1969, Hermanson and O'Shea 1983, Lewis 1996, Orr 1954, Pierson et al. 1996, Pierson et al. 2001, Rainey and Pierson

1996). It is gregarious, and roosts in nursery colonies of typically between 30 and several hundred individuals.

In Sequoia and Kings Canyon, roosts have been identified in fire-scarred basal hollows of giant sequoias (Pierson and Heady 1996), and in Clough Cave (Table 1.1). There is also a night roost on the porch of the Southern Sierra Research Center at Ash Mountain.

Foraging

A. pallidus generally forages low over the ground in relatively open areas: over the grass in blue oak woodland (*e.g.*, near Sycamore Creek and Ash Mountain), manzanita scrub (*e.g.*, at Knapp's Cabin, Kern Hot Springs), over meadows (*e.g.*, Kern Ranger Station), vegetated rock outcrops (*e.g.*, rock bench near Huckleberry Meadow), the open understory of a giant sequoia grove or a ponderosa parkland, and in chaparral (*e.g.*, Shepherd's Saddle) (Figure 1.6).

It feeds primarily on large, ground-dwelling prey − flightless arthropods such as scorpions, Jerusalem crickets, cicadas, wolf spiders and centipedes. Large cerambycid beetles, particularly *Prionus californicus*, and ten-lined June beetles (*Polyphylla decemlineata*) are also major prey items (Johnston and Fenton 2001, Orr 1954, Pierson et al. 2004).

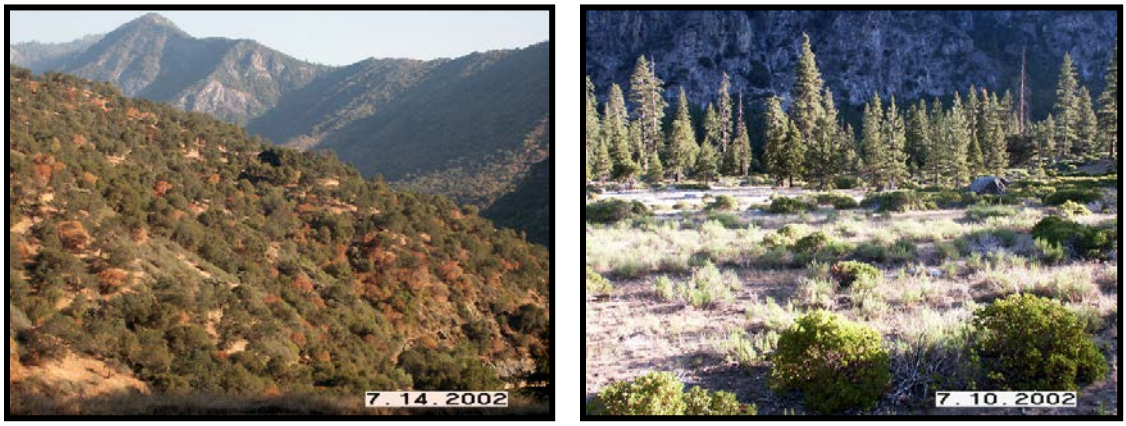


Figure 1.6. Typical foraging habitat for *A. pallidus*: blue oak and California buckeye woodland near Ash Mountain and manzanita scrub/ponderosa parkland in Cedar Grove, sites where the largest number of detections per night were obtained.

Despite very small sample size, an analysis of our netting data using a univariate model indicates that elevation is the strongest indicator for the capture of foraging *A. pallidus* (Table 1.5, Figure 1.7).

Table 1.5. Univariate Model Selection

	df	AIC
Meadow_Scrub	4	48.29001
Forest	2	45.42432
Elev_m	2	43.32500
Water	7	51.85537
Rock	4	47.33351

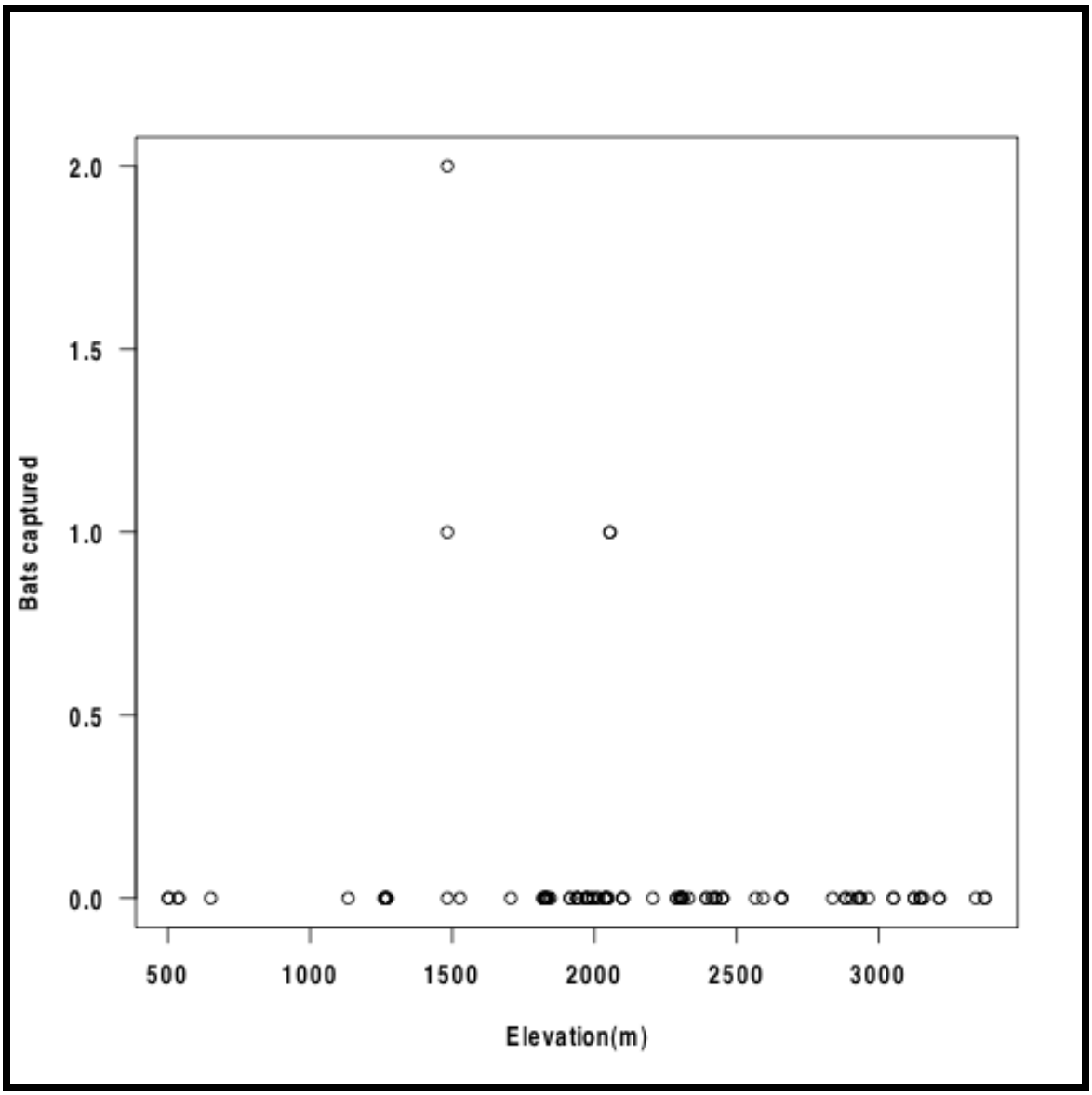


Figure 1.7. Graph showing the relationship between the presence of *A. pallidus* and elevation.

An analysis of the distribution of acoustic detections among four habitat classes showed no significant differences among them (Table 1.6). This analysis did not, however, consider the number of detections per site.

Table 1.6. Chi-square test for differences among foraging habitat classes for *A. pallidus.*

	Forest	**Mdw/Scrub**	**Rock**	**Water**
Observed	8	16	17	11
Expected	11	15	12	13

X^2 (1, N = 52) = 0.35101466 p>.05

1.4. Management Issues

Status. *A. pallidus* is considered a Sensitive Species by the U.S. Forest Service, a Mammal Species of Special Concern by California Department of Fish and Game, and a High Priority species by the Western Bat Working Group. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in the main report narrative), we note that within Sequoia and Kings Canyon the population size for this species appears to be small, and its elevation range restricted. It appears to occur, however, in all the habitats found within that elevation range.

Roosts. Although we have relatively little information on roosting behavior for this species within Sequoia and Kings Canyon, data from elsewhere document a species that uses a variety of roost sites. While it is likely that use of natural roosts predominates in the parks, this species should be considered whenever alterations are proposed to any potential roost sites. This would include, but not be limited to, closures of abandoned mines, alteration of rock/cliff areas (*e.g.*, blasting for road construction or repair), hazard tree removal, bridge construction or repair, and removal of or major modifications of buildings. While this species can also use caves, and there are records from Clough Cave, there is no indication that current recreational use of caves within the parks threatens this species. Clough Cave, however, should remain closed for the sake of this and other species.

Foraging. This species generally forages close to ground in fairly open habitat (*e.g.*, blue oak savannah, dry meadows, manzanita scrub). Any activities that would alter the prey base in these habitats (*e.g.*, trampling of meadows by stock) should trigger consideration of this species.

Fire. Prescribed burns are not likely to pose problems. Crown fires would be expected to destroy some tree roosting habitat in the short-term, and generate tree roosting habitat and enriched foraging habitat in the longer-term.

Climate Change. Given a heavy bias towards males in our net captures, and data from elsewhere, it is likely that reproductive females are found only at the lowest elevations within the parks. We expect that the reproductive range of this species would expand upward in elevation with climate change, making more of the protected park areas available to reproductive females and their young. Also, in many parts of its range this species appears to prefer xeric habitats, and thus may adapt better than other species to drier conditions anticipated with climate change.

2. *Corynorhinus townsendii*, Townsend's Big-eared Bat

2.1. Identification



Figure 2.1. Photograph of *C. townsendii*, showing large ears and distinctive horseshoe shaped rostrum, and a photograph showing a maternity cluster in a mine. (Credit: William E. Rainey)

2.2. Distribution

Geographic Range

C. townsendii is distributed across much of the western North America, from British Columbia south along the Pacific coast to central Mexico and east into the Great Plains, with isolated populations of different subspecies occurring in the southern and southeastern United States.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for *C. townsendii* are mapped in Figure 2.2, and detailed in Tables 2.1-2.3. All records are from Sequoia National Park and the Kaweah drainage. There are two museum records, one from Clough Cave and one, in the Sequoia collection, that was found in a truck that had traveled between Ash Mountain and Crescent Meadow, making the origin of this species unknown (Table 2.1). There are 23 records for this species in the WODB, 20 of them from Clough Cave, representing important repeated observations by T. Jeffrey, the ranger at South Fork Campground, between 1986 and 1990. These records span the spring, summer and fall, and include two January 1986 records of hibernating animals (W. Rainey and E. Pierson) (Table 2.2.). There is also an important record from 1949 for Soldier's Cave. We had captured an adult male of this species at Clough Cave in June of 1987, and visited a cave which contained a large guano deposit for this species, and where a cluster of animals had been observed by park staff in the spring (Table 2.3).

The focus of this inventory was on capture and acoustic surveys in foraging areas, and did not include an inventory of roost sites. Specifically, it did not include a survey of caves. *C. townsendii* is

known to be a cave specialist. It is also an animal that is very adept at avoiding capture in mist-nets, and due to a "whispering", low intensity echolocation call is difficult to detect acoustically. The survey method that is recognized as most appropriate for this species is roost surveys. Thus, the survey methods employed in this inventory, which were the most appropriate for the other 16 species, did overlook *C. townsendii*. We did obtain one capture record of an adult male on the Middle Fork of the Kaweah below Bearpaw Meadow (Table 2.3), but consider our efforts in this inventory inadequate for assessing the status of this species in any of the parks.

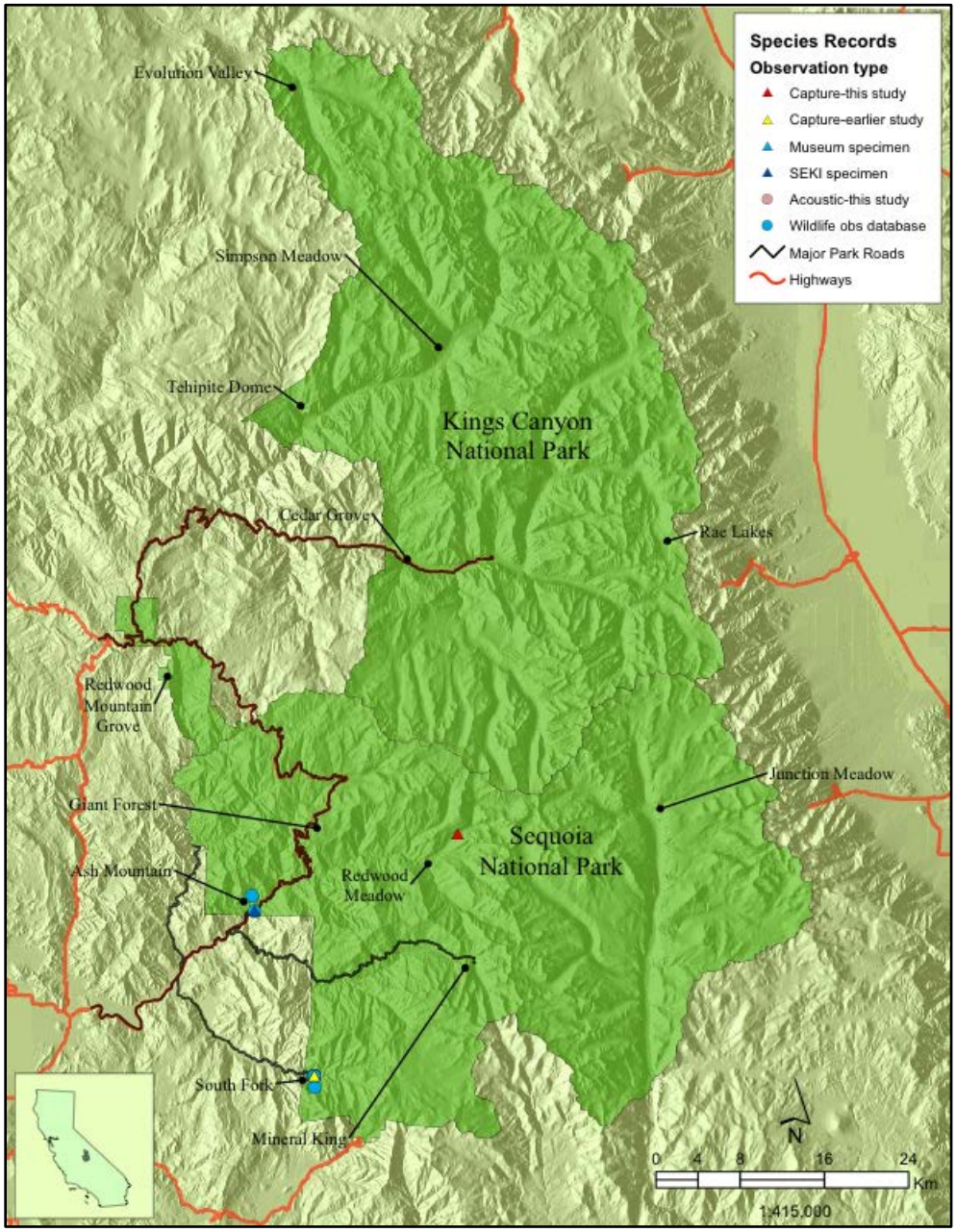


Figure 2.2. Map showing known distribution of *C. townsendii* (Townsend's big-eared bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 2.1. Museum records for *C. townsendii* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector	NOTES
SQNP	MFK Kaweah	Ash Mt/ Cresecent Mdw	36.48985	-118.82811	509	21-Oct-88	M/A	SEKI-8315	47533	Esperanza, A.	Found during day in truck at Crescent Mdw; truck originated in Ash Mt. (most likely place bat got into truck)
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	M/?	CSUN-476		NA	

Table 2.2. Records for *C. townsendii* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
SQNP	SFK Kaweah	Soldiers Cave	36.34093	-118.76065	1490	1-Dec-49	49285	SuptMonthRpt.
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	24-Jan-86	43571	Pierson,E
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	27-Jan-86	43572	Rainey,W
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	12-May-87	44323	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	1-Jun-87	44324	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	8-Jun-87	44325	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave[a]	36.35023	-118.76151	1141	9-Jun-87	44326	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	10-Jun-87	44327	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	6-Jul-87	44328	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	8-Sep-87	44329	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	14-Sep-87	44330	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	21-Sep-87	44331	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	12-Jun-88	46430	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	14-Jul-88	46458	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	13-Sep-88	46522	Jeffrey,T
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	18-Sep-88	46523	Jeffrey,T
SQNP	SFK Kaweah	Fry's Pt/NNE AM	36.50261	-118.83124	967	5-Oct-88	45642	Peachey,W
SQNP	MFK Kaweah	Ash Mt/Crescent Mdw[b]	36.48985	-118.82811	509	21-Oct-88	47533	Esperanza, A.
SQNP	SFK Kaweah	CloughCave	36.35023	-118.76151	1141	14-May-89	46789	Jeffrey,T
SQNP	SFK Kaweah	CloughCave	36.35023	-118.76151	1141	28-May-89	46805	Jeffrey,T
SQNP	SFK Kaweah	S.F.Campground	36.34992	-118.76331	1114	9-Jun-89	46804	Jeffrey,T
SQNP	SFK Kaweah	CloughCave	36.35023	-118.76151	1141	16-Jul-89	46829	Jeffrey,T
SQNP	SFK Kaweah	CloughCave	36.35023	-118.76151	1141	3-Sep-90	49714	Jeffrey,T

[a] Also reported as Pierson and Rainey capture record (Table 2.3)

[b] Also in SEKI museum Collection, SEKI-8315 (Table 2.1)

Table 2.3. Capture records for *C. townsendii* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
SQNP	MFK Kaweah	River blw Bearpaw, Pool #3	36.55901	-118.61414	1938	30-Aug-06						1				1
						TOTALS	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**
EARLIER STUDIES																
SQNP	MFK Kaweah	Walk Softly Cave[a]	NA	NA	510	Jun-91									X	
SQNP	SFK Kaweah	Clough Cave[b]	36.35023	-118.76151	1141	9-Jun-87						1				1
						TOTALS	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**

[a] Guano only; cluster observed April 1991 by J. Despain

[b] Also appears as RECNUM 44326 in WODB

2.3. Habitat Associations

Vegetative Communities

This species is likely concentrated at lower elevations, in blue oak and mixed deciduous forest habitats.

Roosting

C. townsendii is an obligate cavity roosting bat, forming maternity clusters of up to several hundred animals on an open surface. Most of the known roost sites for this species in California are in caves or mines (Barbour and Davis 1969, Humphrey and Kunz 1976, Kunz and Martin 1982, Pierson et al. 1999), although it will also roost in cave-like spaces in anthropogenic structures such as tunnels, bridge cavities, or attics in old or abandoned buildings (Pearson et al. 1952, Fellers and Pierson 2002). A maternity roost has also been identified in a large basal hollow of a coast redwood (Mazurek 2004).

Foraging

Radio-tracking studies of this species in California have documented it foraging in native oak and ironwood forest (Brown et al. 1994), in riparian vegetation along stream courses (Fellers and Pierson 2002), and in oak-dominated gulleys (Pierson et al. 2002). This species is thought to feed primarily on moths.

2.4. Management Issues

Status. *C. townsendii* is considered a Mammal Species of Special Concern by California Department of Fish and Game, a Sensitive Species by the U.S. Forest Service, and a High Priority species by the Western Bat Working Group. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we ranked it as constantly sparse, restricted in its range, and as having specific habitat requirements.

Roosts. This species has been documented roosting in several caves in both the South Fork and Ash Mountain areas. Given its almost obligate cavity-dwelling habits, any management activities regarding caves should give prime consideration to this species. Because unlike many species that seek shelter in crevices, this species roosts on open surfaces where it is extremely vulnerable, and consequently very sensitive to disturbance (Figure 2.2). This species may also hibernate in mines or caves in the parks, and thus would be a species at high risk for white-nose syndrome, should this condition that is devastating bats in the eastern United States reach California.

Foraging. This species is a moth specialist, and should be considered for any management activities that would alter its prey base.

Fire. Prescribed burns are not likely to cause problems for the foraging range of this species. Smoke could impact air quality in caves. A buffer zone is recommended around cave entrances.

Climate Change. This species is known to move up in elevation to hibernate in the White and Inyo Mountains (Szewczak et al. 1998). They are also the only species known to form relatively large hibernating aggregations in California. Because a warming climate would be expected to reduce

suitable hibernating sites, we consider this species at relatively high risk of adverse impacts from climate change.

3. *Eptesicus fuscus*, Big Brown Bat

3.1. Identification

Eptesicus fuscus is a relatively large bat (forearm of 42-51 mm), with glossy deep brown fur and a blunt tragus (which distinguishes it from all *Myotis* species), broad wings, and a keeled calcar (Barbour and Davis 1969) (Figure 3.1). It typically echolocates at ca. 25 kHz, and whereas some of its calls are distinctive, many are not distinguishable from other 25 kHz species (most typically, *Lasionycteris noctivagans* and *Tadarida brasiliensis*).



Figure 3.1. Photograph of *E. fuscus*, showing blunt tragus. (Credit: William E. Rainey).

3.2. Distribution

Geographic Range

E. fuscus, is one of the most widely distributed species in the Western Hemisphere, occurring from western South America to northern Canada, and throughout the United States (Hall 1981). It is found in almost all habitats in California, from sea level to high elevation (Barbour and Davis 1969), although maternity colonies may be concentrated at lower elevations (Pierson et al. 2001).

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for *E. fuscus* are mapped in Figure 3.2, and detailed in Tables 3.1-3.3.

There are numerous prior records for this species in both Sequoia and Kings Canyon (Appendices I, II, and III, Tables 3.1-3.3), including records from all four river drainages. The majority are attributable to three prior survey efforts: those of J. Dixon in the first half of the 20th century (some of this work reported in Grinnell et al. 1930); surveys by J. Petterson in the 1980s, and several surveys by J. Koshear between 1993 and 1995. Some of the most interesting are the high elevation records of J. Dixon for Colby Meadow and J. Petterson for the Chagoopa Plateau. Also important are the multiple records for this species collected by J. Koshear for Redwood Meadow and Junction Meadow in the Kern. Although there were no prior records for Devils Postpile NM, this can best be explained by absence of sampling.

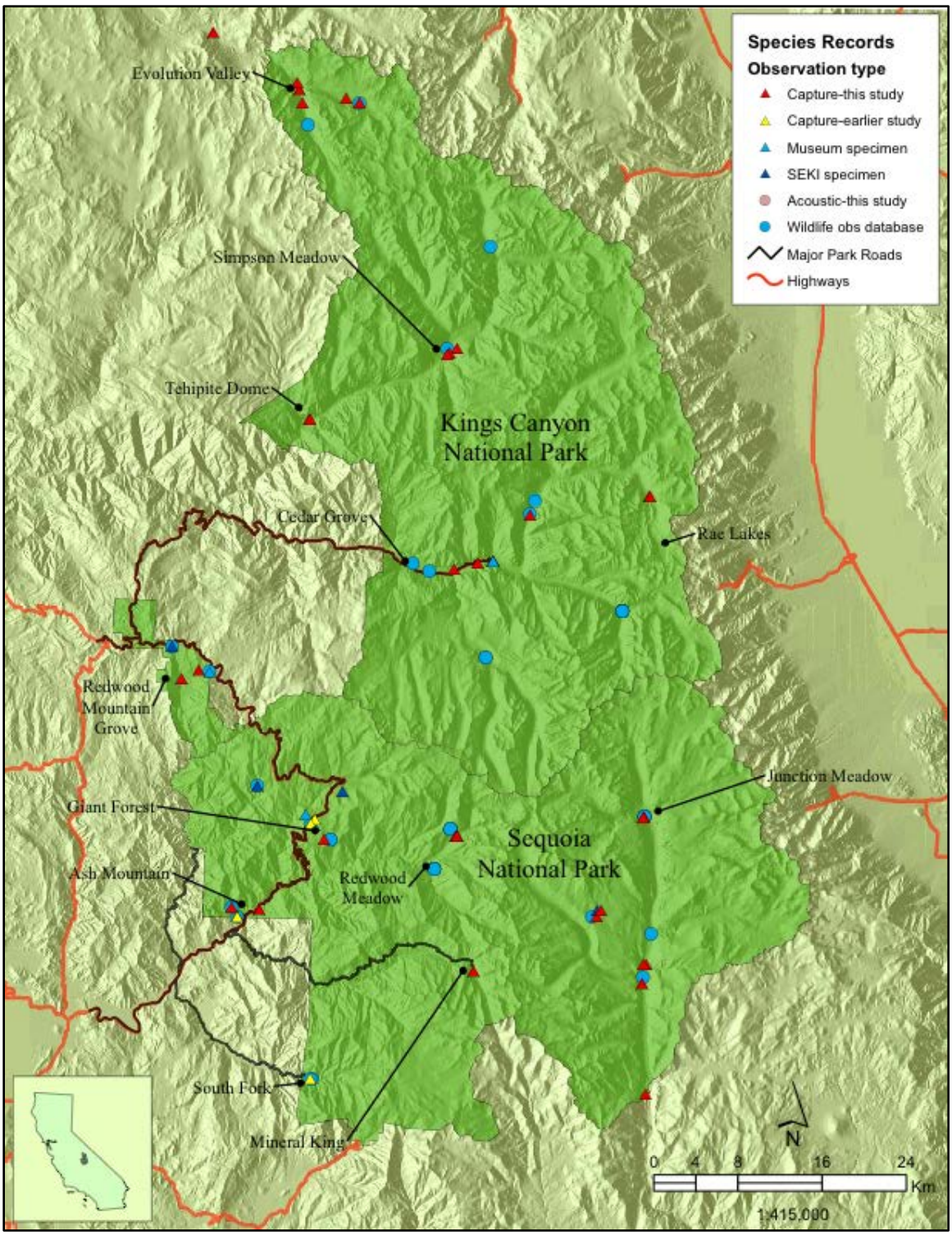


Figure 3.2. Map showing records for *E. fuscus* (big brown bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 3.1. Museum records for *E. fuscus* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector	NOTES
KCNP	NFK Kaweah	Redwood Mt. Grove, N end Redwood Ck	36.71683	-118.91942	1951	29-Jun-88	M/A	SEKI-8309	45194	Petterson, J.	
SQNP	Marble Kaweah	Wolverton	36.59538	-118.73516	2210	30-Jul-67	M/A	SEKI-3504	NA	Basey, H.E.	Road kill
SQNP	Marble Kaweah	Cascade Ck, below Crystal Cave	36.59912	-118.82575	1386	18-Aug-88	M/A	SEKI-8307	45288	Petterson, J.	
SQNP	MFK Kaweah	Sycamore Spring	36.48770	-118.84446	510	12-Jun-88	M/A	SEKI-8353	NA	Petterson, J.	
SQNP	Kern	Chagoopa Plateau, Cr. W of Chagoopa Ck	36.49841	-118.46229	3157	14-Jul-88	M/A	SEKI-8312	NA	Petterson, J.	
KCNP	NFK Kaweah	Big Baldy Ridge	36.69586	-118.87857	2302	16-Aug-51	U	MVZ-114836	42280	Brown, J.L.	
KCNP	Kings	Kings River Canyon, 5,000 ft., Kanawyers Site	36.79445	-118.57897	1541	10-Sep-16	M/A	MVZ-24818		Dixon, J.S.	
KCNP	Kings	Kings River Canyon, 5,000 ft., Kanawyers Site	36.79445	-118.57897	1541	16-Sep-16	M/A	MVZ-24819		Dixon, J.S.	
KCNP	Kings	Kings River Canyon, 5,000 ft., Kanawyers Site	36.79445	-118.57897	1541	13-Sep-16	M/A	MVZ-24820		White, H.G.	
KCNP	Kings	Kings River Canyon, 5,000 ft., Kanawyers Site	36.79445	-118.57897	1541	11-Sep-16	M/A	MVZ-24821		Swarth, H.S.	Map in his field notes
SQNP	Marble Kaweah	Paradise Camp	36.57524	-118.77367	1956	1-Sep-56	M/A	SBMNH-VB56-73		von Bloeker, J.	
SQNP	Marble Kaweah	Giant Forest Highland	36.56669	-118.76453	1979	6-Aug-56	M/A	SBMNH-VB56-1		von Bloeker, J.	
Outside		Mt Whitney, Mirror or Lower Boy Scout Lake?	36.57095	-118.26293	3354	19-Jul-15	M/U	MCZ-11751			
Outside		Hume	36.78726	-118.91261	1588	19-Aug-16	M/U	MVZ-24814			

Table 3.1. Museum records for *E. fuscus* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument (continued).

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector	NOTES
Outside		Hume	36.78726	-118.91261	1588	21-Aug-16	F/U	MVZ-24815			
Outside		Hume	36.78726	-118.91261	1588	21-Aug-16	M/U	MVZ-24816			
Outside		Hume	36.78726	-118.91261	1588	19-Aug-16	M/U	MVZ-24817			
Outside		Hume	36.78726	-118.91261	1588	22-Aug-16	F/U	MVZ-25331			
Outside		San Joaquin River, 12 mi WNW Mammoth PO	37.70748	-119.12547	2574	22-Aug-40	M/U	MVZ-107940			
Outside		Whitaker's Forest, 10 mi NE Badger	36.63924	-118.93899	1438	28-Jun-38	M/U	MVZ-84260			
Outside		Whitney Meadow	36.43413	-118.26710	2964	9-Aug-11	M/U	MVZ-16350			

Table 3.2. Records for *E. fuscus* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
KCNP	San Joaquin	Goddard	37.16439	-118.78476	2733	24-Jul-42	42278	Dixon,J.
KCNP	San Joaquin	Colby Mdw, Evolution Creek	37.18326	-118.73025	2960	25-Jul-42	42279	Dixon,J.
KCNP	MFK Kings	Grouse Meadow	37.06229	-118.58720	2512	22-Jul-94	59559	KoshearJ
KCNP	MFK Kings	Simpson Meadow	36.97549	-118.63169	1808	23-Jul-94	59560	KoshearJ
KCNP	SFK Kings	Kings River Canyon	36.78467	-118.64676	1454	13-Aug-42	42276	Dixon,J.
KCNP	SFK Kings	Cedar Grove, Hotel Creek Trail	36.79117	-118.66451	1429	23-May-80	44195	Norris,L.
KCNP	SFK Kings	Paradise Valley, Kings R	36.84655	-118.53516	2012	28-Jul-81	42282	Easterla,D.
KCNP	SFK Kings	Junction Meadow	36.75345	-118.44036	2498	10-Aug-88	47450	WarnerJ
KCNP	SFK Kings	Roaring River Tr. (nr. Scaffold Mdw?)	36.71249	-118.58487	2257	30-Jun-89	47844	PettersonJ
KCNP	SFK Kings	Roaring River Tr. (nr. Scaffold Mdw?)	36.71249	-118.58487	2257	2-Jul-89	47864	PettersonJ
KCNP	SFK Kings	JunctionMdwBubbs	36.75345	-118.44036	2498	24-Aug-93	60039	KoshearJ
KCNP	SFK Kings	JunctionMdwBubbs	36.75345	-118.44036	2498	24-Aug-93	60041	KoshearJ
KCNP	SFK Kings	JunctionMdwBubbs	36.75345	-118.44036	2498	24-Aug-93	60043	KoshearJ
KCNP	SFK Kings	JunctionMdwBubbs	36.75345	-118.44036	2498	24-Aug-93	60045	KoshearJ
KCNP	SFK Kings	JunctionMdwBubbs	36.75345	-118.44036	2498	24-Aug-93	60047	KoshearJ
KCNP	SFK Kings	Lower Paradise Valley	36.83484	-118.54026	2011	18-Jul-94	59557	KoshearJ
KCNP	NFK Kaweah	Big Baldy Ridge[a]	36.69586	-118.87857	2302	16-Apr-51	42280	Brown, J.L.
KCNP	NFK Kaweah	Redwood Mt. Grove, N end Redwood Ck[b]	36.71683	-118.91942	1951	29-Jun-88	45194	Petterson, J.
SQNP	Marble Kaweah	Cascade Ck, below Crystal Cave[c]	36.59912	-118.82575	1386	18-Aug-88	45288	Petterson, J.
SQNP	Marble Kaweah	Giant Forest, Round Meadow	36.56766	-118.76749	1950	6-Jul-33	42277	Dixon,J.
SQNP	Marble Kaweah	Crescent Meadow	36.55452	-118.74678	2043	26-Jul-94	59563	KoshearJ
SQNP	Marble Kaweah	Crescent Meadow	36.55452	-118.74678	2043	24-Jul-95	59624	KoshearJ
SQNP	MFK Kaweah	Sycamore Creek, Ash Mountain[d]	36.48770	-118.84446	510	13-Jul-95	53104	Pierson, E.
SQNP	MFK Kaweah	Sycamore Spring	36.49556	-118.85039	651	12-Jun-88	45189	Petterson,J.
SQNP	MFK Kaweah	Bearpaw RS	36.56561	-118.61980	2367	25-Jul-95	59625	KoshearJ
SQNP	MFK Kaweah	Bearpaw RS	36.56561	-118.61980	2367	27-Jul-95	59626	KoshearJ
SQNP	MFK Kaweah	Redwood Meadow	36.53111	-118.63590	1837	28-Jul-95	59627	KoshearJ
SQNP	MFK Kaweah	Redwood Meadow	36.53111	-118.63590	1837	28-Jul-95	59629	KoshearJ
SQNP	MFK Kaweah	Redwood Meadow	36.53111	-118.63590	1837	28-Jul-95	59632	KoshearJ

Table 3.2. Records for *E. fuscus* in Park Wildlife Observation Database (WODB), not supported by specimens (continued).

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
SQNP	MFK Kaweah	RedwoodMeadow	36.53111	-118.63590	1837	28-Jul-95	59636	KoshearJ
SQNP	MFK Kaweah	Bearpaw RS	36.56561	-118.61980	2367	6-Jul-96	53877	KoshearJ
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	20-Apr-66	42281	Grater,R.
SQNP	SFK Kaweah	Across River, Campground[e]	36.35061	-118.76373	1115	27-Jul-88	46467	Jeffrey, T.
SQNP	Kern	Kern Hot Springs	36.47832	-118.40494	2099	17-Aug-93	60028	KoshearJ
SQNP	Kern	Chagoopa Plateau	36.49220	-118.46810	3116	18-Aug-93	60027	KoshearJ
SQNP	Kern	Big Arroyo/KernRvr	36.44137	-118.41301	2034	20-Aug-93	60029	KoshearJ
SQNP	Kern	JunctionMdw/Kern	36.57871	-118.41390	2456	21-Aug-93	60031	KoshearJ
SQNP	Kern	JunctionMdw/Kern	36.57871	-118.41390	2456	21-Aug-93	60033	KoshearJ
SQNP	Kern	JunctionMdw/Kern	36.57871	-118.41390	2456	21-Aug-93	60035	KoshearJ
SQNP	Kern	JunctionMdw/Kern	36.57871	-118.41390	2456	21-Aug-93	60037	KoshearJ

[a] MVZ Museum Specimen 114836 (Table 3.1)

[b] SEKI Museum Specimen 8309 (Table 3.1)

[c] SEKI Museum Specimen 8307 (Table 3.1)

[d] Pierson and Rainey capture records (Table 3.3)

[e] Pierson and Rainey capture records (Table 3.3)

Table 3.3. Capture records for *E. fuscus* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
DEPO	MFK San Joaquin	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	24-Aug-01			6			20		1		27
DEPO	MFK San Joaquin	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	28-Jul-04			6	1		7	1	1	1	17
DEPO	MFK San Joaquin	Kings Ck, abv. river confluence	37.59951	-119.09087	2205	29-Jul-04			4			2				6
DEPO	MFK San Joaquin	River, blw Muir Trail Xing	37.61297	-119.08223	2288	29-Jul-04			4	1		1	1			7
KCNP	SFK San Joaquin	Blayney Meadows (outside park)	37.24126	-118.88847	2331	29-Jul-05						5				5
KCNP	SFK San Joaquin	Goddard-Evolution Junction	37.19381	-118.79461	2594	30-Jul-05						3				3
KCNP	SFK San Joaquin	Franklin Meadow	37.18255	-118.79134	2657	31-Jul-05			2			11				13
KCNP	SFK San Joaquin	Colby Meadow	37.18339	-118.73023	2963	1-Aug-05			1	1		5				7
KCNP	SFK San Joaquin	McClure Meadow	37.18724	-118.74464	2933	2-Aug-05						1				1
KCNP	SFK San Joaquin	1 Km blw. Goddard Junction	37.19930	-118.79703	2566	3-Aug-05						1				1
KCNP	MFK Kings	Tehipite, Side Channel #1	36.91227	-118.77769	1265	21-Jul-06					1	3				4
KCNP	MFK Kings	Tehipite, Side Channel #2	36.91243	-118.77670	1270	22-Jul-06						1				1
KCNP	MFK Kings	Simpson Mdw, Side Pool	36.97580	-118.62123	1830	27-Jul-06									1	1
KCNP	MFK Kings	Simpson Mdw, Deep Pool	36.97109	-118.62931	1831	28-Jul-06		1	1			9			1	12
KCNP	MFK Kings	Simpson Mdw, Horsehoe Creek	36.96994	-118.63170	1824	29-Jul-06						1				1
KCNP	SFK Kings	Cedar Grove, River @ Zumwalt	36.79312	-118.59533	1527	10-Jul-02				1		2				3

Table 3.3. Capture records for *E. fuscus* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument (continued).

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
KCNP	SFK Kings	Cedar Grove, River Side Channel	36.78673	-118.62043	1483	11-Jul-02			1	1		22				24
KCNP	SFK Kings	Lower Paradise Valley	36.83484	-118.54026	2011	19-Jul-04						6				6
KCNP	SFK Kings	Baxter Meadow, wet	36.85190	-118.41382	2882	21-Jul-04		1				1				2
KCNP	SFK Kings	Baxter Meadow, near camp	36.85191	-118.41282	2902	22-Jul-04						1				1
KCNP	NF Kaweah	Redwood Creek, Low Trail Xing	36.68922	-118.90831	1706	1-Jul-05	1					4				5
KCNP	NF Kaweah	East FK Redwood Ck, Trail Xing	36.69677	-118.89008	1914	2-Jul-05					1	6				7
SQNP	Marble Kaweah	Huckleberry Ck, blw Crescent Mdw	36.55432	-118.75354	2054	31-Jul-02						1				1
SQNP	EFK Kaweah	River abv Mineral King	36.44421	-118.59245	2393	2-Aug-02			2			1				3
SQNP	MFK Kaweah	River abv Ash Mountain	36.49378	-118.82102	502	14-Jul-02							1			1
SQNP	MFK Kaweah	Sycamore Ck abv road	36.49556	-118.85039	651	28-Jun-05						2				2
SQNP	MFK Kaweah	River blw Bearpaw, Pool #3	36.55901	-118.61414	1938	30-Aug-06						3				3
SQNP	MFK Kaweah	River blw Bearpaw, Pool #6	36.55938	-118.61206	1940	31-Aug-06			4			5				9
SQNP	MFK Kaweah	River blw Bearpaw, Pool #5	36.55899	-118.61271	1940	1-Sep-06			5			9				14
SQNP	Kern	Junction Meadow, Creek	36.57841	-118.41402	2450	27-Aug-04			1			1				2
SQNP	Kern	Junction Meadow, River	36.57804	-118.41533	2450	28-Aug-04			2			3	2	1	1	9
SQNP	Kern	Upper Funston Mdw @ River	36.45207	-118.40990	2040	30-Aug-04			1							1

Table 3.3. Capture records for *E. fuscus* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument (continued).

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
SQNP	Kern	Upper Funston Mdw, Side Channel	36.45295	-118.41235	2045	31-Aug-04				1		9				10
SQNP	Kern	Tarn, E Upper Trail Jct, Chagoopa	36.49267	-118.46293	3156	24-Aug-05						1				1
SQNP	Kern	Tarn, E Treehouse Mdw	36.49799	-118.45844	3146	25-Aug-05									1	1
SQNP	Kern	Kern, 1 Km blw Big Arroyo Br	36.43590	-118.41373	2037	26-Aug-05						7				7
SQNP	Kern	Coyote Creek, Kern RS	36.34200	-118.40837	1973	27-Aug-05						1				1
						Totals	**1**	**2**	**40**	**6**	**2**	**155**	**5**	**3**	**5**	**219**
EARLIER STUDIES																
SQNP	Marble Kaweah	Giant Forest, General's Highway	36.57152	-118.76386	2034	27-Jul-95				1		2				3
SQNP	Marble Kaweah	Giant Forest, Round Meadow	36.56737	-118.76840	1950	11-Sep-95						1				1
SQNP	MFK Kaweah	Sycamore Creek, Ash Mountain[a]	36.48770	-118.84446	510	13-Jul-95						23				23
SQNP	SFK Kaweah	Across River, Campground[b]	36.35061	-118.76373	1115	27-Jul-88						2				2
						Totals	**0**	**0**	**0**	**1**	**0**	**28**	**0**	**0**	**0**	**29**

[a] SEKI WODB RECNUM 53104 (Table 3.2)

[b] SEKI WODB RECNUM 46467 (Table 3.2)

E. fuscus accounted for one third of all net captures in this study, and was the species most frequently encountered in net captures in both Devils Postpile and Kings Canyon, and the second most commonly encountered species in Sequoia National Park. It was very widely distributed, being found from the lowest elevation sites (e.g., ca. 500 m in the vicinity of Ash Mountain) to some of the highest (e.g., 3,156 m on the Chagoopa Plateau). Figure 3.3 compares the relative abundance of this species in the three parks as percentage of total net captures and percentage of sampling sites at which it was detected. Figure 3.4 provides a similar comparison for the four river drainages.

Of the 248 individuals we captured in this and earlier studies, 183 (74%) were adult males, 8 (3%) were juveniles, 40 (16%) were post-lactating females, 8 (3%) were adult non-reproductively active females, and 3 (1%) were reproductively active females – a pregnant female captured in the Redwood Mountain Grove, and single lactating females captured at Simpson Meadow and Baxter Meadow (Table 3.3). A strong bias towards post-lactating females, both here and in Yosemite National Park, suggest that this species raises its young primarily at lower elevations, perhaps predominantly outside the boundaries of Sierra Nevada national parks. Nevertheless, we note with interest, but cannot explain, the record of a lactating female at Baxter Meadow, one of our higher elevation sampling sites.

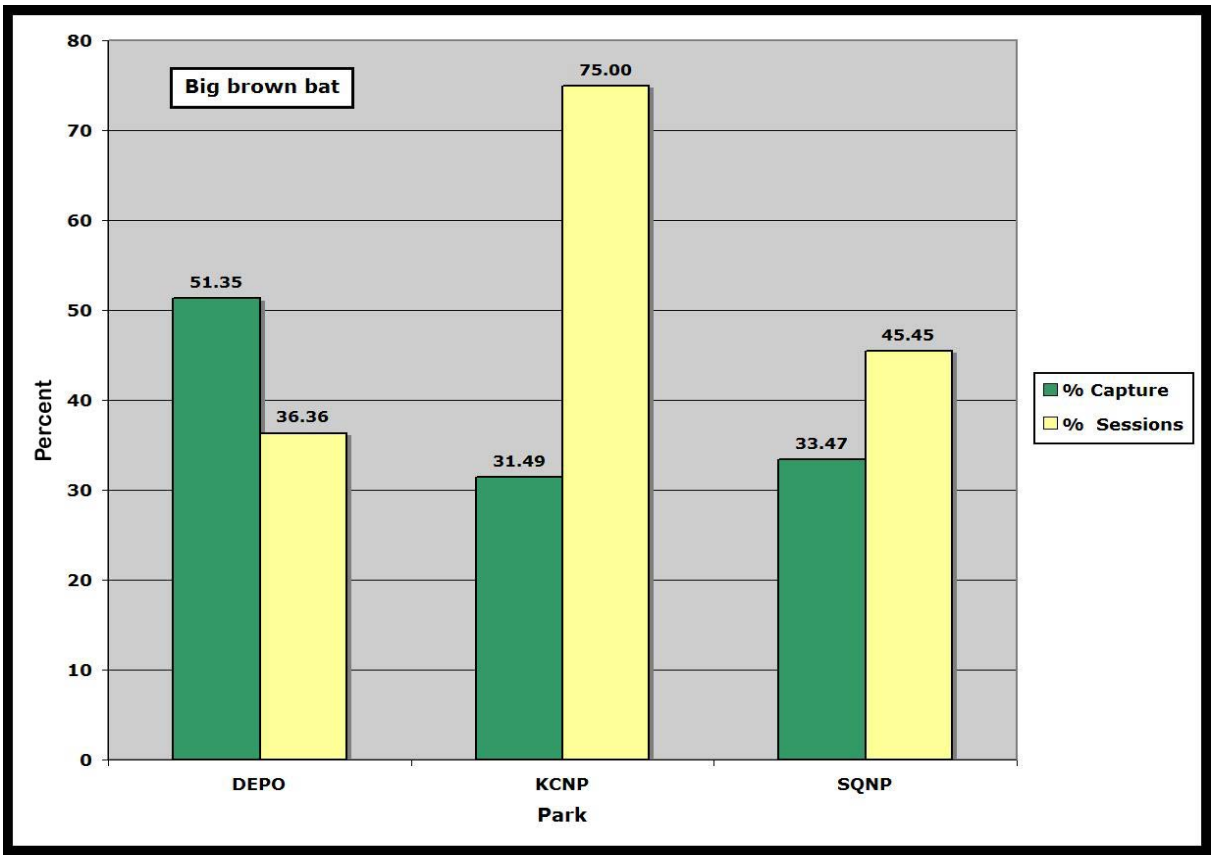


Figure 3.3. A bar graph showing capture records by park as the percentage of total captures and percentage of sampling sessions in which *E. fuscus* were detected.

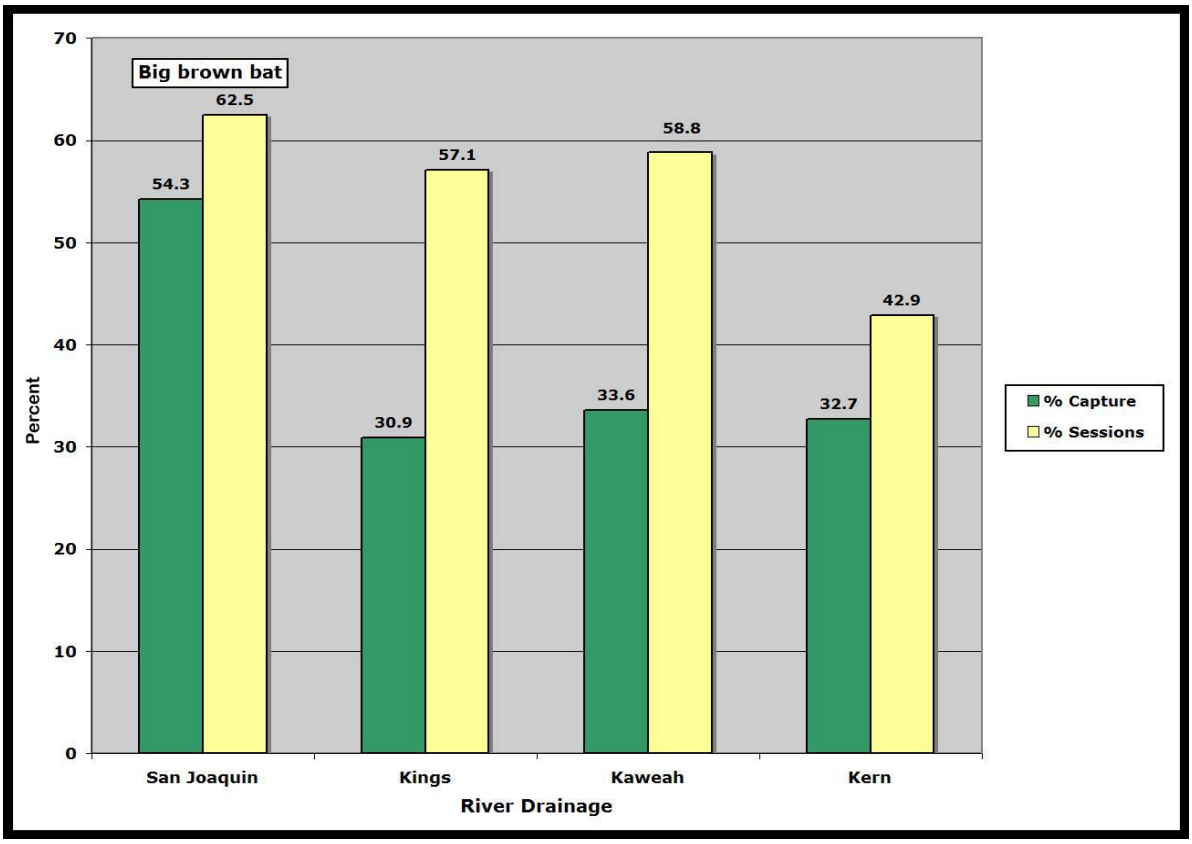


Figure 3.4. A bar graph showing capture records by river drainage as a percentage of total captures and a percentage of sampling sessions in which *E. fuscus* were detected.

3.3. Habitat Associations

Vegetative Communities

E. fuscus was found in all the vegetative communities from the low elevation sites at Ash Mountain to relatively high elevation lodgepole habitat (*e.g.*, Chagoopa Plateau and Evolution Basin). It was most abundant at low and mid-elevation.

Roosting

E. fuscus is primarily a crevice roosting species. Common diurnal roost sites are trees (particularly snags), old buildings, bridges, rock crevices, caves, and mines (Barbour and Davis 1969, Brigham 1991, Kurta and Baker 1990). Big brown bats are colonial, with a typical colony containing 25-75 adults, although colonies up to 700 have been found (Kurta and Baker 1990). Radio-tracking efforts in Giant Forest and the Mariposa Grove in Yosemite National Park documented this species roosting in bark crevices of giant sequoias, under loose bark in dead sugar pine, ponderosa pine, and to a lesser extent, white fir (Pierson and Heady 1996, Pierson et al. 2006). One individual also used several rock crevice roosts in a southwest facing rock wall (Pierson et al. 2006).

Foraging

Big brown bats are foraging habitat generalists, feeding aerially over both water and land, in forested and edge situations. They often emerge early (prior to dark) and can be seen foraging very high (up

to 50 m above the ground), descending later in the evening to 10-15 m (Whitaker et al. 1977). In some habitats they feed predominantly on beetles (Coleoptera), including important agricultural pests (Whitaker 1995). In other localities they may feed primarily on aquatic insects, such as caddisflies (Trichoptera) (Brigham 1991, Verts et al. 1999), and have been known to consume a variety of other insect groups (*e.g.*, Hemiptera, Hymenoptera, Diptera, Plecoptera, a few Lepidoptera). In northern California, radio-tracking and netting data suggest individuals follow watercourses to forage, often flying above canopy level, and not traveling more than a few kilometers from their roosts. They feed over both open river corridors and in much more cluttered settings beneath the riparian canopy of small streams (Rainey and Pierson 1996, E.D. Pierson and W.E. Rainey unpubl. data).

An analysis of our netting data using a univariate model indicates that water is by far the strongest indicator for the capture of foraging *E. fuscus* (Table 3.4).

Table 3.4 Univariate Model Selection.

	df	**AIC**
Meadow_Scrub	4	733.6087
Forest	2	715.1693
Elev_m	2	763.9476
Water	7	513.4144
Rock	4	700.4223

An analysis of captures at water sites shows that we captured more *E. fuscus* at creeks than at non-water sites, and were more likely to capture *E. fuscus* at flooded meadows and ponds than at creeks (Table 3.5, Figure 3.5).

Table 3.5. Terms of the model for water categories.

Coefficients:	**Estimate**	**Std. Error**	**Z Value**	**Pr(>|z|)**
Creek(Intercept)	1.0144	0.1048	9.676	< 2e-16 ***
Flooded Meadow	0.6439	0.2421	2.660	0.00782**
Lake	-16.3169	736.5568	-0.022	0.98233
Marsh	-1.7075	1.0055	-1.698	0.08947
Not Water	-3.-1185	0.4593	-6.789	1.13e-11 ***
Pond	1.4280	0.1809	7.893	2.94e-15 ***
River	0.2204	0.1708	1.290	0.19691

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Null deviance: 640.89 on 102 degrees of freedom

Residual deviance: 378.94 on 96 degrees of freedom

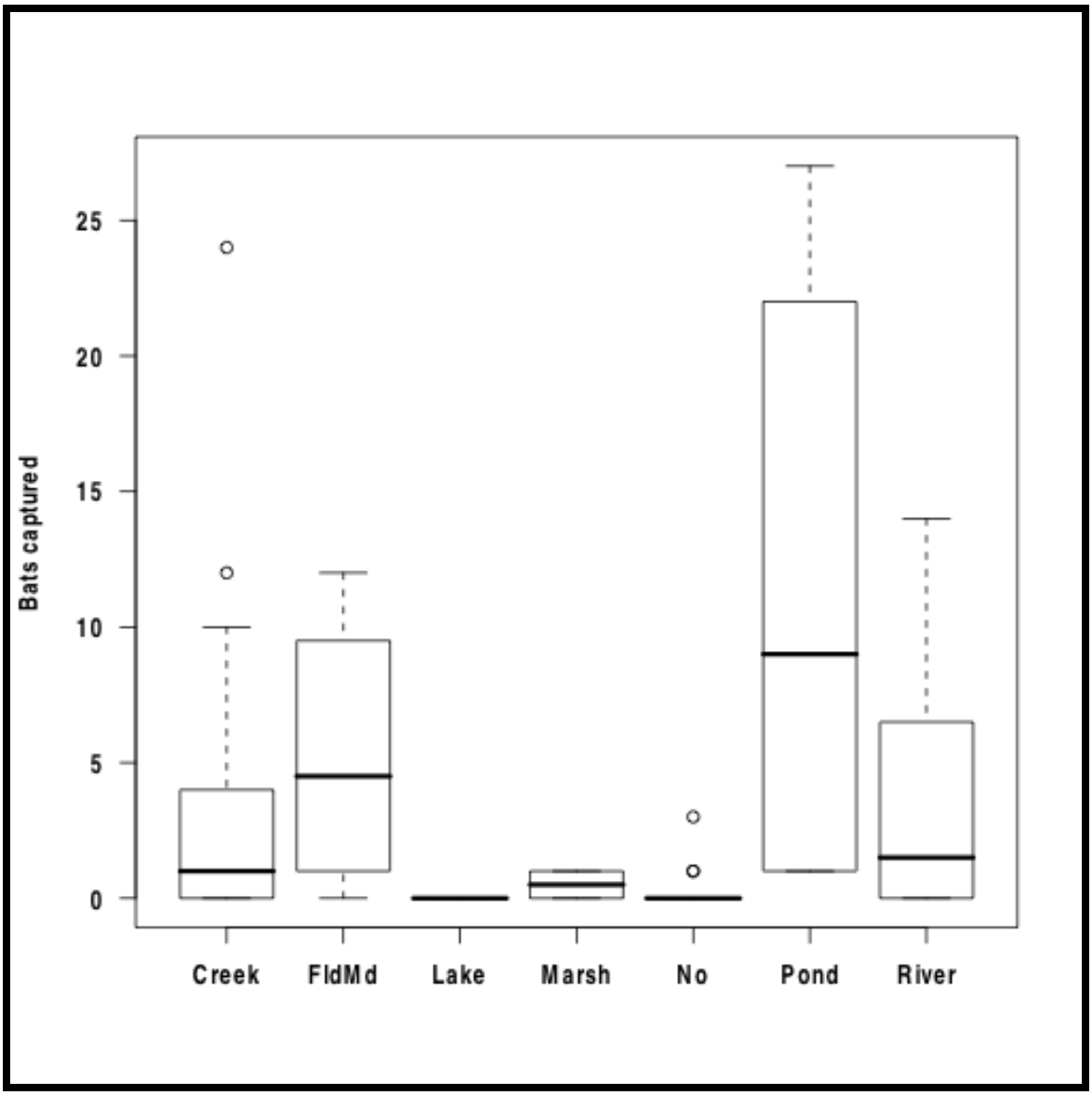


Figure 3.5. Graph showing the quartiles (with median values in bold) for number of *E. fuscus* captured at six types of water sites, and sites that were not at water.

3.4. Management Issues

Status. *E. fuscus* has no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we ranked them as "Common" based on their relative abundance and ubiquitous presence in our surveys.

Roosts. Although we have relatively little information on roosting behavior for this species within Sequoia-Kings Canyon, data from elsewhere documents a species that uses a variety of roost sites. While it is likely that use of natural roosts predominates in the parks, this species should be considered whenever alterations are proposed to any potential roost sites. This would include, but not be limited to, closures of abandoned mines, alteration of rock/cliff areas (*e.g.*, blasting for road

construction or repair), hazard tree removal, bridge construction or repair, and removal of or major modifications of buildings. Radio-tracking studies in Giant Forest (Pierson and Heady 1996) and Yosemite's Mariposa Grove (Pierson et al. 2006), suggest that the predominant roosts used by this species are live giant sequoia trees and conifer snags (cavities and bark crevices) and rock crevices.

Foraging. This species forages in a number of habitats, and was captured during this study at a variety of both land and water sites. Although it is thought to be primarily a beetle specialist, diet analysis along an altitude gradient in Yosemite showed that it switched to foraging primarily on moths at higher elevations. This species is so versatile that management activities would not be expected to have adverse impacts on this species' ability to forage successfully.

Fire. Prescribed burns are not likely to pose problems. Crown fires would be expected to destroy some tree roosting habitat in the short-term, and generate tree roosting habitat and enriched foraging habitat in the longer-term.

Climate Change. It is striking that in the three parks considered in this inventory, and in Yosemite National Park, the majority of big brown bats captured are males or non-reproductive females. While one lactating female was captured at high elevation (Baxter Meadow) in Kings Canyon, we expect based on data collected in this study and other studies throughout northern and central California, that this species raises its young predominantly at low elevations (e.g., Central Valley and foothills). It is likely that with warming climates, the reproductive range of this species will expand up in elevation, and the parks will become more critical for maternity colonies.

4. *Euderma maculatum*, Spotted Bat

4.1. Identification

This is a highly distinctive species morphologically (Figure 4.1). It is a relatively large bat (forearm of 48-51 mm), with very striking coloration. Its dorsal fur is black, with three large white spots, one on the rump and one on each shoulder. Its ears are pink, and larger than those of any other North American bat species (Barbour and Davis 1969). If captured alive or found as an intact specimen, it could not be mistaken for any other species.

It is also distinctive acoustically (Figure 4.2). Its echolocation call, with a characteristic frequency of 5-7 kHz, is generally audible, and distinguishable from the other audible species in the Sierra Nevada (*Eumops perotis*) by the more rapid cadence (shorter inter-pulse intervals) of its calls. In addition to its search phase echolocation call, it often emits a social call ("trill") that appears to be used to claim foraging territory from alert conspecifics (personal observation).



Figure 4.1. Photograph of spotted bat, showing white spots, and long, pink ears. (Credit: William E. Rainey)

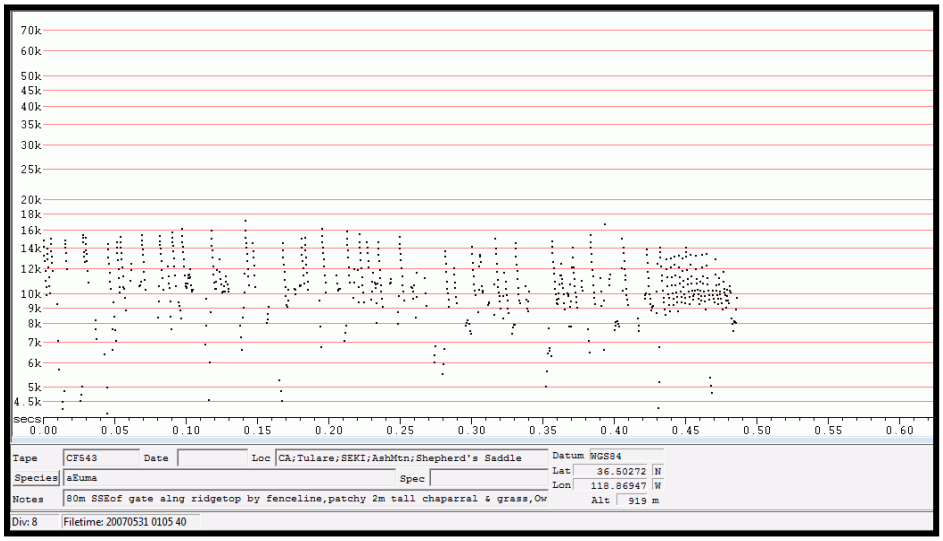


Figure 4.2. Echolocation call of spotted bat, Shepherd's Saddle, Sequoia National Park, 31 May 2007.

4.2. Distribution

Geographic Range

This species is distributed throughout much of the western U.S., with its range extending as far north as southern British Columbia, and as far south as Durango, Mexico. The widely used distribution map from Hall (1981) does not reflect more recent range extensions. There are now records for western Colorado, Oregon, and the Klamath Mountains of northwest California. We have reviewed its distribution in California (Pierson and Rainey 1998c). Within this overall range, the species' distribution appears to be patchy and geomorphically determined, limited to areas with appropriate roosting habitat (Pierson and Rainey 1998c).

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for the spotted bat are detailed in Table 4.1-4.4 and mapped in Figure 4.3.

Table 4.1. Museum records for *E. maculatum* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/ Age	MUS ID	REC NUM	Collector
KCNP	Marble Kaweah	Wilsonia	36.73472	-118.95474	2017	20-Jun-75	U/U	CAS-16721	52113	Stocking, S.

Table 4.2. Records for *E. maculatum* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
KCNP	Marble Kaweah	Wilsonia[a]	36.73472	-118.95474	2017	20-Jun-83	52113	Stocking, S.
KCNP	MFK Kings	Grouse Meadow	37.06317	-118.58889	2511	22-Jul-94	59558	Koshear, J.
KCNP	MFK Kings	Simpson Meadow	36.97285	-118.63183	1808	23-Jul-94	59561	Koshear, J.
SQNP	Marble Kaweah	Crescent Meadow	36.55730	-118.74696	2044	26-Jul-94	59562	Koshear, J.

[a] Also entered as CAS museum specimen #16721 (Table 4.1)

Table 4.3. Capture records for *E. maculatum* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
EARLIER STUDIES							Preg	Lact	Plac	Null	Par	Male	Female	Male		
SQNP	Marble Kaweah	Giant Forest, Sunset Rock	36.57524	-118.77367	1953	13-Sep-95			1							1
						TOTALS	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

Table 4.4. Acoustic records for *E. maculatum* obtained in this study. "X" = Present, files not counted.

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	Ranger Station	Cottonwood, nr. Pkg,	37.63028	-119.08516	2280	23-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	28-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	28-Jul-04	X
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	25-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Deep pool, floodplain-net site	36.97580	-118.62123	1819	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail #2	36.97344	-118.62930	1830	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Whitethorn, PIJE, downslope trail	36.97161	-118.62993	1827	29-Jul-06	X
KCNP	SFK Kings	Cedar Grove	Cliff base @ Zumwalt Mdw Pkg	36.79421	-118.59793	1540	9-Jul-02	3
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 1	36.78374	-118.63663	1469	9-Jul-02	13
KCNP	SFK Kings	Cedar Grove	Service Rd, betw Knapp & Cedar Grv	36.78274	-118.64697	1461	9-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Burn by rd between bridges, E of CG	36.78456	-118.62061	1486	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 1	36.78374	-118.63663	1469	10-Jul-02	1

Table 4.4. Acoustic records for *E. maculatum* obtained in this study. "X" = Present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	SFK Kings	Cedar Grove	Pool in side channel, near E end River Rd	36.78679	-118.62020	1481	10-Jul-02	20
KCNP	SFK Kings	Cedar Grove	Talus at E end of River Rd	36.78809	-118.61687	1494	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, S edge	36.79098	-118.59503	1516	10-Jul-02	5
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, talus slope	36.79048	-118.59558	1534	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,N edge	36.79237	-118.59704	1539	10-Jul-02	4
KCNP	SFK Kings	Baxter Meadow	Upper marshy pond	36.85190	-118.41382	2882	21-Jul-04	X
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	1-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	1-Jul-05	9
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	2-Jul-05	12
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	3-Jul-05	27
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 10 m fr river, upstrm net	36.44412	-118.59223	2414	2-Aug-02	2
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 50 m upslope fr net site	36.44463	-118.59184	2412	2-Aug-02	2
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 500 m upstrm Pack Sta, net	36.44421	-118.59245	2413	2-Aug-02	X
SQNP	EFK Kaweah	Mineral King	Abv Ranger Station	36.45348	-118.60994	2325	3-Aug-02	3
SQNP	EFK Kaweah	Mineral King	Aspen Flat Cottonwoods	36.44018	-118.59047	2401	3-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Empire Mill site, 75 m fr road	36.45450	-118.59910	2399	3-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Farewell Gap trail, upslope fr net site	36.44389	-118.59134	2402	3-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Faculty Flat Rocks	36.45794	-118.62525	2256	5-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Highbridge Ck Rocks	36.46036	-118.63172	2234	5-Aug-02	23

Table 4.4. Acoustic records for *E. maculatum* obtained in this study. "X" = Present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Marble Kaweah	Giant Forest	Crescent Mdw	36.55364	-118.74691	2044	30-Jul-02	9
SQNP	Marble Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	30-Jul-02	2
SQNP	Marble Kaweah	Giant Forest	Hazelwood meadow	36.56343	-118.76624	2039	30-Jul-02	15
SQNP	Marble Kaweah	Giant Forest	Hazelwood trees	36.56419	-118.76451	2034	30-Jul-02	15
SQNP	Marble Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-02	-118
SQNP	Marble Kaweah	Giant Forest	Moro Rock, first rest area, 1/2 to top	36.54554	-118.76456	2003	30-Jul-02	14
SQNP	Marble Kaweah	Giant Forest	Round Mdw mdw	36.56901	-118.76663	2000	30-Jul-02	30
SQNP	Marble Kaweah	Giant Forest	Round Mdw tree	36.56973	-118.76777	2043	30-Jul-02	3
SQNP	Marble Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Pila snag	36.55230	-118.75900	2060	31-Jul-02	1
SQNP	Marble Kaweah	Giant Forest	Huckleberry Rock, bare rock below Rd	36.55355	-118.75900	2059	31-Jul-02	5
SQNP	Marble Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	31-Jul-02	58
SQNP	Marble Kaweah	Giant Forest	Net abv rd, Huckelberry Mdw Tr Xng	36.55459	-118.75301	2054	31-Jul-02	2
SQNP	Marble Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	29-Jul-02	1
SQNP	Marble Kaweah	Lodgepole	Wet mdw nr. Wolverton Ck	36.59604	-118.73688	2211	29-Jul-02	15
SQNP	Marble Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	30-Jul-02	1
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Redwood Meadow	36.53188	-118.63554	1839	1-Sep-06	X
SQNP	Kern	Junction Meadow, Kern River	On log in PIJE grove	36.57897	-118.41311	2461	27-Aug-04	XX

Table 4.4. Acoustic records for *E. maculatum* obtained in this study. "X" = Present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Kern	Junction Meadow, Kern River	Up trail from Junction Mdw	36.58146	-118.41344	2490	27-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	On another log in PIJE grove	36.57910	-118.41303	2457	28-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Up trail from Junction Mdw	36.58146	-118.41344	2490	28-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Base of talus	36.47763	-118.40243	2129	29-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Center of meadow, on log	36.45274	-118.41297	2049	31-Aug-04	X
SQNP	Kern	Lower Funston Meadow	Base of talus	36.38268	-118.41175	1973	2-Sep-04	X
SQNP	Kern	Lower Funston Meadow	Grove of Jeffrey at base of talus	36.38388	-118.41124	1978	2-Sep-04	X
SQNP	Kern	Lower Funston Meadow	Open meadow, edge by willows	36.38206	-118.41017	1974	2-Sep-04	XX
SQNP	Kern	Kern Ranger Station	Log, upslope Ranger Station	36.34254	-118.40972	1970	3-Sep-04	X
SQNP	Kern	Kern Ranger Station	Open manzanita/Jeffrey by camp	36.34258	-118.41015	1981	3-Sep-04	X
SQNP	Kern	Kern Ranger Station	Pasture at RS	36.34251	-118.40843	1964	3-Sep-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 30 m blw trail xing	36.47600	-118.40382	2098	21-Aug-05	11
SQNP	Kern	Moraine Lake	Sky Parlor Mdw 1	36.46125	-118.44861	2796	23-Aug-05	3
SQNP	Kern	Moraine Lake	Sky Parlor Mdw 2	36.46180	-118.44830	2807	23-Aug-05	2
SQNP	Kern	Chagoopa, Upper Trail Jct	Meadow, wet area	36.49291	-118.46903	3110	24-Aug-05	4
SQNP	Kern	Kern Ranger Station	Pasture at RS	36.34251	-118.40843	1964	27-Aug-05	1
SQNP	Kern	Kern Ranger Station	Ponderosa snag	36.34833	-118.40833	1979	27-Aug-05	2
							TOTAL SAMPLING SESSIONS	67

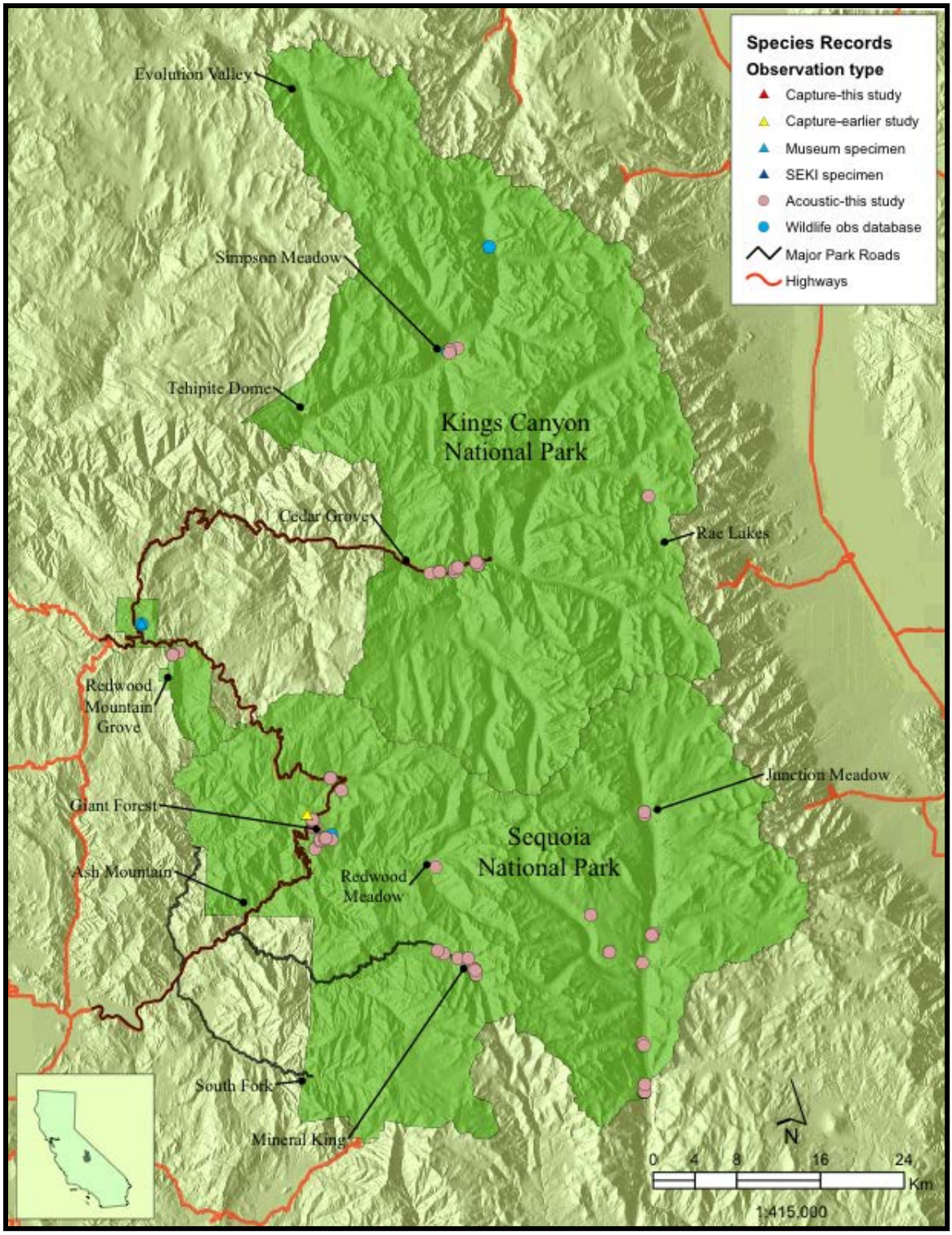


Figure 4.3. Map showing records for *E. maculatum* (spotted bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

There is one 1975 museum record (California Academy of Sciences) for a spotted bat from Wilsonia (Table 4.1, Appendix II). This record is also reported in the park database, along with acoustic records reported by J. Koshear form Grouse, Simpson and Crescent Meadows (Table 4.2, Appendix III). The first spotted bat to be captured alive in California, was a post-lactating female caught in a mist net at Sunset Rock in 1995 (Table 4.3, Appendix V).

All detections in this study were acoustic (Table 4.4, Appendix VII). Although relatively rare, spotted bats were detected in all three parks and all four river drainages. They appear at the greatest percentage of sampling sites in Sequoia National Park and the Kaweah drainage, and the fewest in Devils Postpile and the San Joaquin drainage drainage (Figures 4.4 and 4.5).

Spotted bats were widely distributed from low elevation sites (i.e., long-term detector at Shepherd's Saddle; Figure 4.3) to over 3,000 m on the Chagoopa Plateau. Given that this species was detected at multiple relatively high elevation sites we were surprised not to obtain any detections in the San Joaquin drainage within Kings Canyon (Goddard Canyon and Evolution Basin). Spotted bats were, however, detected near the San Joaquin River at Blayney Meadow, just outside park boundaries. We thus expect that, while rare, they likely occur in both Goddard Canyon and Evolution Basin, and their presence would be documented with more extensive sampling.

The greatest number of acoustic files per station occurred on the open rock bench adjacent to Huckleberry Creek on the road to Crescent Meadow. There were also multiple files per night in the manzanita flat west of Knapp's cabin in Cedar Grove, in the parking area for the Redwood Mountain Grove, in the dry creek bed of Highbridge Creek on the road to Mineral King, at several sites in Giant Forest, and multiple sites in the Kern drainage (Table 4.4). They appear at the greatest percentage of sampling sites in Sequoia National Park and the Kaweah drainage, and the fewest in Devils Postpile and the San Joaquin drainage drainage (Figures 4.4 and 4.5).

The acoustic detections obtained in this survey (Table 4.4) also provide records from multiple meadows – from dry sites like Empire Mill in Mineral King and sage habitat adjacent to Simpson Meadow to wet meadows like Zumwalt, Simpson, Lower Funston, Kern Ranger Station, and Sky Parlor. Spotted bats were detected in all giant sequoia areas (particularly meadows) that were sampled: Round, Hazelwood, Crescent Meadows in Giant Forest area, the meadow in the Redwood Meadow Grove, and in the parking area (not a meadow) for the Redwood Mountain Grove.

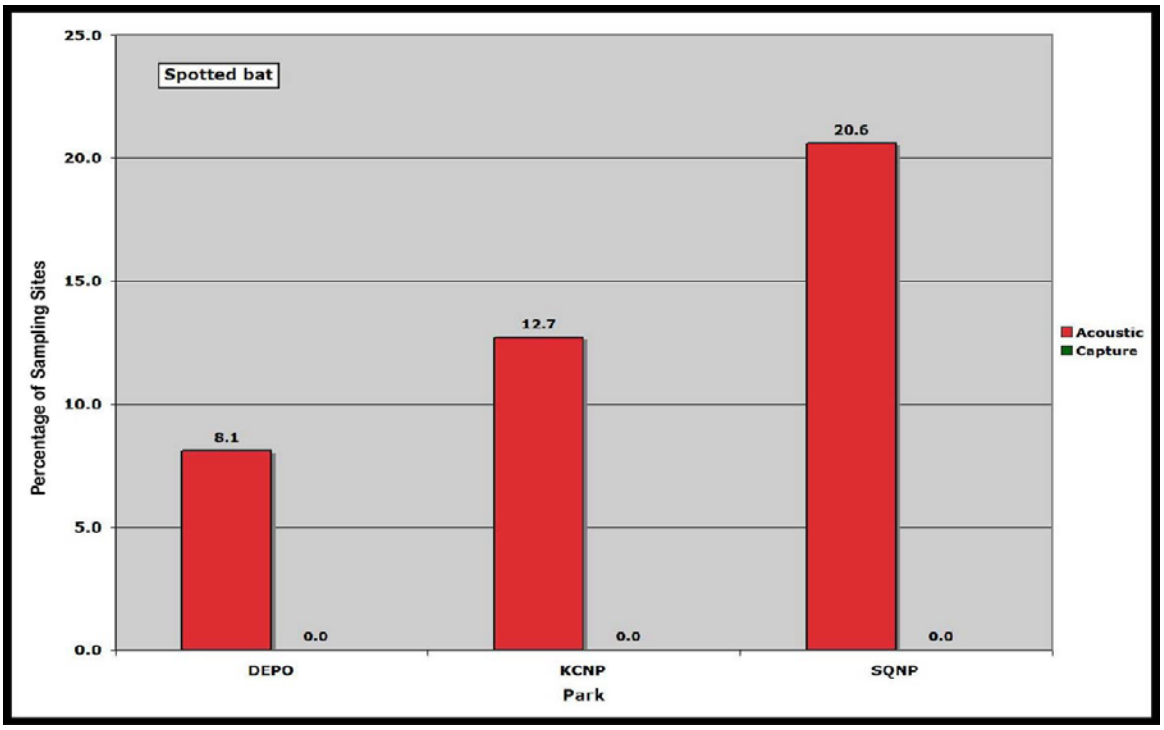


Figure 4.4. A bar graph comparing capture and acoustic records by park as measured by the percentage of sampling sites at which spotted bats were detected.

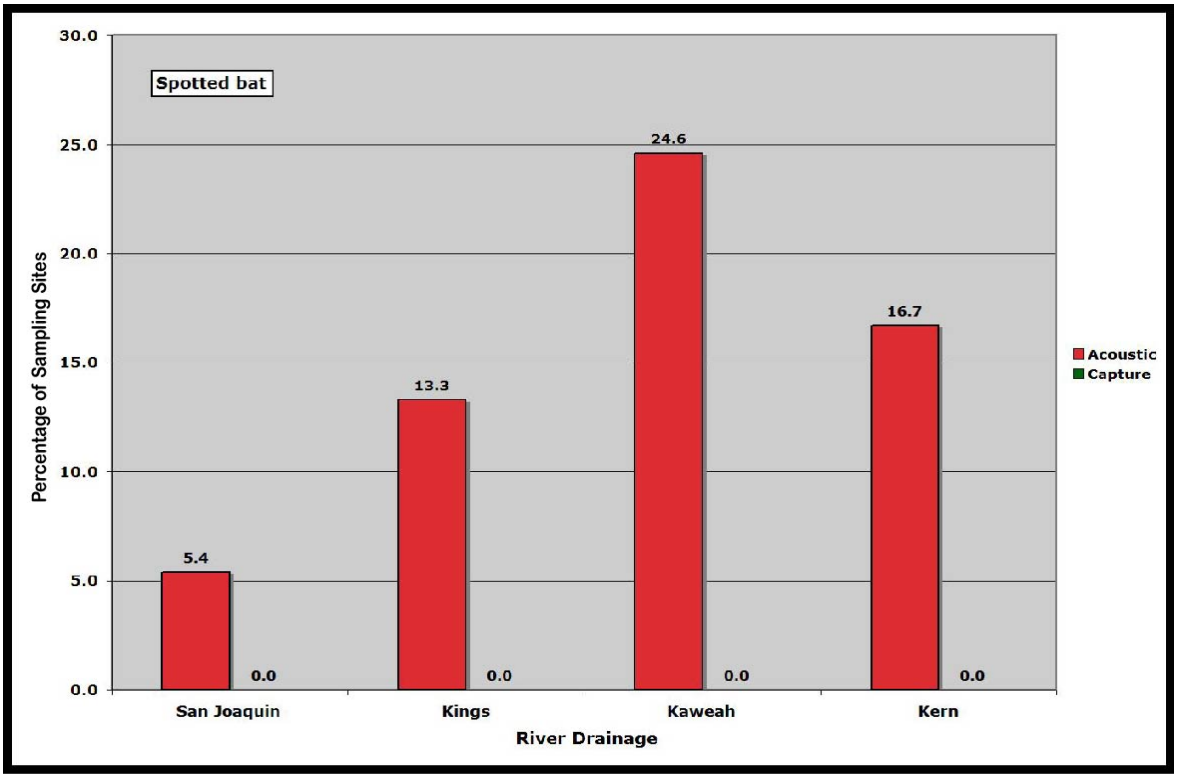


Figure 4.5. A bar graph comparing capture and acoustic records by river drainage as measured by the percentage of sampling sites at which spotted bats were detected.

4.3. Habitat Associations

Vegetative Communities

Although the majority of museum records are from low elevation, this species is now known to be widely distributed in the Sierra Nevada, with acoustic records up to >3,000 m. It has been collected most often in dry, rough desert terrain, but occurs in habitats ranging from desert scrub to montane coniferous forest. In this study it occurred in a number of habitats.

Roosting

Limited information suggests that spotted bats roost non-colonially, predominantly in crevices in high cliff faces (Wai-Ping and Fenton 1989). Surveys in the Sierra Nevada suggest that they are most abundant in areas with fractured rock (Pierson and Rainey 1996, 1998a & c).

Foraging

Spotted bats can most reliably be found foraging over wet meadows and seeps (*e.g*, Round Meadow in Giant Forest, meadow at Kern Ranger Station, seep at Hazelwood), but are also encountered in drier meadows, rock benches, and along forest edges. A Chi-square test suggests there are significant differences among foraging habitat classes, with this species less likely to be found at water, and more likely to be found in meadow/scrub habitat (Table 4.5).

Table 4.5. Chi-square test for differences among foraging habitat classes for *E. maculatum*.

	Forest	**Mdw/Scrub**	**Rock**	**Water**
Observed	17	26	17	9
Expected	13	21	16	19

X^2 (1, N = 69) = 0.051542561 p>.05

Spotted bats feed primarily on large (5-12 mm) moths (most likely noctuids). Most observations suggest spotted bats forage alone (Wai-Ping and Fenton 1989), sometimes maintaining exclusive feeding areas (Leonard and Fenton 1983), and other times using a “trapline” strategy (Woodsworth et al. 1981). Individuals generally forage 5-15 m off the ground in large elliptical paths, with axes of 200-300 m (Wai-Ping and Fenton 1989, Navo et al. 1992, Pierson and Rainey 1996). Recent radio-tracking studies in Arizona have documented this species travelling one-way distances from the roost site of up to 40 km each night (Chambers et al. 2005).

4.4. Management Issues

Status. Spotted bats are considered a Mammal Species of Special Concern by California Department of Fish and Game, and a High Priority species by the Western Bat Working Group. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in the main report narrative), we ranked this species as “constantly sparse” based on the paucity of sites at which it was detected. We ranked its range as large based on the elevational gradient over which it was found, from lowest to highest elevation. Although it does occur in a variety of forest types, as indicated by wide elevational

distribution, we have ranked its habitat as restricted based on the fact it is thought to roost only in cliffs, and it appears to forage preferentially in meadows and meadow-like areas.

Roosts. Although we have no information on roosting behavior for this species within Sequoia and Kings Canyon or Devils Postpile, data from elsewhere suggest this species roosts exclusively in cliffs. A radio-tracking study in Yosemite National Park (Pierson and Rainey 1996) suggested that spotted bats roosted in areas of fractured rock, and thus would be unlikely to be affected by recreational climbing. Given how limited the information is on roosting, however, this species should be considered for any management activity that impacts cliff habitat, including road construction and policies regarding recreational climbing. The Ministry of Environment, Lands, and Parks for the Province of Brish Columbia, Canada suggested that this species was unusually sensitive to noise (Blood 1993).

Foraging. Acoustic data collected in this inventory, plus data collected during a radio-tracking study in Yosemite Park (Pierson and Rainey 1996) suggest that this species forages preferentially over meadows (both wet and dry) and along forest edges. Any activities that would alter the prey base in meadows and other open habitats should trigger consideration of this species.

Fire. Prescribed burns are not likely to pose problems for this species.

Climate Change. It is unknown how climate change would affect this species. We expect that the reproductive range would expand upward in elevation with climate change, making more of the protected park areas available to reproductive females and their young. How it would adapt to a drier climate is unknown.

5. *Eumops perotis*, Western mastiff bat

5.1. Identification

Eumops perotis is morphologically distinctive (Figure 5.1). It is North America's largest bat, with a forearm of 72-82 mm and a wingspan of up to 570 mm. The distal half of the tail is free from the tail membrane, and its large, forward leaning ears are joined at the mid-line (Barbour and Davis 1969). It has a highly distinctive and generally audible echolocation call at ca. 8-12 kHz. It can be distinguished from the other audible species (*Euderma maculatum*) by the much longer (up to one second) inter-pulse interval (Figure 5.2).



Figure 5.1. Photograph of western mastiff bat. (Credit: William E. Rainey)

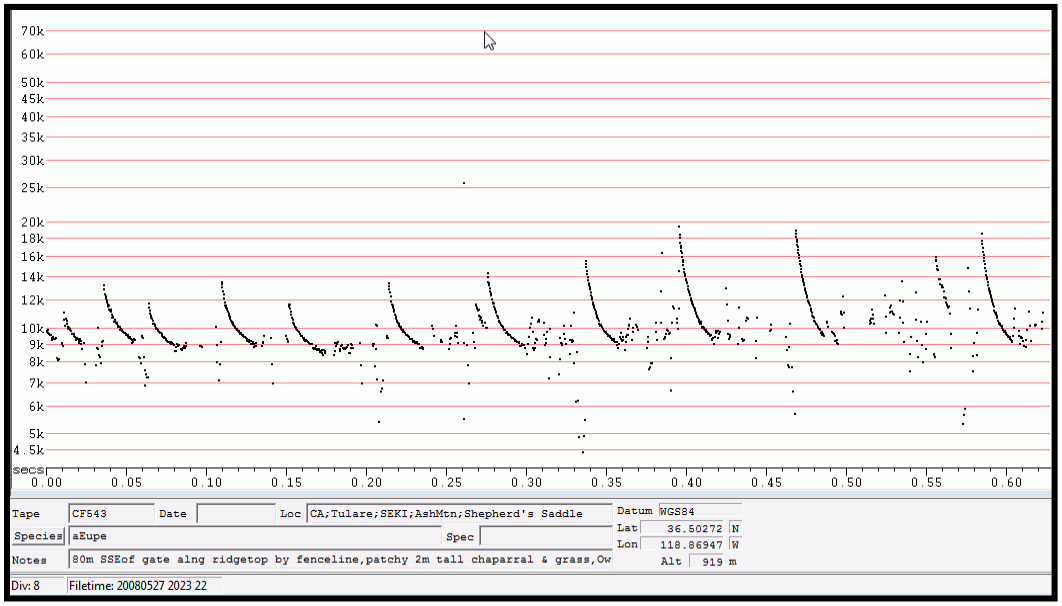


Figure 5.2. Echolocation call of western mastiff bat, Shepherd's Saddle, Sequoia National Park, May 27, 2008.

5.2. Distribution

Geographic Range

Eumops perotis has a disjunct distribution, with two subspecies confined to South America. The subspecies that occurs in North America, *E. p. californicus*, ranges from central Mexico across the southwestern United States (parts of California, southern Nevada, Arizona, southern New Mexico and western Texas) (Bradley and O'Farrell 1967, Eger 1977).

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for the western mastiff bat are mapped in Figure 5.3, and detailed in Table 5.1. There are no capture records, no museum records, and no records in the park database for this species from any of the parks. It was first detected acoustically during a survey in Giant Forest in 1995, at which time it was determined that this cliff-roosting species likely roosted on Moro Rock (Pierson and Heady 1996).

While this species is rare in many parts of the state, it is relatively abundant in the central Sierra Nevada wherever there are granite cliffs. By stationing investigators near the base of potential cliff-roosts we confirmed the presence of this species at Moro Rock, and detected them at emergence time at the cliff-face just inside the park entrance station on the Mineral King Road, and at the cliffs just east of Shepherd's Saddle.

With acoustic surveys we obtained records for this species from all the parks and all the river drainages. It was detected during 148 (36.3%) of all sampling sessions, and was distributed from the lowest elevation sites (e.g., Ash Mountain and Tehipite Valley) to some of the highest (e.g., Eagle Lake above Mineral King, Lower Rae Lake, Colby and McClure Meadows, and several sites on the Chagoopa Plateau). We detected it most frequently (during > 40 % sampling sessions) in Kings Canyon and in the Kings drainage, and the least frequently (23-24 % of sampling sites) in Devils Postpile and the San Joaquin drainage (Figures 5.4 and Figure 5.5).

It was detected in large numbers at sites in Giant Forest, presumably in association with the roost site on Moro Rock. While we also obtained large numbers of files per site at some of the Cedar Grove sites, we obtained many fewer at the bottoms of narrow canyons as in the Kern Trench or Tehipite Valley. Our observation of large numbers of animals foraging at Moraine Lake suggests that in narrow canyons, where the open meadow habitat the animals prefer for foraging is limited, the majority go up to the canyon rims to feed.

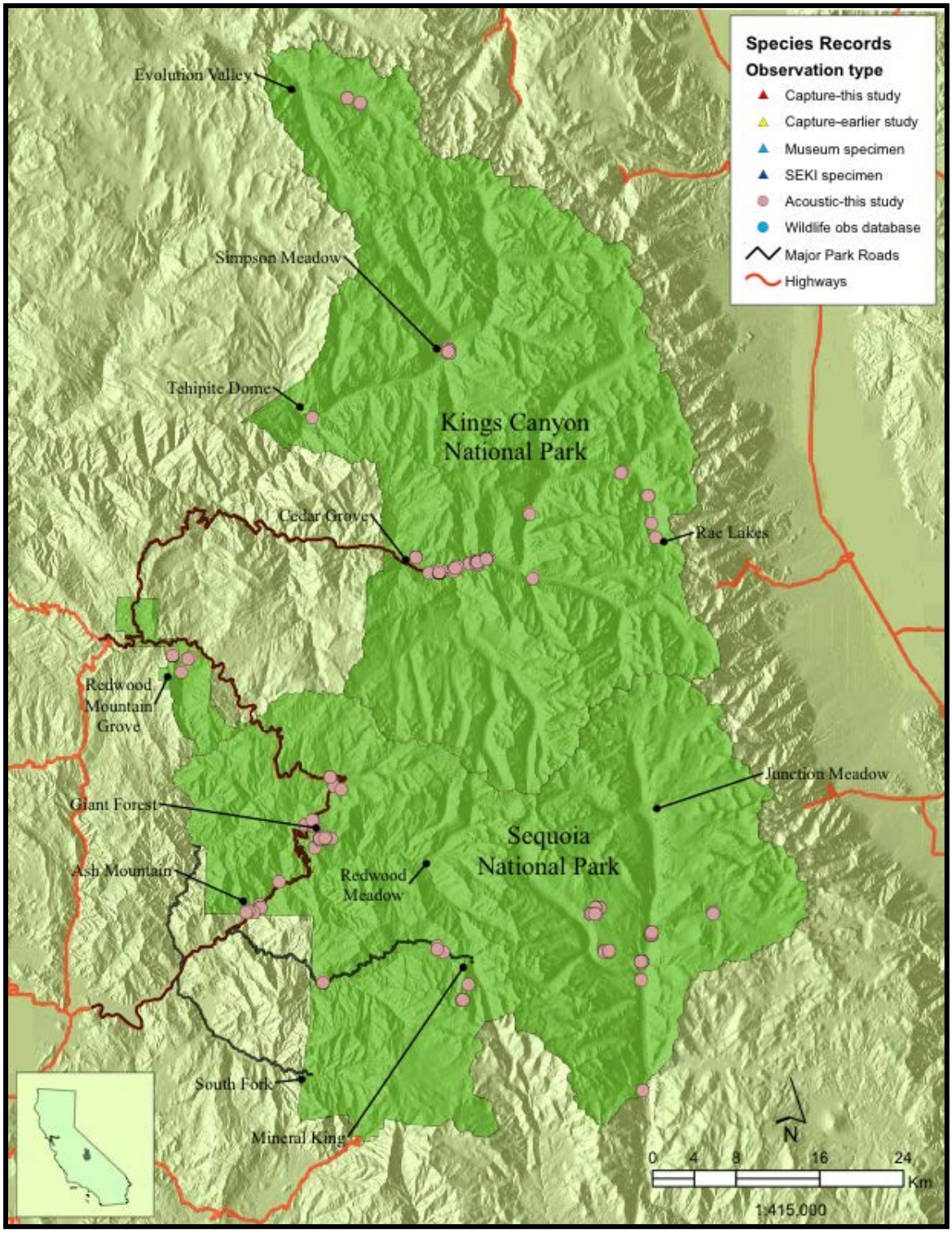


Figure 5.3. Map showing records for *Eumops perotis* (western mastiff bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 5.1. Acoustic records for *E. perotis* obtained in this study. "X" = present, files not counted.

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	Postpile	Postpile, top	37.62442	-119.08328	2329	23-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Buttress Notch	37.61836	-119.08661	2381	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	East side Buttress, N end	37.62017	-119.08662	2379	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Lower end seep, SE Buttresses	37.61366	-119.08543	2292	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	28-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	28-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	29-Jul-04	X
KCNP	SFK San Joaquin	Colby Mdw	Mdw/River edge	37.18321	-118.72972	2967	1-Aug-05	1
KCNP	SFK San Joaquin	Colby Mdw	Rock abv camp	37.18398	-118.73019	2979	1-Aug-05	1
KCNP	SFK San Joaquin	McClure Mdw	Mdw nr camp	37.18832	-118.74419	2942	2-Aug-05	1
KCNP	SFK San Joaquin	McClure Mdw	River edge	37.18790	-118.74409	2939	2-Aug-05	1
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Campsite	36.97166	-118.63129	1817	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Floodplain net site	36.97563	-118.63169	1819	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Floodplain pool	36.97569	-118.63109	1819	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail	36.97330	-118.62932	1822	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail #2	36.97344	-118.62930	1830	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Top Rock outcrop	36.97104	-118.62931	1831	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Top Rock outcrop	36.97104	-118.62931	1831	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Helipad log	36.97256	-118.63127	1807	29-Jul-06	X

Table 5.1. Acoustic records for *E. perotis* obtained in this study. "X" = present, files not counted. (continued)

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	Postpile	Postpile, top	37.62442	-119.08328	2329	23-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Buttress Notch	37.61836	-119.08661	2381	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	East side Buttress, N end	37.62017	-119.08662	2379	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Lower end seep, SE Buttresses	37.61366	-119.08543	2292	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	28-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	28-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	29-Jul-04	X
KCNP	SFK San Joaquin	Colby Mdw	Mdw/River edge	37.18321	-118.72972	2967	1-Aug-05	1
KCNP	SFK San Joaquin	Colby Mdw	Rock abv camp	37.18398	-118.73019	2979	1-Aug-05	1
KCNP	SFK San Joaquin	McClure Mdw	Mdw nr camp	37.18832	-118.74419	2942	2-Aug-05	1
KCNP	SFK San Joaquin	McClure Mdw	River edge	37.18790	-118.74409	2939	2-Aug-05	1
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Campsite	36.97166	-118.63129	1817	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Floodplain net site	36.97563	-118.63169	1819	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Floodplain pool	36.97569	-118.63109	1819	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail	36.97330	-118.62932	1822	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail #2	36.97344	-118.62930	1830	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Top Rock outcrop	36.97104	-118.62931	1831	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Top Rock outcrop	36.97104	-118.62931	1831	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Helipad log	36.97256	-118.63127	1807	29-Jul-06	X

Table 5.1. Acoustic records for *E. perotis* obtained in this study. "X" = present, files not counted. (continued)

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	MFK Kings	Tehipite Valley	Talus, base of dome	36.91378	-118.77546	1330	22-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Talus, base of dome	36.91378	-118.77546	1330	22-Jul-06	X
KCNP	SFK Kings	Arrowhead Lake	Rocky peninsula overlooking lake	36.82844	-118.40937	3157	22-Jul-04	X
KCNP	SFK Kings	Baxter Meadow	Rocky slope	36.85191	-118.41282	2902	21-Jul-04	X
KCNP	SFK Kings	Baxter Meadow	Upper marshy pond	36.85190	-118.41382	2882	21-Jul-04	X
KCNP	SFK Kings	Bubbs Creek	Sphinx Trail Jct, campsite, on rock	36.77940	-118.53593	1901	23-Sep-05	1
KCNP	SFK Kings	Cedar Grove	Cliff base @ Zumwalt Mdw Pkg	36.79421	-118.59793	1540	9-Jul-02	20
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 1	36.78374	-118.63663	1469	9-Jul-02	32
KCNP	SFK Kings	Cedar Grove	N river @ Zumwalt Mdw	36.79301	-118.59547	1524	9-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Road's End	36.79672	-118.58380	1565	9-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Service Rd, betw Knapp & Cedar Grv	36.78274	-118.64697	1461	9-Jul-02	108
KCNP	SFK Kings	Cedar Grove	Burn area S rd, near Granite Ck	36.79098	-118.60434	1510	10-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Burn by rd between bridges, E of CG	36.78456	-118.62061	1486	10-Jul-02	18
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 1	36.78374	-118.63663	1469	10-Jul-02	58
KCNP	SFK Kings	Cedar Grove	N river @ Zumwalt Mdw	36.79301	-118.59547	1524	10-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Pool in side channel, near E end River Rd	36.78679	-118.62020	1481	10-Jul-02	5
KCNP	SFK Kings	Cedar Grove	River just E. Knapp's cabin	36.78369	-118.63337	1467	10-Jul-02	42
KCNP	SFK Kings	Cedar Grove	Talus at E end of River Rd	36.78809	-118.61687	1494	10-Jul-02	5
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, S edge	36.79098	-118.59503	1516	10-Jul-02	19
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, talus slope	36.79048	-118.59558	1534	10-Jul-02	59
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,N edge	36.79237	-118.59704	1539	10-Jul-02	9
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,NW crnr	36.79158	-118.59697	1520	10-Jul-02	15

Table 5.1. Acoustic records for *E. perotis* obtained in this study. "X" = present, files not counted. (continued)

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	SFK Kings	Cedar Grove	River Rd, 1st turnout	36.78715	-118.61978	1477	11-Jul-02	6
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	23-Jul-04	X
KCNP	SFK Kings	Lower Paradise Valley	Grassy clearing at river edge	36.83501	-118.54024	2018	19-Jul-04	X
KCNP	SFK Kings	Lower Rae Lake	Lake shore	36.81647	-118.40522	3227	22-Jul-04	X

Table 5.1. Acoustic records for *E. perotis* obtained in this study. "X" = present, files not counted. (continued)

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	SFK Kings	Woods Creek Crossing	Log adj to rock outcrop	36.87236	-118.44191	2607	20-Jul-04	X
KCNP	SFK Kings	Woods Creek Crossing	Meadow adj to small stream	36.87115	-118.44342	2580	20-Jul-04	X
KCNP	NFK Kaweah	Redwood Mt. Grove	Redwood Ck, abv Lower Trail Crossing	36.69395	-118.91100	1955	30-Jun-05	3
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	1-Jul-05	30
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	1-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	2-Jul-05	13
KCNP	NFK Kaweah	Redwood Mt. Grove	Hart Meadow	36.70694	-118.90160	1966	3-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	3-Jul-05	22
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	3-Jul-05	2
SQNP	EFK Kaweah	Mineral King	Cliffs east of Lookout Point, Entrance Sta	36.43034	-118.75281	1264	1-Aug-02	23
SQNP	EFK Kaweah	Mineral King	Cliffs east of Lookout Point, Entrance Sta	36.43034	-118.75281	1264	1-Aug-02	18
SQNP	EFK Kaweah	Mineral King	Eagle Lake Tr., Mdw abv sinkhole	36.43003	-118.59778	2743	4-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Eagle Lake, forested shore	36.41718	-118.60467	3059	4-Aug-02	13
SQNP	EFK Kaweah	Mineral King	Eagle Lake, outlet ck	36.41766	-118.60414	3060	4-Aug-02	5
SQNP	EFK Kaweah	Mineral King	Eagle Lake, w end dam	36.41723	-118.60369	3054	4-Aug-02	8
SQNP	EFK Kaweah	Mineral King	Faculty Flat Rocks	36.45794	-118.62525	2256	5-Aug-02	123
SQNP	EFK Kaweah	Mineral King	Highbridge Ck	36.46334	-118.63184	2192	5-Aug-02	19
SQNP	EFK Kaweah	Mineral King	Highbridge Ck Rocks	36.46036	-118.63172	2234	5-Aug-02	245
SQNP	Marble FK Kaweah	Giant Forest	Beetle Rock, 50 m to forest edge	36.56462	-118.77499	1963	30-Jul-02	234
SQNP	Marble FK Kaweah	Giant Forest	Crescent Mdw	36.55364	-118.74691	2044	30-Jul-02	76
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	30-Jul-02	89
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood meadow	36.56343	-118.76624	2039	30-Jul-02	60

Table 5.1. Acoustic records for *E. perotis* obtained in this study. "X" = present, files not counted. (continued)

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood trees	36.56419	-118.76451	2034	30-Jul-02	85
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-02	138
SQNP	Marble FK Kaweah	Giant Forest	Moro Rock, first rest area, 1/2 to top	36.54554	-118.76456	2003	30-Jul-02	33
SQNP	Marble FK Kaweah	Giant Forest	Round Mdw mdw	36.56901	-118.76663	2000	30-Jul-02	231
SQNP	Marble FK Kaweah	Giant Forest	Round Mdw tree	36.56973	-118.76777	2043	30-Jul-02	87
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Pila snag	36.55230	-118.75900	2060	31-Jul-02	32
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	31-Jul-02	24
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock at edge of seep blw rd	36.55391	-118.75900	2072	31-Jul-02	30
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, bare rock below Rd	36.55355	-118.75900	2059	31-Jul-02	47
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	31-Jul-02	49
SQNP	Marble FK Kaweah	Giant Forest	Mdw at Tunnel Tree	36.55376	-118.75900	2036	31-Jul-02	56
SQNP	Marble FK Kaweah	Giant Forest	Net abv rd, Huckelberry Mdw Tr Xng	36.55459	-118.75301	2054	31-Jul-02	9
SQNP	Marble FK Kaweah	Giant Forest	Net blw rd, Huckleberry Mdw Tr Xng	36.55432	-118.75354	2054	31-Jul-02	5
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	29-Jul-02	2
SQNP	Marble FK Kaweah	Lodgepole	Red fir forest along highway	36.59874	-118.74489	2110	29-Jul-02	16
SQNP	Marble FK Kaweah	Lodgepole	Wet mdw nr. Wolverton Ck	36.59604	-118.73688	2211	29-Jul-02	50
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	30-Jul-02	31
SQNP	MFK Kaweah	Ash Mt	Alder Creek, below road	36.49268	-118.82482	542	12-Jul-02	23
SQNP	MFK Kaweah	Ash Mt	Marble Fork Confluence	36.51569	-118.80184	635	12-Jul-02	6
SQNP	MFK Kaweah	Ash Mt	Above Parking at net site	36.49555	-118.82218	543	14-Jul-02	5
SQNP	MFK Kaweah	Ash Mt	Gravel bar 30 m abv abve net site	36.49390	-118.82068	501	14-Jul-02	1
SQNP	MFK Kaweah	Ash Mt	Gravel terrace, 100 m abv net site	36.49370	-118.82206	493	14-Jul-02	1

Table 5.1. Acoustic records for *E. perotis* obtained in this study. "X" = present, files not counted. (continued)

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	MFK Kaweah	Ash Mt	Net site	36.49371	-118.82092	494	14-Jul-02	1
SQNP	MFK Kaweah	Ash Mt	Rocks behind Research office	36.48948	-118.82825	523	14-Jul-02	5
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr, E on dirt rd., just abv. Hwy	36.48935	-118.83494	500	14-Jul-02	5
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr. - Farther East on dirt rd	36.49004	-118.83413	512	14-Jul-02	10
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr. -dry ck at 1st turn out	36.48870	-118.83641	482	14-Jul-02	5
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Base of talus	36.47763	-118.40243	2129	29-Aug-04	XX
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Bench, S. of ck	36.47541	-118.40348	2164	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Near base of talus	36.47567	-118.40276	2140	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 30 m blw trail xing	36.47600	-118.40382	2098	22-Aug-05	2
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 40 m up trail xing	36.47760	-118.40353	2100	22-Aug-05	1
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 50 m blw trail xing	36.47652	-118.40383	2097	22-Aug-05	7
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Talus slope	36.47779	-118.40270	2110	22-Aug-05	2
SQNP	Kern	Chagoopa, Treehouse Mdw	Burn pond, marsh	36.49836	-118.45844	3173	25-Aug-05	1
SQNP	Kern	Chagoopa, Treehouse Mdw	Burn pond, open water	36.49799	-118.45844	3196	25-Aug-05	1
SQNP	Kern	Chagoopa, Treehouse Mdw	Meadow edge	36.49849	-118.46284	3162	25-Aug-05	2
SQNP	Kern	Chagoopa, Treehouse Mdw	Open Mdw, creek	36.49834	-118.46250	3157	25-Aug-05	3
SQNP	Kern	Chagoopa, Treehouse Mdw	Rock slope	36.49832	-118.46322	3168	25-Aug-05	2
SQNP	Kern	Chagoopa, Upper Trail Jct	E edge Mdw, Trail Jct	36.49316	-118.46871	3108	24-Aug-05	1
SQNP	Kern	Chagoopa, Upper Trail Jct	Larger moraine pond	36.49282	-118.46271	3156	24-Aug-05	17
SQNP	Kern	Chagoopa, Upper Trail Jct	Meadow, wet area	36.49291	-118.46903	3110	24-Aug-05	4

Table 5.1. Acoustic records for *E. perotis* obtained in this study. "X" = present, files not counted. (continued)

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Kern	Chagoopa, Upper Trail Jct	Sandy Flat	36.49297	-118.46653	3124	24-Aug-05	16
SQNP	Kern	Chagoopa, Upper Trail Jct	Smaller moraine pond	36.49294	-118.46384	3134	24-Aug-05	6
SQNP	Kern	Kern Ranger Station	Log, upslope Ranger Station	36.34254	-118.40972	1970	27-Aug-05	2
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Flood plain	36.43745	-118.41348	2030	26-Aug-05	1
SQNP	Kern	Lower Rock Creek Crossing	Edge of boggy meadow	36.49583	-118.33678	2908	24-Aug-04	X
SQNP	Kern	Lower Rock Creek Crossing	Willow patch mid-meadow	36.49515	-118.33744	2901	24-Aug-04	X
SQNP	Kern	Moraine Lake	Lakeshore by camp	36.46186	-118.45367	2844	23-Aug-05	116
SQNP	Kern	Moraine Lake	Lodgepole nr camp	36.46166	-118.45319	2834	23-Aug-05	88
SQNP	Kern	Moraine Lake	Rocky lakeshore	36.46093	-118.45296	2837	23-Aug-05	82
SQNP	Kern	Moraine Lake	Sky Parlor Mdw 1	36.46125	-118.44861	2796	23-Aug-05	25
SQNP	Kern	Moraine Lake	Sky Parlor Mdw 2	36.46180	-118.44830	2807	23-Aug-05	13
SQNP	Kern	Upper Funston Meadow	Center of meadow, on log	36.45274	-118.41297	2049	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Nr. Base of talus, meadow edge	36.45196	-118.41351	2053	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Open area near stock rail	36.45317	-118.41299	2041	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Campsite, Upper Funston Mdw	36.45305	-118.41267	2054	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Center of meadow, on log	36.45274	-118.41297	2049	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Willow edge below talus	36.45278	-118.41342	2068	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Side channel near campsite	36.45295	-118.41235	2076	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Talus above trail	36.45273	-118.41406	2046	31-Aug-04	X
				TOTAL SAMPLING SESSIONS				148

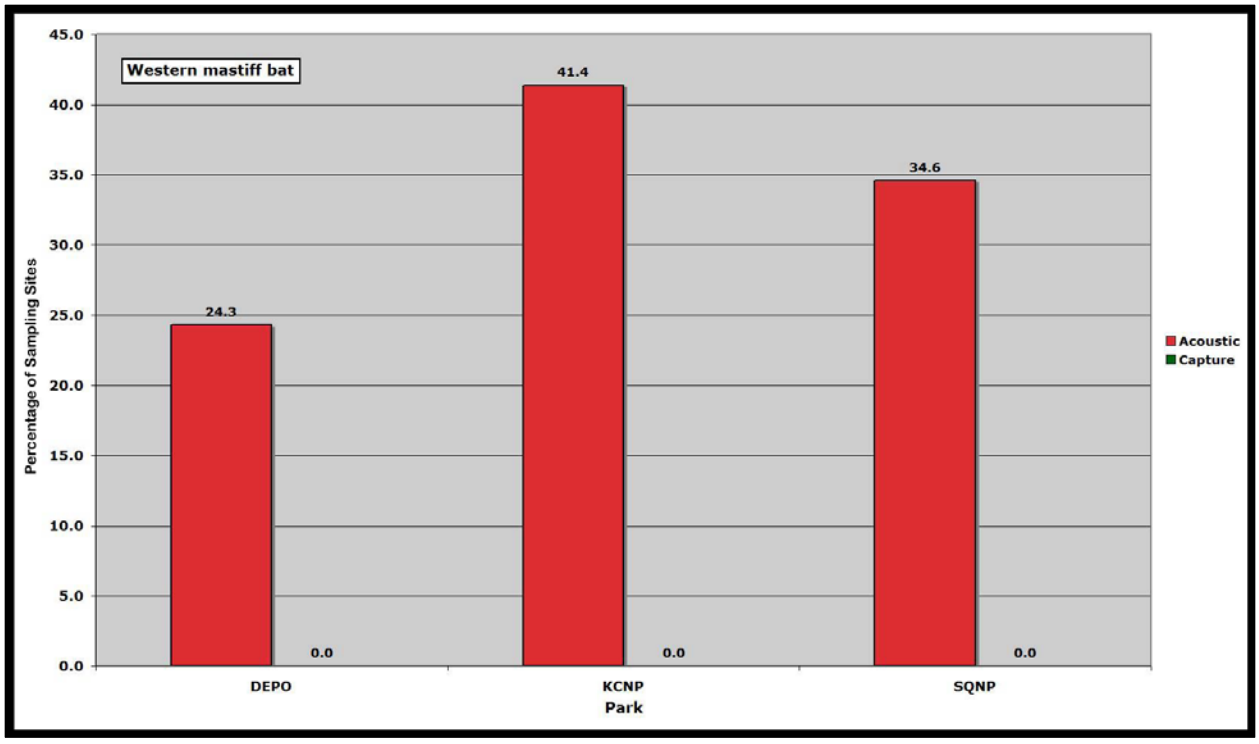


Figure 5.4. A bar graph comparing capture and acoustic records by park as measured by the percentage of sampling sites at which western mastiff bats were detected.

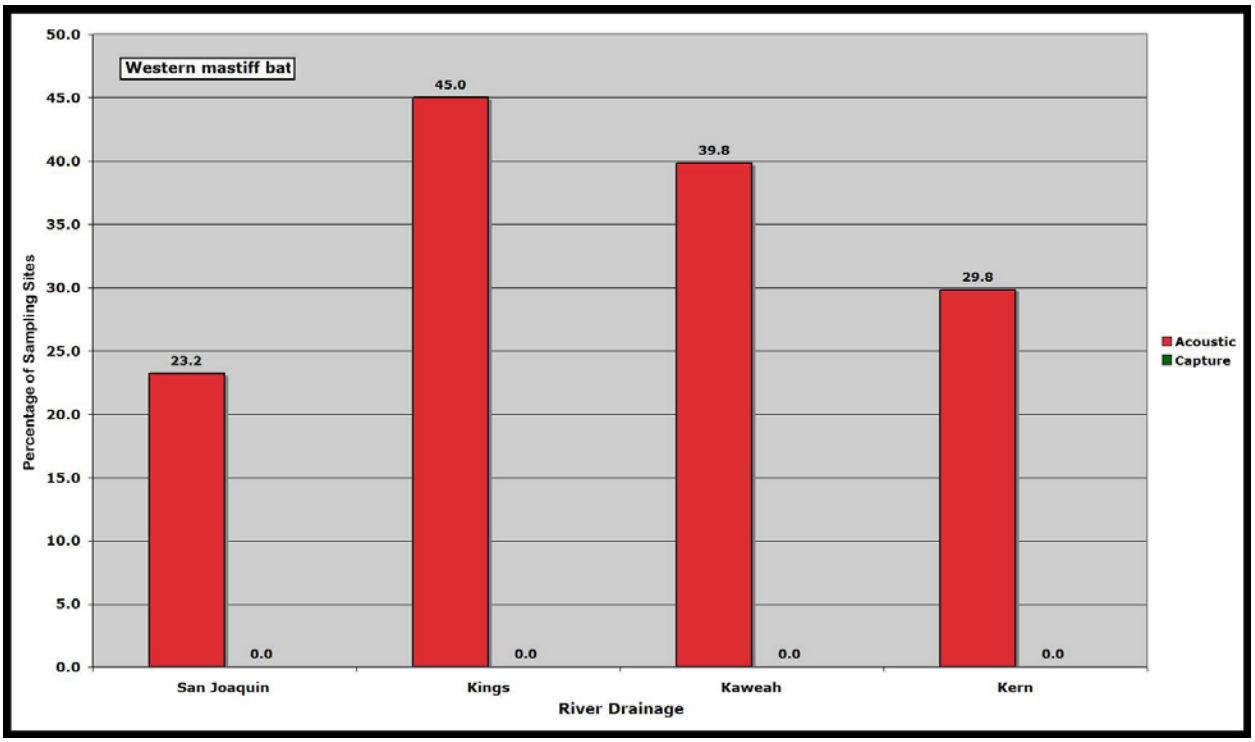


Figure 5.5. A bar graph comparing capture and acoustic records by river drainage as measured by the percentage of sampling sites at which western mastiff bats were detected.

Seasonal Distribution

Long-term acoustic data was collected at Shepherd's Saddle near Ash Mountain, where observations suggested that mastiff bats were roosting in a rock face just east of the saddle. Data collected over a four year period documented that the animals were present in the area year round, but show a marked increase in activity between August and November, at a time when this non-hibernating species is likely moving down slope to escape the cooling temperatures at higher elevation (Figure 5.6).

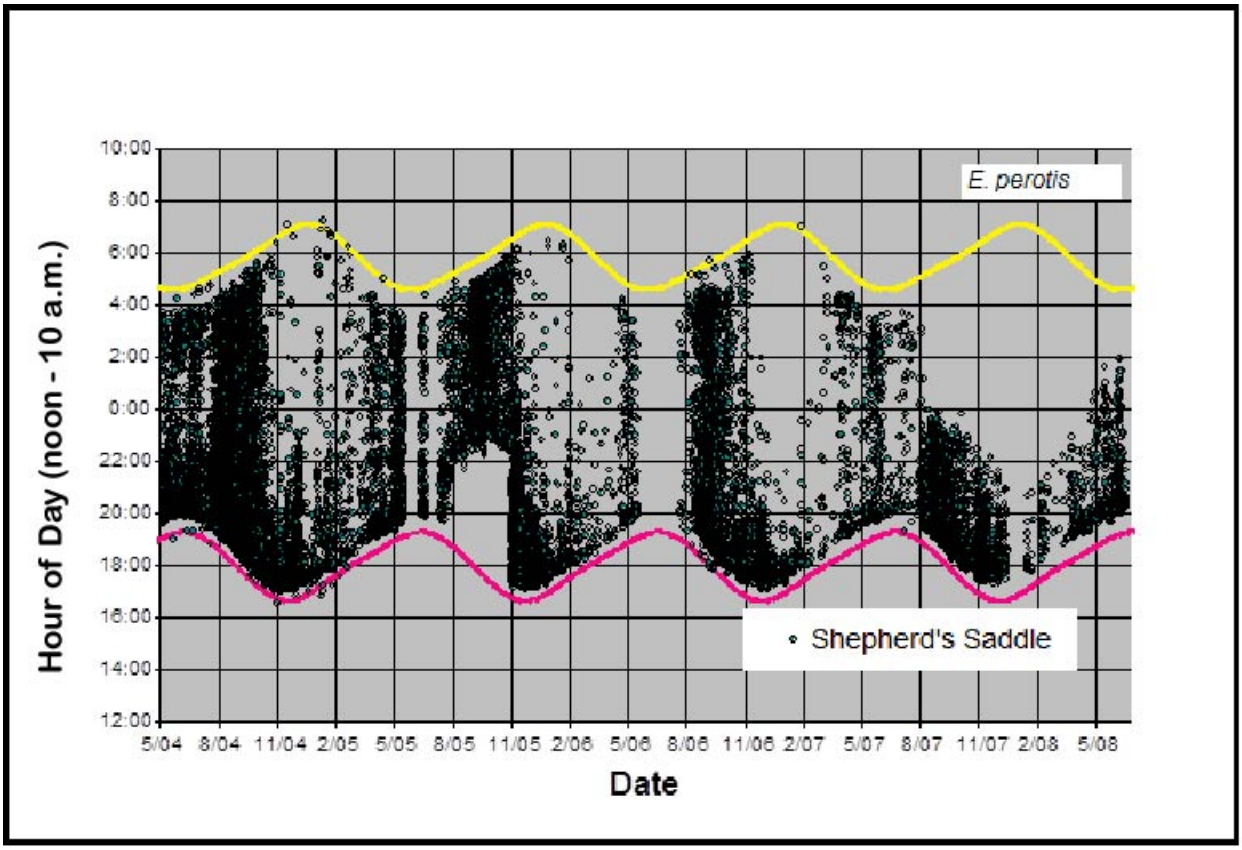


Figure 5.6. Seasonal pattern of mastiff bat acoustic activity at Shepherd's Saddle. Symbols indicate 5-minute intervals with at least one identified call file.

5.3. Habitat Associations

Vegetative Communities

Although generally regarded as a desert bat, recent surveys have documented a distribution in California that is far broader than was previously realized (Pierson and Rainey 1996, 1998a, Rainey and Pierson 1996). Once thought to occur primarily in southern California, *E. perotis* is now known to occur almost as far north as the Oregon border (Pierson et al. 1996, Rainey and Pierson 1996), with roosts in the Sierra Nevada up to 1,400 m, and foraging animals at >3,000 m. The distribution of *E. perotis* is likely geomorphically determined, with the species being present only where there are significant rock features offering suitable roosting habitat (*e.g.*, granite cliffs, basaltic tablelands). It is, however, found in a variety of habitats, from desert scrub to chaparral to oak woodland and into the ponderosa pine belt.

Roosting

This species, North America's largest bat, roosts in moderate size colonies, mostly in cliffs – particularly under slabs of exfoliating granite or crevices in basaltic columns. Building roosts have been identified in the Los Angeles basin, but all roosts that are known north of the Los Angeles basin are in rock crevices in cliffs. A number of roosts have been identified in Yosemite Valley, all on granite cliffs (Pierson and Rainey 1996).

Foraging

As fast-flying aerial foragers, individuals can travel large distances per night (up to 25 km one-way distance from the roost). They forage high over meadows, lakes, and other open areas, feeding primarily on moths.

5.4. Management Issues

Status. Western mastiff bats are considered a Mammal Species of Special Concern by California Department of Fish and Game, and a High Priority species by the Western Bat Working Group. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we ranked it as locally abundant and occurring over a large elevation range, but as having restricted habitat requirements based on its nearly obligate cliff-roosting behavior (likely to be the only type of roost found within these parks), and its apparent preference for foraging over meadows and sparsely vegetated rocky areas.

Roosts. We have identified three roosting areas for this species (Moro Rock, the cliffs just inside the park boundary at the Entrance Station on the Minereal King Road, and at Shepherd's Saddle). Any management activity that involves cliffs should trigger concern for this species.

Foraging. This species generally forages high above the ground in fairly open habitat (*e.g.*, wet and dry meadows, lakes, manzanita scrub, blue oak savannah, ponderosa parkland). Any activities that would alter the prey base in these habitats (*e.g.*, trampling of meadows by stock) should trigger consideration of this species.

Fire. Prescribed burns are not likely to pose problems for this species.

Climate Change. The impact of climate change on this species is unknown. Given, however, that it is known to occur in extremely xeric habitats in southern California (e.g., Anza Borrego Park or canyons near the Salton Sea), the more arid conditions expected with warmer temperatures might be expected to affect this species less than some others. Maternity colonies, now thought to be confined primarily to elevations below 2,500 m, could expand to higher elevations.

6. *Lasionycteris noctivagans*, Silver-haired bat

6.1. Identification

Lasionycteris noctivagans is a medium-sized bat with a forearm of 37-44 mm (Figure 6.1). Its fur is generally black (sometimes dark brown) with silver-tips. The interfemoral membrane is furred. Its ears are short and rounded. Its size, along with its frosted fur, distinguishes it from all other species. The only other species with frosted fur are either larger (*Lasiurus cinereus*) or red (*Lasiurus blossevillii*). Its echolocation calls are generally not distinguishable, and overlap in frequency with those of other 25 kHz species, especially *Eptesicus fuscus* and *Tadarida brasiliensis*.



Figure 6.1. Photograph of silver-haired bat. (Credit: William E. Rainey)

6.2. Distribution

Geographic Range

L. noctivagans has a broad distribution from southern Alaska, throughout southern Canada, most of the United States, and into the San Carlos Mountains of northeastern Mexico (Kunz 1982). Its distribution in California is generally thought to be concentrated in the northern half of the state, with most of the breeding records occurring in the upper Sacramento drainage (Rainey and Pierson 1996), the Trinity Mountains and northern coast ranges (Pierson and Rainey 1998b), and the northern Sierra Nevada. S. Sweet (personal communication) reports, however, finding breeding females on Mt. Pinos in Ventura County. Although there are relatively few records for southern California (Constantine 1998b), they are concentrated in the winter, suggesting that some individuals of this migratory species may over-winter in southern California.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for the silver-haired bat are mapped in Figure 6.2, and detailed in Table 6.1-6.3.

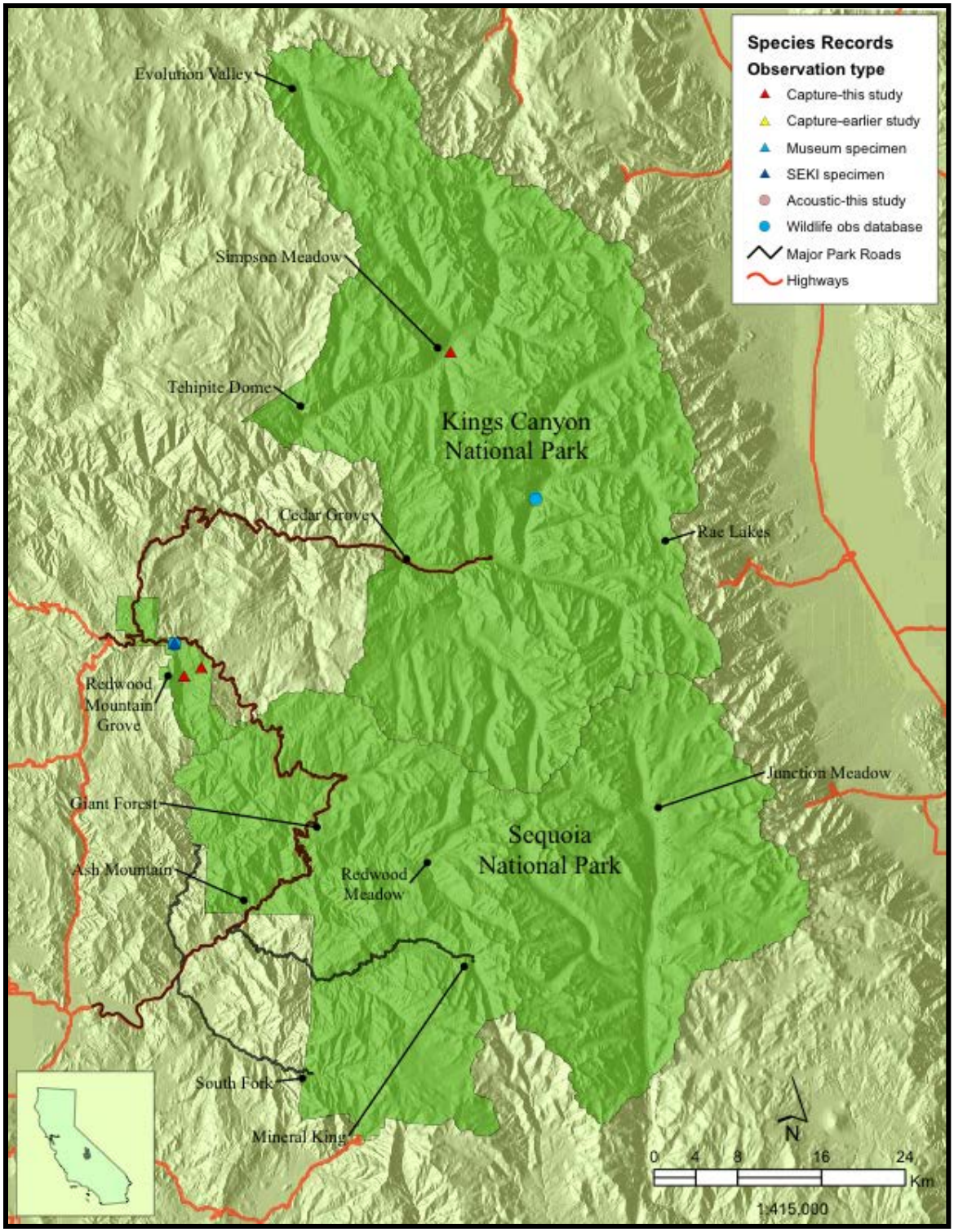


Figure 6.2. Map showing records for *Lasionycteris noctivagans* (silver-haired bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

There are only two prior records for this species, both from Kings Canyon: one from Paradise Valley and the other from Redwood Creek (very close to the sites of our captures in the same drainage) (Tables 6.1 and 6.2).

Overall, *L. noctivagans* was relatively rare in net captures, being detected in only 8 (11.8%) of our sampling sessions. While it was the seventh most frequently encountered species (Figure 7 in main report narrative), its distribution appears to be highly skewed. It was the second most frequently captured species at Devils Postpile, where the majority of animals were captured during two sampling sessions at the same site, the Sag Pond on the King Creek Trail. It was relatively rare in Kings Canyon, and absent from capture records for Sequoia National Park (Figure 6.3). Of the five individuals captured in Kings Canyon, three were in the Redwood Mountain Grove. It was detected in the San Joaquin, Kings, and Kaweah (*i.e.*, Redwood Creek) drainages, and appeared to be absent in the Kern (Figure 6.4). Its occurrence in Redwood Creek, very close to the border of Sequoia National Park (in what is essentially the Kaweah drainage) makes it highly likely that it does occur, although is likely rare, in Sequoia NP.

Aside from one post-lactating female captured in Devils Postpile, all individuals captured were adult males (Table 6.3). This is consistent with data collected in Yosemite National Park suggesting that this species does not raise its young in the Central Sierra Nevada.

Available records, while limited, suggest that this species occurs in a fairly narrow elevation band, between approximately 1700 and 2425 m for the geographic area included in this study (Tables 6.1-6.3).

Table 6.1. Museum records for *L. noctivagans* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/ Age	MUS ID	REC NUM	Collector
KCNP	NFK Kaweah	N. end Redwood Creek	36.71683	-118.91942	1951	29-Jun-88	M/A	SEKI-8311	45195	Petterson, J

Table 6.2. Records for *L. noctivagans* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
KCNP	NFK Kaweah	N. end Redwood Creek[a]	36.71683	-118.91942	1951	29-Jun-88	45195	Petterson, J
KCNP	MFK Kings	Paradise Valley	36.84655	-118.53516	2012	28-Jul-81	42623	Easterla,D.

[a] Also in SEKI museum collection as SEKI-8311 (Table 6.1)

Table 6.3. Capture records for *L. noctivagans* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
DEPO	MFK San Joaquin	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	24-Aug-01						7				7
DEPO	MFK San Joaquin	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	28-Jul-04						3				3
DEPO	MFK San Joaquin	Kings Ck, abv. river confluence	37.59951	-119.09087	2205	29-Jul-04			1			4				5
DEPO	MFK San Joaquin	San Joaquin, blw Muir Trail	37.61297	-119.08223	2288	29-Jul-04						1				1
DEPO	MFK San Joaquin	San Joaquin, nr. Ranger Station	37.63028	-119.08516	2304	30-Jul-04						1				1
KCNP	SFK Kings	Simpson Meadow, Deep Pool	36.97109	-118.62931	1831	31-Jul-06						2				2
KCNP	NFK Kaweah	Redwood Ck, Lower Trail Xing	36.68922	-118.90831	1706	01-Jul-05						2				2
KCNP	NFK Kaweah	EFK Redwood Ck, Trail Xing	36.69677	-118.89008	1914	02-Jul-05						1				1
						TOTALS	**0**	**0**	**1**	**0**	**0**	**21**	**0**	**0**	**0**	**22**

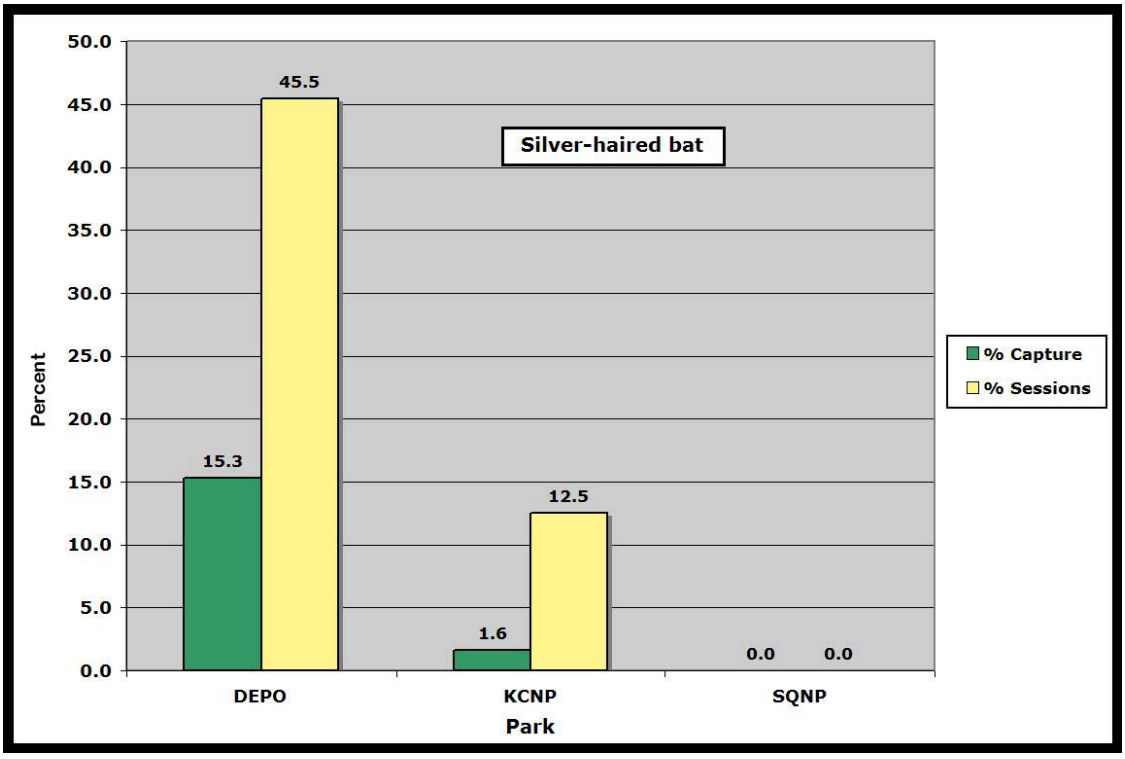


Figure 6.3. A bar graph comparing capture records by park as measured by the percentage of total captures and percentage of sampling sesssions in which silver-haired bats were detected

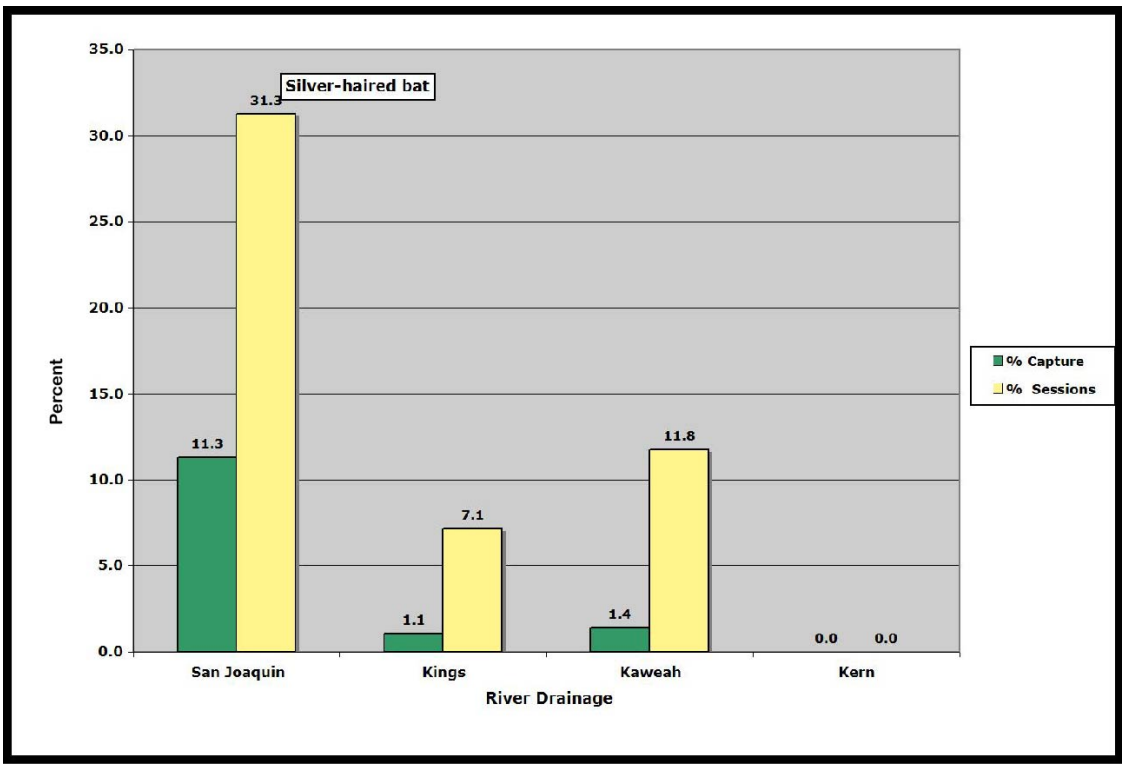


Figure 6.4. A bar graph comparing capture records by river drainage as measured by the percentage of total capturess and percentage of sampling sessions in which silver-haired bats were detected.

An analysis of our netting data using a univariate model indicates that water is by far the strongest indicator for the capture of *L. noctivagans* (Table 6.4).

Table 6.4. Univariate Model Selection

	df	AIC
Meadow_Scrub	4	146.9672
Forest	2	142.9672
Elev_m	2	148.7853
Water	7	104.8518
Rock	4	145.9784

An analysis of captures at water sites shows that we were more likely to capture *L. noctivagans* at ponds than at creeks, and capture rate at creeks was significantly greater than zero (Table 6.5, Figure 6.5).

Table 6.5. Terms of the model for water categories.

Coefficients:	Estimate	Std. Error	Z Value	Pr(>|z|)
Creek(Intercept)	-1.1939	0.3162	-3.776	0.000160 ***
Flooded Meadow	-19.1087	7770.9319	-0.002	0.998038
Lake	-19.1087	8973.0992	-0.002	0.998301
Marsh	-19.1087	10989.7572	-0.002	0.998613
Not Water	-19.1087	2427.2313	-0.008	0.993719
Pond	2.1102	0.4472	4.719	2.37e-06 ***
River	-0.8855	0.7746	-1.143	0.252955

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Null deviance: 123.396 on 102 degrees of freedom

Residual deviance: 69.344 on 96 degrees of freedom

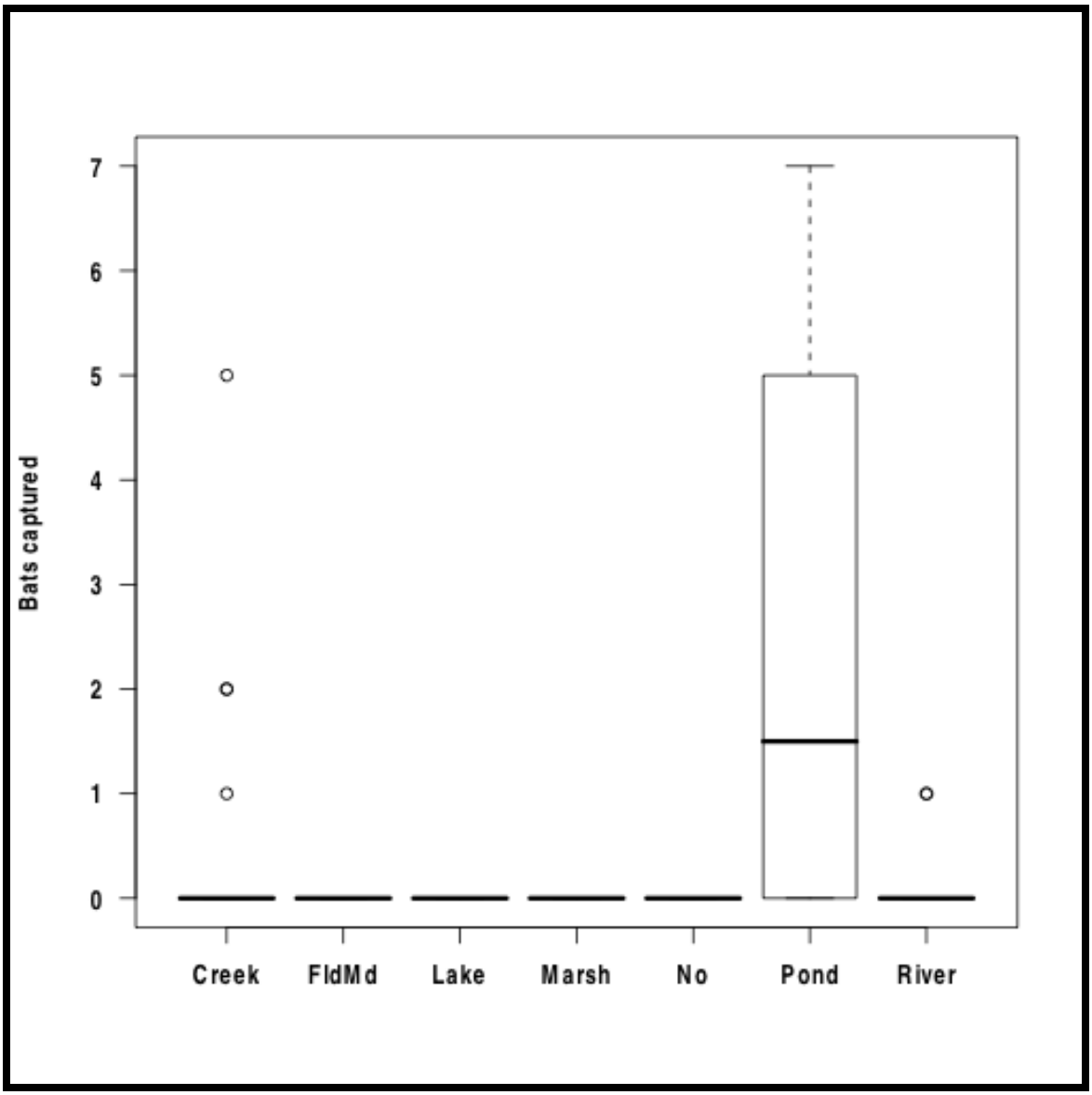


Figure 6.5. Graph showing the quartiles (with median values in bold) for number of *L. noctivagans* captured at six types of water sites, and sites that were not at water.

6.3. Habitat Associations

Vegetative Communities

L. noctivagans is a forest bat, associated primarily with north temperate zone conifer and mixed conifer/hardwood forests. A netting study in Oregon showed a strong association with old growth forest (Perkins and Cross 1988).

Roosting

Several radio-tracking studies have documented that this species roosts in warm seasons almost exclusively in trees - in woodpecker holes, bole and branch cavities, and under flaking bark (Barbour and Davis 1969, Betts 1996 & 1998, Campbell *et al*. 1996, Rainey and Pierson 1996, Vonhof 1996). Roosts are generally in large diameter dead or dying trees, in locations that are high (> 15 m) and uncluttered. In a study in the Mariposa Grove in Yosemite National Park, we located four roosts

belonging to two adult males – all were under flaking bark in two sugar pine snags, one ponderosa pine snag, and one still living ponderosa pine (Pierson et al. 2006)

This species has been found hibernating in hollow trees, under sloughing bark, in rock crevices, and occasionally in buildings, mines and caves (Barbour and Davis 1969, Kunz 1982). There is a record of silver-haired bat hibernating in leaf litter (Sanborn 1953), a pattern that is likely poorly detected and, like similar behavior in western red bats (see below), is probably more common than is realized.

Foraging

L. noctivagans forages above the canopy, in forest clearings, and in the riparian zone along water courses (Barclay 1985 & 1986, Kunz 1982, Rainey and Pierson 1996). Radio-tracking has shown that it travels considerable distances from roost sites to foraging areas (Rainey and Pierson 1996). Although the species is known to take a wide variety of insects, including Diptera, Homoptera, Hemiptera, Hymenoptera and Coleoptera, moths appear to be a major portion of dietary prey (Barclay 1985 & 1986, Kunz 1982, van Zyll de Jong 1985, Whitaker et al. 1981a). In a study in the upper Sacramento River drainage the diet of this species was dominated by Lepidoptera and Trichoptera (Rainey and Pierson 1996).

6.4. Management Issues

Status. Silver-haired bats have no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), however, we placed this species in the most restricted category for Sequoia and Kings Canyon. Its population is evidently sparse in the central Sierra Nevada, it has a limited elevational distribution, and with its obligate tree-roosting habits has restricted habitat requirements. It may reach the southern limit of its summer distribution near the border between Sequoia and Kings Canyon.

Roosts. Any management activities that affect large diameter trees should trigger consideration of this species. Of particular concern would be tree removal for construction or for hazard abatement. Because this species may hibernate in leaf litter, management activities that affect leaf litter (brush clearing or prescribed burns) would be of concern for this species.

Foraging. This species has a fairly broad foraging niche, feeding on both aquatic and terrestrial prey. Thus any management activity that would reduce prey base, particularly Lepidoptera or Trichoptera, would be of concern for this species.

Fire. Because silver-haired bats have been found hibernating in leaf litter, prescribed burns that occur between the late fall and the early spring are of potentially serious concern for this species.

Climate Change. This is the only species in California for which the distribution of reproductive females appears to be concentrated in the northern part of the state, and the animals occurring in the central Sierra Nevada appear to be predominantly males and/or non-reproductive females. How climate change might be expected to alter this distribution is unknown, but given its limited elevational distribution, a significant impact from climate change could be expected.

7. *Lasiurus blossevillii*, Western red bat

7.1. Identification

Lasiurus blossevillii is a medium sized bat with a short rostrum, short rounded ears, and a heavily furred interfemoral membrane (Barbour and Davis 1969, Shump and Shump 1982a) (Figure 7.1). It can generally be distinguished by the brick-red color of its fur. The color, however, can vary from intense red to yellow-brown. It can, nevertheless, be distinguished from *Lasiurus cinereus* based on size. *L. blossevillii* has a forearm of 35-45 mm; *Lasiurus cinereus* is larger, with a forearm of 46-58 mm. This species also has a distinctive echolocation call, which is typified by a porpoising pattern from pulse to pulse, and has a characteristic frequency of ca. 45 kHz (Figure 7.2).



Figure 7.1. Photograph of Western red bat. (Credit: Keith Paul, USFWS)

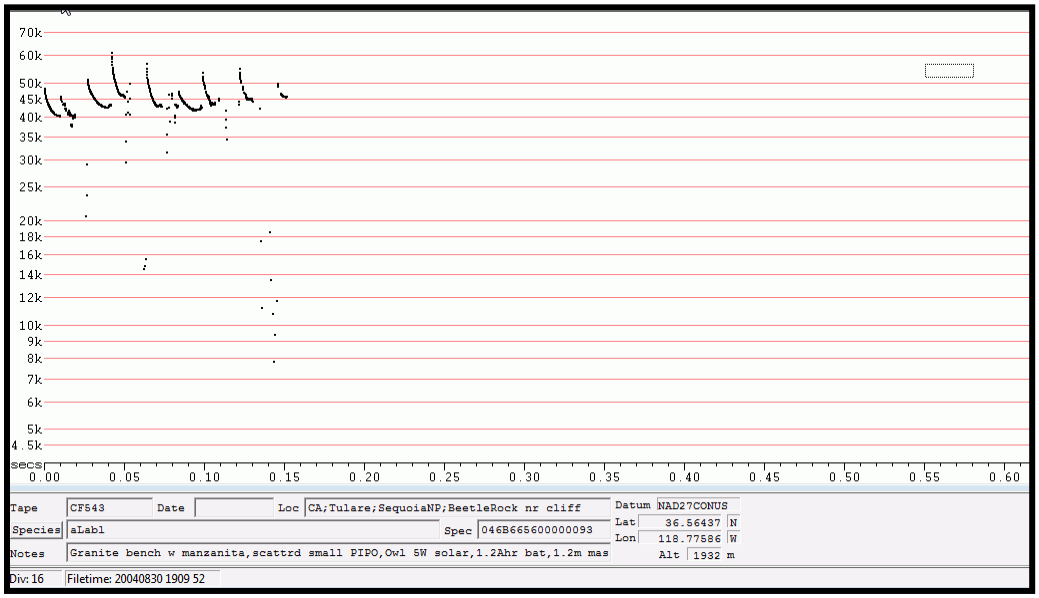


Figure 7.2. Echolocation call of western red bat, Beetle Rock, Sequoia National Park, August 30, 2004.

7.2. Distribution

Geographic Range

Until recently the western red bat was considered a subspecies of *Lasiurus borealis*, and was known as *L. b. teliotis* (Shump and Shump 1982a). Based on two recent phylogenetic studies (Baker et al. 1988; Morales and Bickham 1995), however, this taxon is now recognized as a separate species, *L. blossevillii*, with a distribution that extends from southern British Columbia through the western U.S., Mexico, Central America, and South America, although the work of Morales and Bickham (1995) suggests that the South American populations should be treated as a separate species.

In California, the majority of records are from the coastal areas from the San Francisco Bay area south, plus the Central Valley and bordering foothills, with a limited number of records from southern California, extending as far east as western Riverside and central San Diego Counties. There are a few records from higher elevations and the east side of the Sierra Nevada (Constantine 1998b, Pierson et al. 2000, J. Szewczak personal communication). Breeding females for this foliage-roosting species appear to be highly associated with lower elevation riparian habitats, particularly relatively intact stands of cottonwood and sycamore in the Central Valley and southern coastal areas (Pierson et al. 2000).

Winter populations of both sexes are concentrated along the central and southern coast (Pierson et al. 1999). Grinnell (1918) suggested that red bats in California were sexually segregated in summer, with males moving to higher elevations, a pattern more recently noted in other species (*e.g.*, Cryan et al. 2000). There are records for red bats (most likely males or non-reproductive females) up to 2,500 m in the Sierra Nevada (Pierson et al. 2000 & 2001).

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for *L. blossevillii* are mapped in Figure 7.3, and detailed in Table 7.1 – 7.4.

There was only one prior record for this species, a museum specimen from Burnt Point on the North Fork Kaweah (Tables 7.1 and 7.2). Interestingly, this is an adult female collected in late August. Reproductive status is unknown. There is one other record from Three Rivers, collected in 1891. While this locality is outside the park, it is close enough to park boundaries, and the other record, to be of interest.

We obtained two capture records for this species, one from Redwood Creek in Kings Canyon NP, and the other at Pool #7, above the Yucca Creek confluence on the North Fork of the Kaweah. This second record is very close to the Burnt Point. The two individuals we captured were both adult males. This is consistent with sparse records elsewhere in the Sierra Nevada, which suggest that mountain distribution is primarily males.

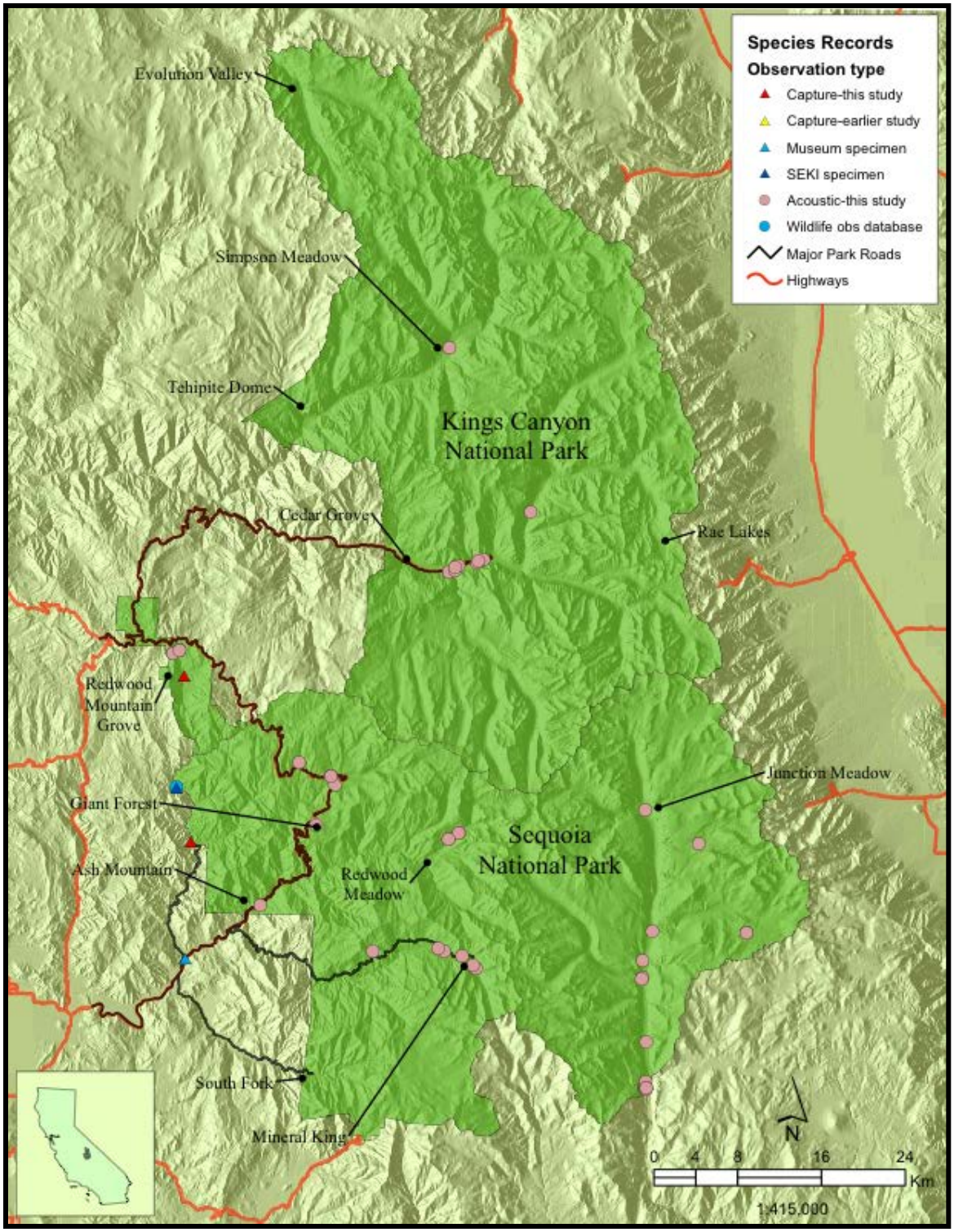


Figure 7.3. Map showing records for *Lasiurus blossevillii* (western red bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 7.1. Museum records for *L. blossevillii* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector	NOTES
SQNP	NFK Kaweah	Burnt Point	36.59356	-118.91399	731	21-Aug-88	F/A	SEKI-8308	45295	Petterson, J.	
Outside	Kaweah	Three Rivers	36.44713	-118.90111	252	17-Sep-1895	M/U	USNM-31177		NA	Outside park, but noteworthy record; Grinnell 1918

Table 7.2. Records for *L. blossevillii* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
SQNP	NFK Kaweah	Burnt Point[a]	36.59356	-118.91399	731	21-Aug-88	45295	Petterson, J.

[a] Also in SEKI museum collection as specimen #8308 (Table 7.1)

Table 7.3. Capture records for *L. blossevillii* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
KCNP	NFK Kaweah	Redwood Ck, Lower Trail Xing	36.68922	-118.90831	1706	01-Jul-05						1				1
SQNP	NFK Kaweah	Pool #7, abv Yucca Ck	36.54697	-118.89764	538	31-Jul-06						1				1
						TOTALS	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**2**

Table 7.4. Acoustic records for *L. blossevillii* obtained in this study. "X" = present, files not counted; XX = numerous files, not counted.

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	MFK Kings	Simpson Meadow	Very large pool, net site	36.97564	-118.63080	1819	28-Jul-06	X
KCNP	SFK Kings	Cedar Grove	1st pull out W Road's end	36.79371	-118.59024	1527	9-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Sidebar River, W Roaring R Xing	36.78251	-118.62710	1471	9-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Burn by rd between bridges, E of CG	36.78456	-118.62061	1486	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Talus at E end of River Rd	36.78809	-118.61687	1494	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,NW crnr	36.79158	-118.59697	1520	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Island, betw River and side channel	36.78645	-118.62046	1482	11-Jul-02	1
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	21-Jul-04	X
KCNP	SFK Kings	Lower Paradise Valley	Grassy clearing at river edge	36.83501	-118.54024	2018	19-Jul-04	X
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	1-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	1-Jul-05	2
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	2-Jul-05	3
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	2-Jul-05	4
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	3-Jul-05	3
SQNP	EFK Kaweah	Mineral King	Cottonwoods, W of Tar Gap Pkg	36.45376	-118.60579	2325	1-Aug-02	8
SQNP	EFK Kaweah	Mineral King	Redwood Ck, blw Xng Mineral King Rd	36.45586	-118.70159	2323	1-Aug-02	2
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 50 m upstream CF002	36.44347	-118.59234	2408	2-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Farewell Gap trail, upslope fr net site	36.44389	-118.59134	2402	3-Aug-02	3
SQNP	EFK Kaweah	Mineral King	Eagle Lake Tr., 200 m trailhead	36.44571	-118.59455	2418	4-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Faculty Flat Rocks	36.45794	-118.62525	2256	5-Aug-02	16
SQNP	EFK Kaweah	Mineral King	Highbridge Ck Rocks	36.46036	-118.63172	2234	5-Aug-02	3
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood trees	36.56419	-118.76451	2034	30-Jul-02	1
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	29-Jul-02	3
SQNP	Marble FK Kaweah	Lodgepole	Halstead Ck, wet mdw abv rd Xng	36.61741	-118.78325	2143	29-Jul-02	1

Table 7.4. Acoustic records for *L. blossevillii* obtained in this study. "X" = present, files not counted; XX = numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Marble FK Kaweah	Lodgepole	Red fir forest along highway	36.59874	-118.74489	2110	29-Jul-02	3
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	30-Jul-02	2
SQNP	MFK Kaweah	Ash Mt	Gravel terrace, 100 m abv net site	36.49370	-118.82206	493	14-Jul-02	1
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Manzanita Terrace #2	36.55369	-118.62296	1942	29-Aug-06	XX
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Long pool, upstream	36.55975	-118.61156	1956	30-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Rock Bar below Pool #6	36.55941	-118.61207	1951	31-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Lower Terrace	36.55356	-118.62277	1910	1-Sep-06	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita campsite	36.47734	-118.30349	2096	21-Aug-05	1
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 40 m up trail xing	36.47760	-118.40353	2100	22-Aug-05	2
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita campsite	36.47734	-118.30349	2096	22-Aug-05	1
SQNP	Kern	Junction Meadow, Kern River	Up trail from Junction Mdw	36.58146	-118.41344	2490	28-Aug-04	X
SQNP	Kern	Kern Ranger Station	Open manzanita/Jeffrey by camp	36.34258	-118.41015	1981	3-Sep-04	X
SQNP	Kern	Kern Ranger Station	Log, upslope Ranger Station	36.34254	-118.40972	1970	27-Aug-05	1
SQNP	Kern	Kern Ranger Station	Coyote CK, nr. Trail Xing	36.34210	-118.40840	1966	27-Aug-05	1
SQNP	Kern	Kern Ranger Station	Pasture at RS	36.34251	-118.40843	1964	27-Aug-05	2
SQNP	Kern	Kern Ranger Station	Ponderosa snag	36.34833	-118.40833	1979	27-Aug-05	1
SQNP	Kern	Kern Ranger Station	Pasture RS 1	36.34266	-118.40793	1964	28-Aug-05	1
SQNP	Kern	Kern Ranger Station	Pasture Center	36.34251	-118.40810	1964	28-Aug-05	1
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Flood plain	36.43745	-118.41348	2030	26-Aug-05	3
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Talus abv camp	36.43659	-118.41445	2044	26-Aug-05	5
SQNP	Kern	Lower Crabtree Meadow	Dry part of mdw, marmot mounds	36.55282	-118.35542	3146	26-Aug-04	2
SQNP	Kern	Lower Funston Meadow	Cobble bar, river floodplain	36.38240	-118.40876	1972	2-Sep-04	X
SQNP	Kern	Upper Funston Meadow	Willow edge below talus	36.45278	-118.41342	2068	31-Aug-04	X
							TOTAL SAMPLING SESSIONS	47

The vast majority of the distributional data gathered in this inventory effort comes from electronic capture of diagnostic echolocation calls. We detected this species during 47 (11.5 %) sampling sessions. It was not detected at all in Devils Postpile or in the San Joaquin drainage. It was detected most frequently in Sequoia (15.0 % of sampling sessions) and in the Kaweah drainage (18.6 % of sampling sessions). It was detected least frequently in Kings Canyon (9.6 % of sampling sessions) and the Kings drainage (8.3 % of sampling sessions) (Figures 7.4 and 7.5). For 46 of the sampling sessions the elevation ranges from the Ash Meadow area to about 2,400 m (in the Mineral King area). There is one striking record that involves two very clear echolocation sequences in Lower Crabtree Meadow at 3,146 m. We have treated this as an outlier, and consider the normal elevation range for this species to be more restricted.

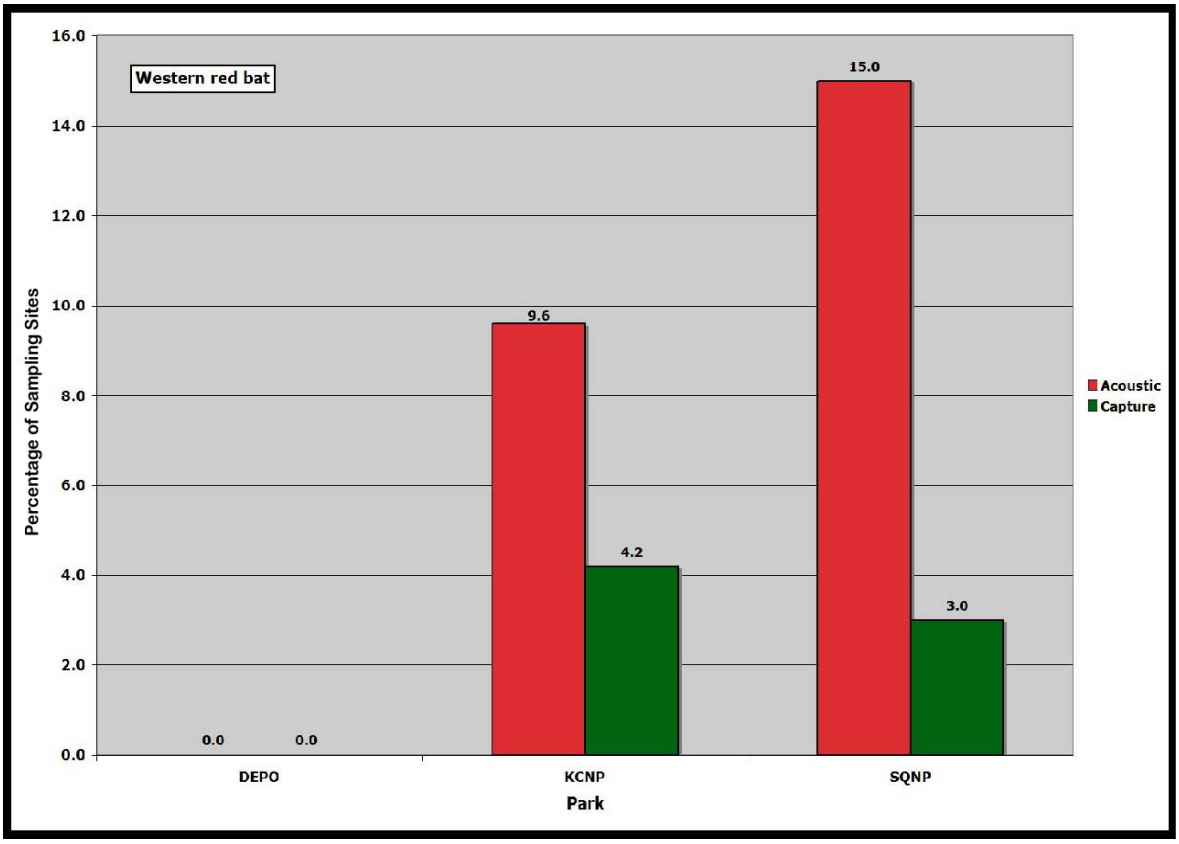


Figure 7.4. A bar graph comparing capture and acoustic records by park as measured by the percentage of sampling sites at which western red bats were detected.

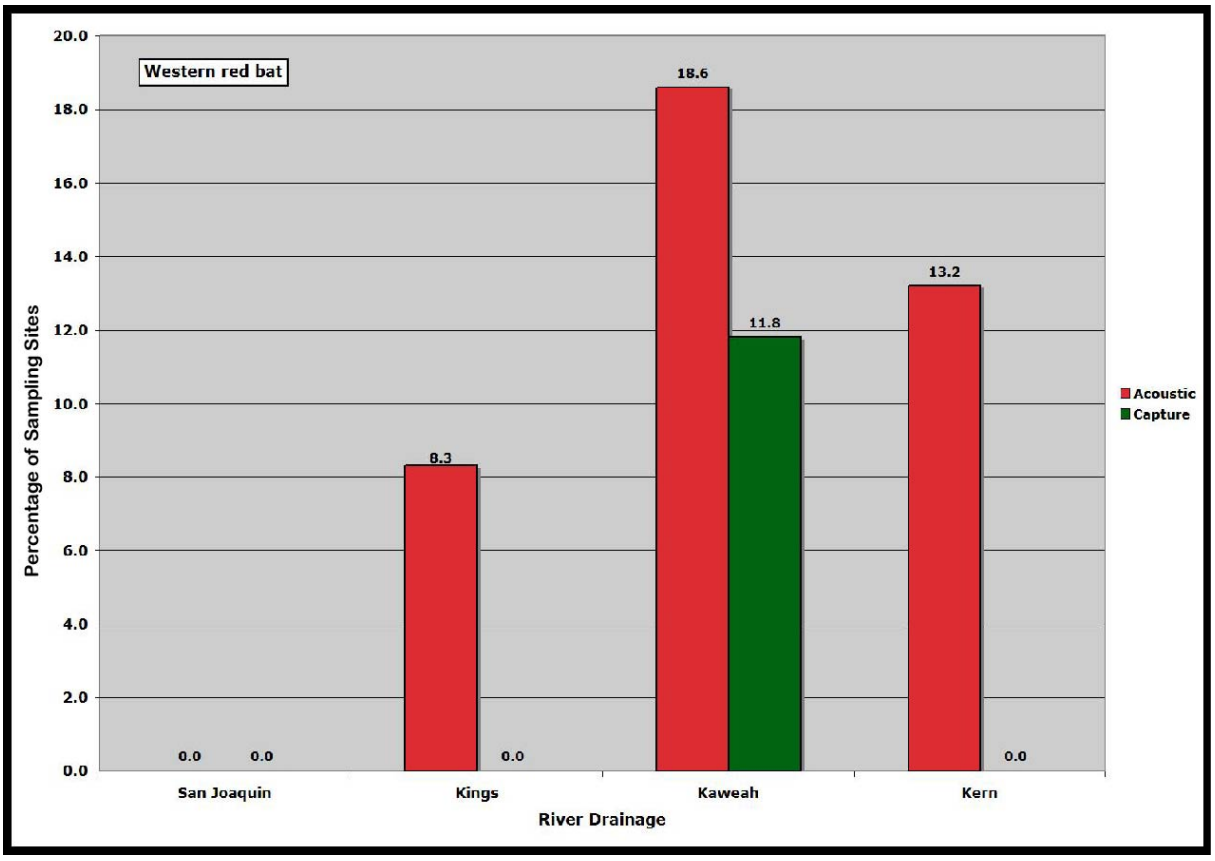


Figure 7.5. A bar graph comparing capture and acoustic records by river drainage as measured by the percentage of sampling sites at which western red bats were detected.

Seasonal Distribution

A long-term acoustic detector at Shepherd's Saddle near Ash Mountain provided four years of seasonal data for this species, showing a marked pulse of activity in later April to early May, corresponding with the expected timing of the northward, spring migration. Also, importantly and unexpectedly, there are occasional winter records (Figure 7.6).

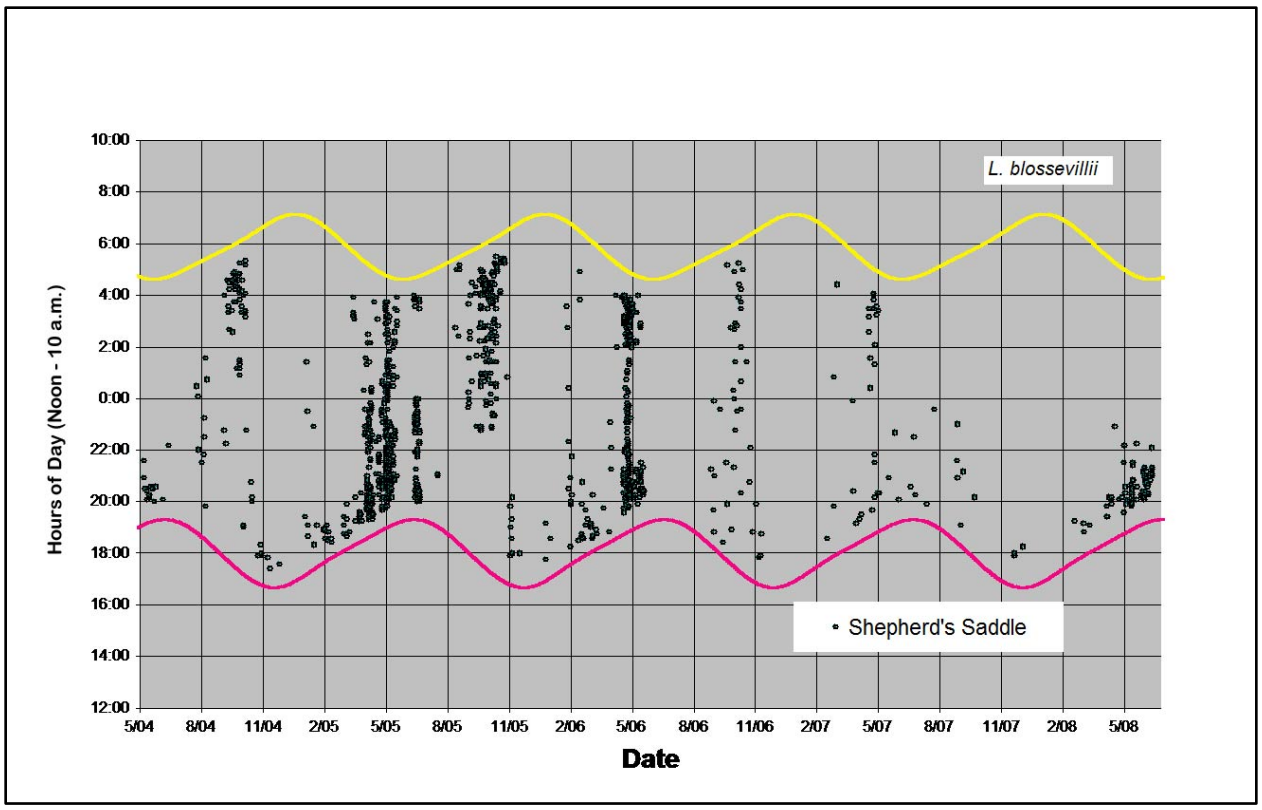


Figure 7.6. Seasonal pattern of western red bat acoustic activity at Shepherd's Saddle in Sequoia National Park. Symbols indicate 5 minute intervals with at least one identified call. Curved lines show calculated local sunrise and sunset.

7.3. Habitat Associations

Vegetative Communities

Although *L. blossevillii* is most typically associated with low elevation riparian habitats, i.e., cottonwood and willow riparian, the acoustic surveys show it is found in most habitats below 2,400 m. It was predictably detected in association with black cottonwood (e.g., near Tar Gap Parking in Mineral King and the gallery forest near Simpson Meadow), but was also found in mixed deciduous forest and giant sequoia groves.

Roosting

L. blossevillii is a non-colonial, foliage roosting species that is generally solitary. At low elevation sites (*e.g.*, in the Central Valley), *L. blossevillii* roosts in fruit orchards, mature cottonwood and sycamore trees, and willow riparian. Acoustic detections have been obtained in association with black cottonwood in both Yosemite and Sequoia national parks. Other potential roosting sites have not been identified.

Recent studies in the Central Valley found that summering populations are substantially more abundant in remnant stands of cottonwood/sycamore riparian that extend >50 m back from the river than they are in younger, less extensive stands (Pierson et al. 1999). Red bats have been observed emerging near canopy level in mature cottonwood stands, especially where there are extensive

grapevine tangles. This species also roosts extensively in orchards. Constantine (1959) found the species roosting in fruit trees (apricot, fig, and orange) in the Central Valley of California. Dalquest (1945) noted daytime roosting sites for *L. blossevillii* in tamarisk windbreaks along irrigation ditches in California's Central Valley. They also have been found in peach orchards (Grinnell 1918), and detected at emergence time in stands of eucalyptus and adjacent to almond, apricot, fig, and walnut orchards (Pierson et al. 1999). Other roosts in non-native vegetation include mulberry (Grinnell 1918) and china berry (Constantine 1959). A radio-tracking study in the Central Valley in 2009 documented roosting by post-lactating females in a walnut orchard and native California pipe-vine (*Aristolochia californica*) (L. Lewis, USFWS, personal communication).

Animals discovered in winter in Golden Gate Park in San Francisco were roosting in *Sparmannia africana*, a large-leafed, exotic, evergreen plant commonly planted in gardens in the Bay area (Orr 1950). Winter behavior of this species is not well understood. Saugey et al. (1998) recently documented, through a radio-tracking study in Arkansas, that when temperatures dropped, some individuals of the closely related *L. borealis* moved from trees to hibernate in the leaf litter. Red bats apparently arouse from hibernation on warm days to feed (Shump and Shump 1982a), and Orr's observations suggest that this species forages periodically during the winter in the San Francisco Bay area (Orr 1950).

Foraging

L. blossevilli forages in a number of different habitats. A chi-square test of our detections indicted that their distribution did not differ from expected (Table 7.5). They were detected over meadows and open areas (e.g., pasture at Kern Ranger Station, sagebrush near Mineral King, manzanita terrace near the Middle Fork Kaweah below Bearpaw Meadow, chaparral at Shepherd's Saddle), in sparsely vegetated rocky areas (e.g., Clover Ridge near Lodgepole, Faculty Flat Rocks near Mineral King, a cobble bar in Lower Funston Meadow), in forested areas (Hazelwood area in Giant Forest, Redwood Creek in Redwood Mountain Grove), over or near water (e.g., side pool in the river at Simpson Meadow, and along the river at several sites in Cedar Grove).

Table 7.5. Chi-square test for differences among foraging habitat classes for *L. blossevillii.*

	Forest	**Mdw/Scrub**	**Rock**	**Water**
Observed	9	16	10	11
Expected	10	14	11	12

X^2 (1, N = 46) = 0.90553498

Red bats forage on a number of insect taxa, flying at both canopy height and low over the ground (Shump and Shump 1982a). One diet sample from California suggests this species feeds primarily on small moths, but takes a variety of other insects, particularly orthopterans (Ross 1961). Other dietary information has come from *L. borealis* in the eastern U.S. In a study conducted in Indiana, Whitaker (1972) found that red bats ate 26% moths. Other studies (summarized in Shump and Shump 1982a) have also found Homoptera, Coleoptera, Hymenoptera, Diptera in the diet.

7.4. Management Issues

Status. *L. blossevillii* is considered a Mammal Species of Special Concern by California Department of Fish and Game, a Sensitive Species by the U.S. Forest Service, and a High Priority species by the Western Bat Working Group. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we ranked it as constantly sparse, restricted in its range, and as having specific habitat requirements. Even though its foraging habitat appears to be broad, its roosting habitat may be quite restricted.

Roosts. We have no information on the roosting requirements of this species in the Sierra Nevada. Detections at dusk near black cottonwoods suggest they do use these trees for roosting. Sycamore, found at the lowest elevations (e.g., near Ash Mountain) are also likely roost trees. This species should be of concern for any management activities that affect riparian forest habitat.

Foraging. The acoustic data suggest a very broad habitat niche for foraging. Nevertheless, management activities that affect meadows or water sources should include consideration of this species.

Fire. Because red bats have been found hibernating in leaf litter, prescribed burns that occur between the late fall and the early spring are of potentially serious concern for this species.

Climate Change. The impact of climate change on this species is unknown.

8. *Lasiurus cinereus*, Hoary bat

8.1. Identification

Lasiurus cinereus is a large bat (forearm of 46-58 mm.) with a short rostrum, short rounded ears, and a heavily furred interfemoral membrane (Barbour and Davis 1969, Shump and Shump 1982b). It can generally be distinguished by its distinctive coloration -- dark grey fur, with frosted white tips, a yellow face, and ears rimmed in black (Figure 8.1). This species has a distinctive echolocation call that has a characteristic frequency that varies from 16 to 25 kHz. A call sequence is typified by a porpoising pattern from pulse to pulse (Figure 8.2).



Figure 8.1. Photograph of hoary bat. (Credit: William E. Rainey)

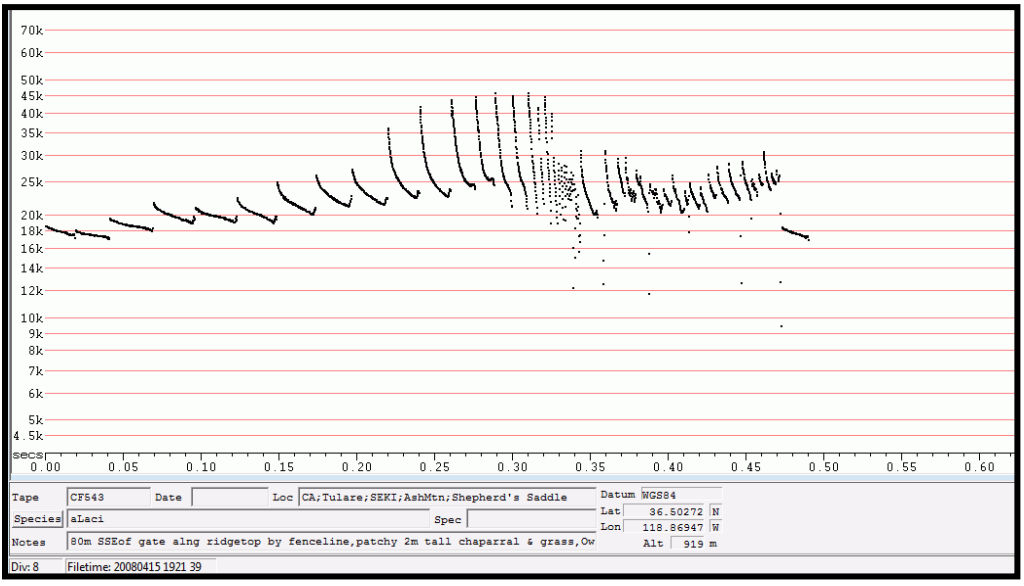


Figure 8.2. Echolocation call of hoary bat, Shepherd's Saddle, Sequoia National Park, April 15, 2008.

8.2. Distribution

Geographic Range

L. cinereus is the most widespread of all North American bats (Shump and Shump 1982b). It ranges from near tree line in Canada, southward at least to Guatemala, and from Brazil to Argentina and Chile in South America. Hoary bats are uncommon throughout most of the eastern U.S. and in the northern Rocky Mountains, but are more common in the prairie states and Pacific Northwest. Breeding females are distributed primarily in southern Canada and the central portion (Great Plains) of the United States (Findley and Jones 1964).

Although adult females have been found occasionally in California, with one recent report of a lactating female near the Oregon border (M. Colberg, U.S. Forest Service, personal communication), there is no evidence they raise their young in the Sierra Nevada. The majority of records (and all mid-summer records) are males. This species is found throughout California, with records from the Central Valley to > 2,500 m in the Sierra Nevada. It is highly associated with cottonwood riparian habitat, and is also found in forested areas. A netting study in Oregon showed a strong association with old growth Douglas-fir forest (Perkins and Cross 1988). This species is known to undergo long distance seasonal migrations (Cryan 2003), with increased numbers of animals appearing along the California coast in the fall (Dalquest 1943, Tenaza 1966) and in southern California in the winter (Vaughan and Krutzsch 1954). Data obtained recently in the Central Valley and the Sierra foothills (Pierson et al. 2000) suggest that this species migrates through the Central Valley and adjacent foothills in the spring and the fall.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for the hoary bat are mapped in Figure 8.3, and detailed in Tables 8.1-8.4.

The only prior records are one museum specimen from a locality just outside Kings Canyon, near Badger (Table 8.1.), and a WODB record for Cedar Grove (Table 8.2).

We captured seven hoary bats in this study, six adult males and one adult female. While *L. cinereus* was one of the least frequently occurring species in net captures, we captured them at three localities: one in Devils Postpile, one in Kings Canyon, and one in the Kern drainage in Sequoia NP. The Devils Postpile animal, captured in late August, was a post-lactating, and most likely migratory, female.

The primary distributional information for this species was obtained from acoustic records. Overall it was detected during 190 (46.6 %) sampling sessions. It was detected with the greatest frequency (64.9 % of sessions) in Devils Postpile and in the San Joaquin drainage (51.8 % of sessions). It was detected with the least frequency (42.5 % sessions) in Sequoia and the Kern drainage (42.1% of sessions) (Figures 8.4 and 8.5). This species covers a very wide elevation range from low elevation sites near Ash Mountain to Dusy Basin at 3,425 m, providing what is likely a high elevation record for this species.

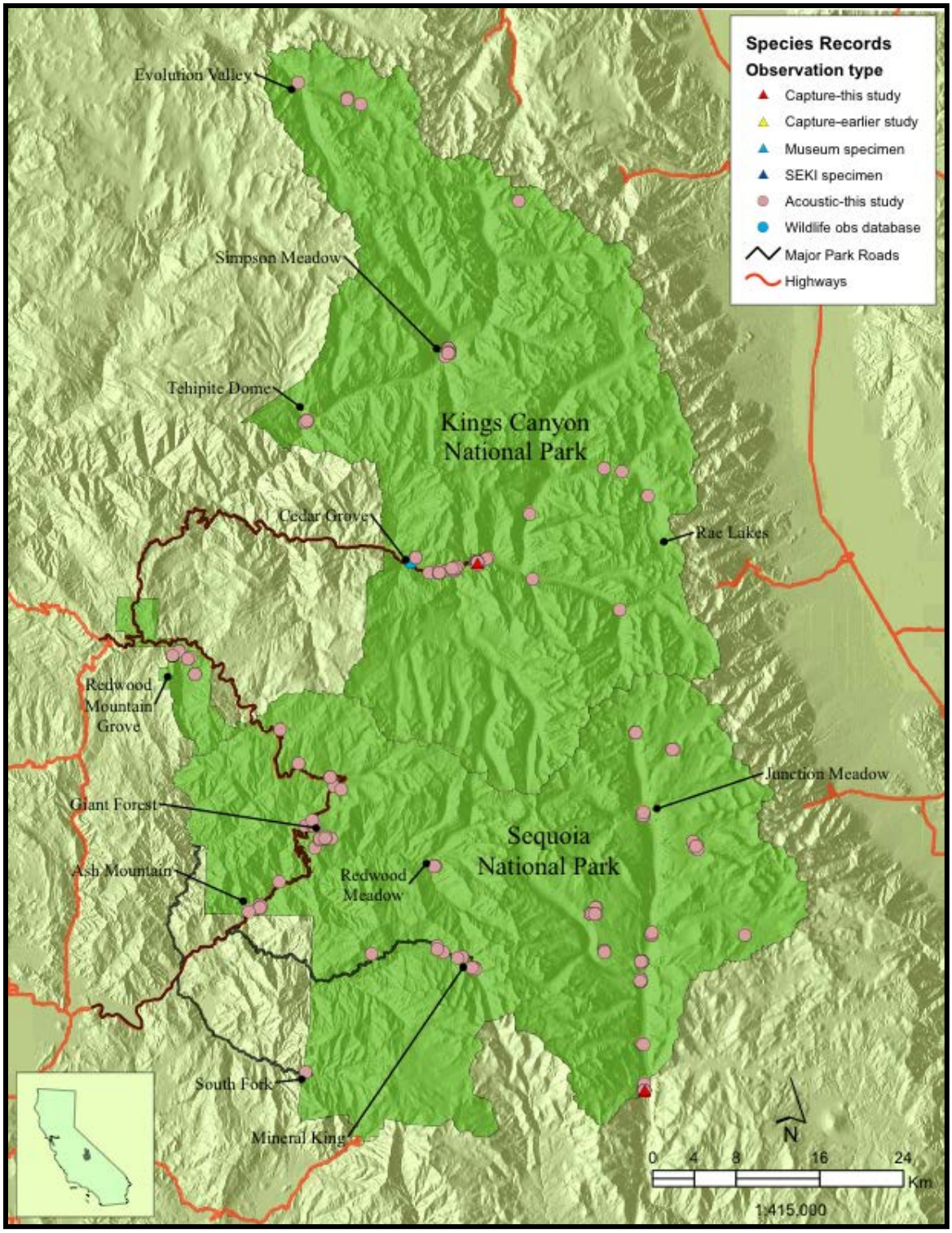


Figure 8.3. Map showing records for *Lasiurus cinereus* (hoary bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 8.1. Museum records for *L. cinereus* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector	NOTES
Outside		Hwy 6 mi NE Badger	36.67445	-118.91711	2964	22-Jun-34	U	MVZ-84261			

Table 8.2. Records for *L. cinereus* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
KCNP	SFK Kings	Cedar Grove Campground	36.79088	-118.66736	1417	24-Jun-73	42622	Schmoldt, D.

Table 8.3. Capture records for *L. cinereus* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
DEPO	MFK San Joaquin	San Joaquin, nr. Ranger Station	37.63028	-119.08516	2304	23-Aug-01			1							1
KCNP	SFK Kings	Cedar Grove, River @ Zumwalt	36.79312	-118.59533	1527	10-Jul-02						3				3
SQNP	Kern	Coyote Ck, Kern RS	36.34200	-118.40837	1970	27-Aug-05						1				1
SQNP	Kern	Kern RS, Meadow	36.34266	-118.40793	1970	28-Aug-05						2				2
						TOTALS	**0**	**0**	**1**	**0**	**0**	**6**	**0**	**0**	**0**	**7**

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; XX = numerous files, not counted.

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	Postpile	Postpile, talus, Ctr S edge	37.62493	-119.08424	2339	23-Aug-01	X
DEPO	MFK San Joaquin	Postpile	Postpile, talus, dowstream	37.62454	-119.08406	2337	23-Aug-01	X
DEPO	MFK San Joaquin	Postpile	Postpile, top	37.62442	-119.08328	2329	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Cottonwood, nr. Pkg,	37.63028	-119.08516	2280	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Cottonwood, upstrm Pkg	37.63069	-119.08532	2280	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Gravel bar, nr. Mdw nets	37.62901	-119.08441	2325	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Mdw edge, nr. Mdw nets	37.62870	-119.08438	2314	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, 70m N Soda Spg	37.62810	-119.08487	2158	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, Forest Edge	37.62832	-119.08570	2349	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, Willow Riparian	37.62911	-119.08447	2316	23-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Buttress Notch	37.61836	-119.08661	2381	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	East side Buttress, N end	37.62017	-119.08662	2379	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Lower end seep, SE Buttresses	37.61366	-119.08543	2292	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	28-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	28-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	28-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Meadow near footbridge	37.62799	-119.08480	2302	28-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	29-Jul-04	X
DEPO	MFK San Joaquin	Rainbow Falls	Rock outcrop above King Ck	37.59939	-119.08945	2210	29-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	29-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Meadow near footbridge	37.62799	-119.08480	2302	29-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	30-Jul-04	X

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; “XX “= numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	Rainbow Falls	Rock outcrop above King Ck	37.59939	-119.08945	2210	30-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	30-Jul-04	X
KCNP	SFK San Joaquin	Colby Mdw	Mdw/River edge	37.18321	-118.72972	2967	1-Aug-05	1
KCNP	SFK San Joaquin	McClure Mdw	Mdw nr camp	37.18832	-118.74419	2942	2-Aug-05	8
KCNP	SFK San Joaquin	McClure Mdw	River edge	37.18790	-118.74409	2939	2-Aug-05	5
KCNP	SFK San Joaquin	McClure Mdw	Shallow pool flooded mdw	37.18724	-118.74464	2933	2-Aug-05	5
KCNP	SFK San Joaquin	Blw. Goddard-Evolution Jct	Bench abv. Cyn floor	37.20017	-118.79784	2851	3-Aug-05	1
KCNP	MFK Kings	Dusy Basin	Edge of NW Big Lake	37.10210	-118.55732	3455	21-Aug-02	6
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	25-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Helipad log	36.97256	-118.63127	1807	25-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Campsite	36.97166	-118.63129	1817	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Floodplain net site	36.97563	-118.63169	1819	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Floodplain pool	36.97569	-118.63109	1819	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail	36.97330	-118.62932	1822	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail #2	36.97344	-118.62930	1830	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Top Rock outcrop	36.97104	-118.62931	1831	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Open PIJE stand, near PIJE snag	36.96851	-118.63390	1814	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Top Rock outcrop	36.97104	-118.62931	1831	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Very large pool, net site	36.97564	-118.63080	1819	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Helipad log	36.97256	-118.63127	1807	29-Jul-06	X

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; “XX” = numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	MFK Kings	Simpson Meadow	Whitethorn, PIJE, downslope trail	36.97161	-118.62993	1827	29-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Willow thicket	36.97138	-118.63122	1815	29-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Boulder Meadow	36.91164	-118.78181	1295	20-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Crown Ck Floodplain	36.90984	-118.78397	1271	20-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Side channel at camp	36.9-1193	-118.78077	1269	20-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Boulder Meadow	36.91164	-118.78181	1295	21-Jul-06	X
KCNP	SFK Kings	Baxter Meadow	Upper marshy pond	36.85190	-118.41382	2882	21-Jul-04	X
KCNP	SFK Kings	Bubbs Creek	Sphinx Trail Jct, campsite, on rock	36.77940	-118.53593	1901	23-Sep-05	20
KCNP	SFK Kings	Bubbs Creek	Lower Junction Mdw	36.75413	-118.44200	2496	27-Sep-05	1
KCNP	SFK Kings	Castle Dome Meadow	Talus slope, 100 m from forest edge	36.87418	-118.46139	2506	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	1st pull out W Road's end	36.79371	-118.59024	1527	9-Jul-02	13
KCNP	SFK Kings	Cedar Grove	Cliff base @ Zumwalt Mdw Pkg	36.79421	-118.59793	1540	9-Jul-02	35
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 1	36.78374	-118.63663	1469	9-Jul-02	36
KCNP	SFK Kings	Cedar Grove	N river @ Zumwalt Mdw	36.79301	-118.59547	1524	9-Jul-02	610
KCNP	SFK Kings	Cedar Grove	Road's End	36.79672	-118.58380	1565	9-Jul-02	9
KCNP	SFK Kings	Cedar Grove	Service Rd, betw Knapp & Cedar Grv	36.78274	-118.64697	1461	9-Jul-02	20
KCNP	SFK Kings	Cedar Grove	Burn by rd between bridges, E of CG	36.78456	-118.62061	1486	10-Jul-02	8
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 1	36.78374	-118.63663	1469	10-Jul-02	22
KCNP	SFK Kings	Cedar Grove	N river @ Zumwalt Mdw	36.79301	-118.59547	1524	10-Jul-02	224
KCNP	SFK Kings	Cedar Grove	Pool in side channel, near E end River Rd	36.78679	-118.62020	1481	10-Jul-02	5
KCNP	SFK Kings	Cedar Grove	River just E. Knapp's cabin	36.78369	-118.63337	1467	10-Jul-02	125
KCNP	SFK Kings	Cedar Grove	Talus at E end of River Rd	36.78809	-118.61687	1494	10-Jul-02	13

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; “XX” = numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, S edge	36.79098	-118.59503	1516	10-Jul-02	29
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, talus slope	36.79048	-118.59558	1534	10-Jul-02	36
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,N edge	36.79237	-118.59704	1539	10-Jul-02	237
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,NW crnr	36.79158	-118.59697	1520	10-Jul-02	254
KCNP	SFK Kings	Cedar Grove	Island, betw River and side channel	36.78645	-118.62046	1482	11-Jul-02	1
KCNP	SFK Kings	Cedar Grove	River Rd, 1st turnout	36.78715	-118.61978	1477	11-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Roadside, diagonal up road	36.78692	-118.62274	1470	11-Jul-02	1
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	20-Jul-04	XX
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	21-Jul-04	XX
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	22-Jul-04	XX
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	23-Jul-04	XX
KCNP	SFK Kings	Lower Paradise Valley	Grassy clearing at river edge	36.83501	-118.54024	2018	19-Jul-04	XX
KCNP	SFK Kings	Woods Creek Crossing	Log adj to rock outcrop	36.87236	-118.44191	2607	21-Jul-04	X
KCNP	NFK Kaweah	Redwood Mt. Grove	Btw. Hart Mdw & Goliath	36.69243	-118.89602	1955	30-Jun-05	2

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; “XX” = numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	1-Jul-05	9
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	1-Jul-05	147
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	1-Jul-05	4
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	2-Jul-05	2
KCNP	NFK Kaweah	Redwood Mt. Grove	Btw. Hart Mdw & Goliath	36.69243	-118.89602	1955	2-Jul-05	2
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	2-Jul-05	225
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	2-Jul-05	2
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	3-Jul-05	9
KCNP	NFK Kaweah	Redwood Mt. Grove	Hart Meadow	36.70694	-118.90160	1966	3-Jul-05	20
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	3-Jul-05	151
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	3-Jul-05	3
SQNP	EFK Kaweah	Mineral King	Cottonwoods, W of Tar Gap Pkg	36.45376	-118.60579	2325	1-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Redwood Ck, blw Xng Mineral King Rd	36.45586	-118.70159	2323	1-Aug-02	6
SQNP	EFK Kaweah	Mineral King	Cottonwoods, nr. Tar Gap Pkg	36.45363	-118.60475	2330	2-Aug-02	2
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 10 m fr river, upstrm net	36.44412	-118.59223	2414	2-Aug-02	2
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 50 m upslope fr net site	36.44463	-118.59184	2412	2-Aug-02	6
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 50 m upstream CF002	36.44347	-118.59234	2408	2-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Abv Ranger Station	36.45348	-118.60994	2325	3-Aug-02	7
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 500 m upstrm Pack Sta, net	36.44421	-118.59245	2413	3-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Farewell Gap trail, upslope fr net site	36.44389	-118.59134	2402	3-Aug-02	3
SQNP	EFK Kaweah	Mineral King	Eagle Lake Tr., 200 m trailhead	36.44571	-118.59455	2418	4-Aug-02	3
SQNP	EFK Kaweah	Mineral King	Faculty Flat Rocks	36.45794	-118.62525	2256	5-Aug-02	100

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; “XX” = numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	EFK Kaweah	Mineral King	Highbridge Ck	36.46334	-118.63184	2192	5-Aug-02	116
SQNP	EFK Kaweah	Mineral King	Highbridge Ck Rocks	36.46036	-118.63172	2234	5-Aug-02	44
SQNP	Marble FK Kaweah	Giant Forest	Beetle Rock, 50 m to forest edge	36.56462	-118.77499	1963	30-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	Crescent Mdw	36.55364	-118.74691	2044	30-Jul-02	9
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	30-Jul-02	3
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood meadow	36.56343	-118.76624	2039	30-Jul-02	104
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood trees	36.56419	-118.76451	2034	30-Jul-02	2
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-02	2
SQNP	Marble FK Kaweah	Giant Forest	Moro Rock, first rest area, 1/2 to top	36.54554	-118.76456	2003	30-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	Round Mdw tree	36.56973	-118.76777	2043	30-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Pila snag	36.55230	-118.75900	2060	31-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	31-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	Mdw at Tunnel Tree	36.55376	-118.75900	2036	31-Jul-02	7
SQNP	Marble FK Kaweah	Giant Forest	Net abv rd, Huckelberry Mdw Tr Xng	36.55459	-118.75301	2054	31-Jul-02	2
SQNP	Marble FK Kaweah	Giant Forest	Net blw rd, Huckleberry Mdw Tr Xng	36.55432	-118.75354	2054	31-Jul-02	1
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	29-Jul-02	2
SQNP	Marble FK Kaweah	Lodgepole	Dorst Ck, below rd Xng	36.64602	-118.80391	2023	29-Jul-02	2
SQNP	Marble FK Kaweah	Lodgepole	Halstead Ck, wet mdw abv rd Xng	36.61741	-118.78325	2143	29-Jul-02	5
SQNP	Marble FK Kaweah	Lodgepole	Red fir forest along highway	36.59874	-118.74489	2110	29-Jul-02	60
SQNP	Marble FK Kaweah	Lodgepole	Wet mdw nr. Wolverton Ck	36.59604	-118.73688	2211	29-Jul-02	1
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	30-Jul-02	1
SQNP	MFK Kaweah	Ash Mt	Alder Creek, below road	36.49268	-118.82482	542	12-Jul-02	1

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; “XX” = numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	MFK Kaweah	Ash Mt	Marble Fork Confluence	36.51569	-118.80184	635	12-Jul-02	1
SQNP	MFK Kaweah	Ash Mt	Above Parking at net site	36.49555	-118.82218	543	14-Jul-02	2
SQNP	MFK Kaweah	Ash Mt	Gravel bar 30 m abv abve net site	36.49390	-118.82068	501	14-Jul-02	2
SQNP	MFK Kaweah	Ash Mt	Gravel bar dwn fr net site	36.49429	-118.82032	499	14-Jul-02	1
SQNP	MFK Kaweah	Ash Mt	Gravel terrace, 100 m abv net site	36.49370	-118.82206	493	14-Jul-02	1
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr. - Farther East on dirt rd	36.49004	-118.83413	512	14-Jul-02	1
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Redwood Meadow	36.53188	-118.63554	1839	31-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Redwood Meadow	36.53188	-118.63554	1839	1-Sep-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Redwood Meadow	36.53133	-118.63645	1823	2-Sep-06	X
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Rock face, above entrance road	36.35282	-118.76980	1080	13-Jul-02	1
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Bench, S. of ck	36.47541	-118.40348	2164	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Near base of talus	36.47567	-118.40276	2140	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita campsite	36.47734	-118.30349	2096	21-Aug-05	1
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 50 m blw trail xing	36.47652	-118.40383	2097	22-Aug-05	2
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Talus slope	36.47779	-118.40270	2110	22-Aug-05	2
SQNP	Kern	Chagoopa, Treehouse Mdw	Meadow edge	36.49849	-118.46284	3162	25-Aug-05	7
SQNP	Kern	Chagoopa, Treehouse Mdw	Open Mdw, creek	36.49834	-118.46250	3157	25-Aug-05	2
SQNP	Kern	Chagoopa, Treehouse Mdw	Rock slope	36.49832	-118.46322	3168	25-Aug-05	1
SQNP	Kern	Chagoopa, Upper Trail Jct	E edge Mdw, Trail Jct	36.49316	-118.46871	3108	24-Aug-05	1
SQNP	Kern	Chagoopa, Upper Trail Jct	Larger moraine pond	36.49282	-118.46271	3156	24-Aug-05	1
SQNP	Kern	Chagoopa, Upper Trail Jct	Meadow, wet area	36.49291	-118.46903	3110	24-Aug-05	1

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; “XX” = numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Kern	Chagoopa, Upper Trail Jct	Sandy Flat	36.49297	-118.46653	3124	24-Aug-05	1
SQNP	Kern	Chagoopa, Upper Trail Jct	Smaller moraine pond	36.49294	-118.46384	3134	24-Aug-05	2
SQNP	Kern	Junction Meadow, Kern River	Rock outcrop at campsite	36.57792	-118.41325	2469	27-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Shallow side channel near campsite	36.57841	-118.41402	2450	27-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Up trail from Junction Mdw	36.58146	-118.41344	2490	28-Aug-04	X
SQNP	Kern	Kern Cut-Off, Abv Mitochondria Lk	Base cliff	36.64977	-118.42400	3341	20-Aug-05	4
SQNP	Kern	Kern Cut-Off, Abv Mitochondria Lk	Lower Mdw	36.64906	-118.42371	3340	20-Aug-05	4
SQNP	Kern	Kern Cut-Off, Abv Mitochondria Lk	Rock slope abv mdw	36.64944	-118.42338	3353	20-Aug-05	1
SQNP	Kern	Kern Ranger Station	Log, upslope Ranger Station	36.34254	-118.40972	1970	27-Aug-05	1
SQNP	Kern	Kern Ranger Station	Pasture at RS	36.34251	-118.40843	1964	27-Aug-05	3
SQNP	Kern	Kern Ranger Station	Ponderosa snag	36.34833	-118.40833	1979	27-Aug-05	3
SQNP	Kern	Kern Ranger Station	Pasture RS 1	36.34266	-118.40793	1964	28-Aug-05	3
SQNP	Kern	Kern Ranger Station	Pasture Center	36.34251	-118.40810	1964	28-Aug-05	11
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Fir stand talus base	36.43590	-118.41373	2037	26-Aug-05	1
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Flood plain	36.43745	-118.41348	2030	26-Aug-05	2
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Side Channel	36.43670	-118.41299	2045	26-Aug-05	1
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Talus abv camp	36.43659	-118.41445	2044	26-Aug-05	5
SQNP	Kern	Lower Crabtree Meadow	W. trail to Wallace Ck	36.55701	-118.36049	3230	25-Aug-04	X
SQNP	Kern	Lower Crabtree Meadow	Campsite on rock bench	36.55133	-118.35789	3156	26-Aug-04	X
SQNP	Kern	Lower Crabtree Meadow	Dry part of mdw, marmot mounds	36.55282	-118.35542	3146	26-Aug-04	X
SQNP	Kern	Lower Crabtree Meadow	S. end of L. Crabtree Mdw	36.55046	-118.35484	3152	26-Aug-04	X

Table 8.4. Acoustic records for *L. cinereus* obtained in this study. "X" = present, files not counted; “XX” = numerous files, not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Kern	Lower Crabtree Meadow	Shore Whitney Ck, Deep pool net site	36.55230	-118.35684	3146	26-Aug-04	X
SQNP	Kern	Lower Funston Meadow	Base of talus	36.38268	-118.41175	1973	2-Sep-04	X
SQNP	Kern	Lower Funston Meadow	Open meadow, edge by willows	36.38206	-118.41017	1974	2-Sep-04	X
SQNP	Kern	Moraine Lake	Lakeshore by camp	36.46186	-118.45367	2844	23-Aug-05	12
SQNP	Kern	Moraine Lake	Lodgepole nr camp	36.46166	-118.45319	2834	23-Aug-05	4
SQNP	Kern	Moraine Lake	Rocky lakeshore	36.46093	-118.45296	2837	23-Aug-05	3
SQNP	Kern	Tyndall Frog Ponds	Effluent Creek	36.63495	-118.38392	3372	19-Aug-05	4
SQNP	Kern	Tyndall Frog Ponds	Foot of talus	36.63506	-118.38209	3371	19-Aug-05	1
SQNP	Kern	Tyndall Frog Ponds	Frog Pond 1	36.63548	-118.38353	3369	19-Aug-05	2
SQNP	Kern	Upper Funston Meadow	Center of meadow, on log	36.45274	-118.41297	2049	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Nr. Base of talus, meadow edge	36.45196	-118.41351	2053	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Open area near stock rail	36.45317	-118.41299	2041	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Side channel near campsite	36.45295	-118.41235	2076	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Center of meadow, on log	36.45274	-118.41297	2049	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Side channel near campsite	36.45295	-118.41235	2076	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Talus above trail	36.45273	-118.41406	2046	31-Aug-04	X
							TOTAL SAMPLING SESSIONS	190

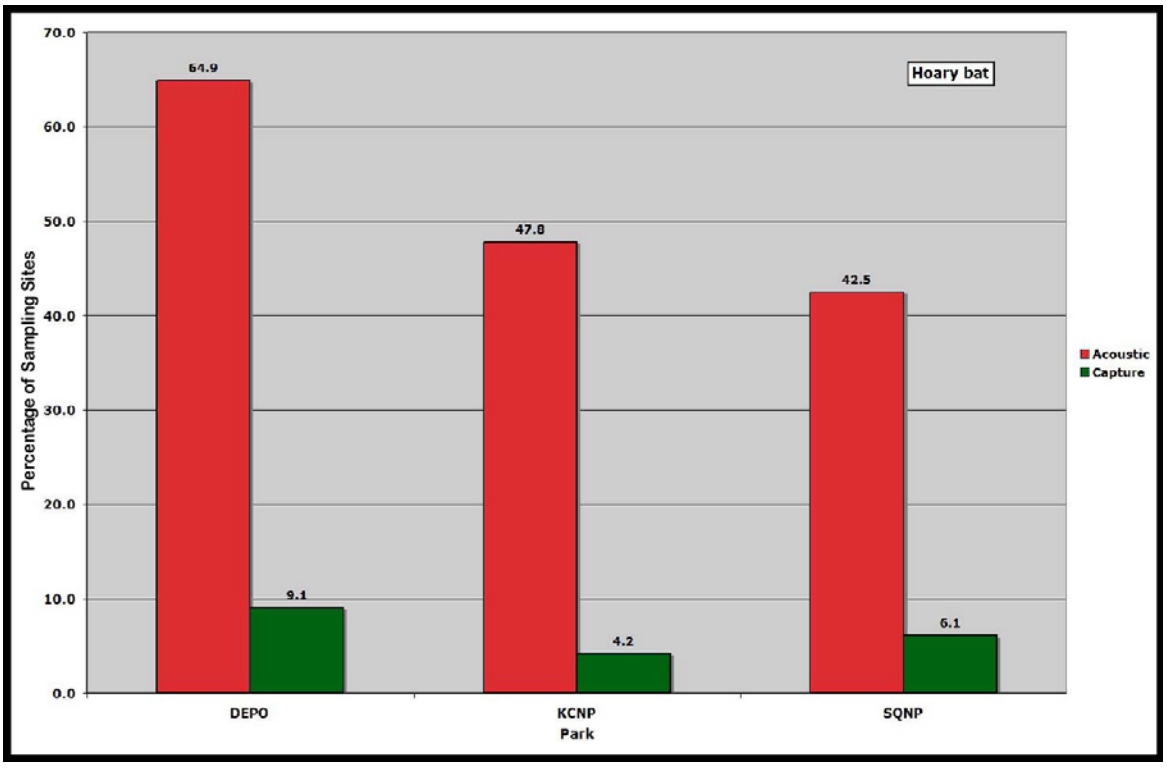


Figure 8.4. A bar graph comparing capture and acoustic records by park as measured by the percentage of sampling sites at which hoary bats were detected.

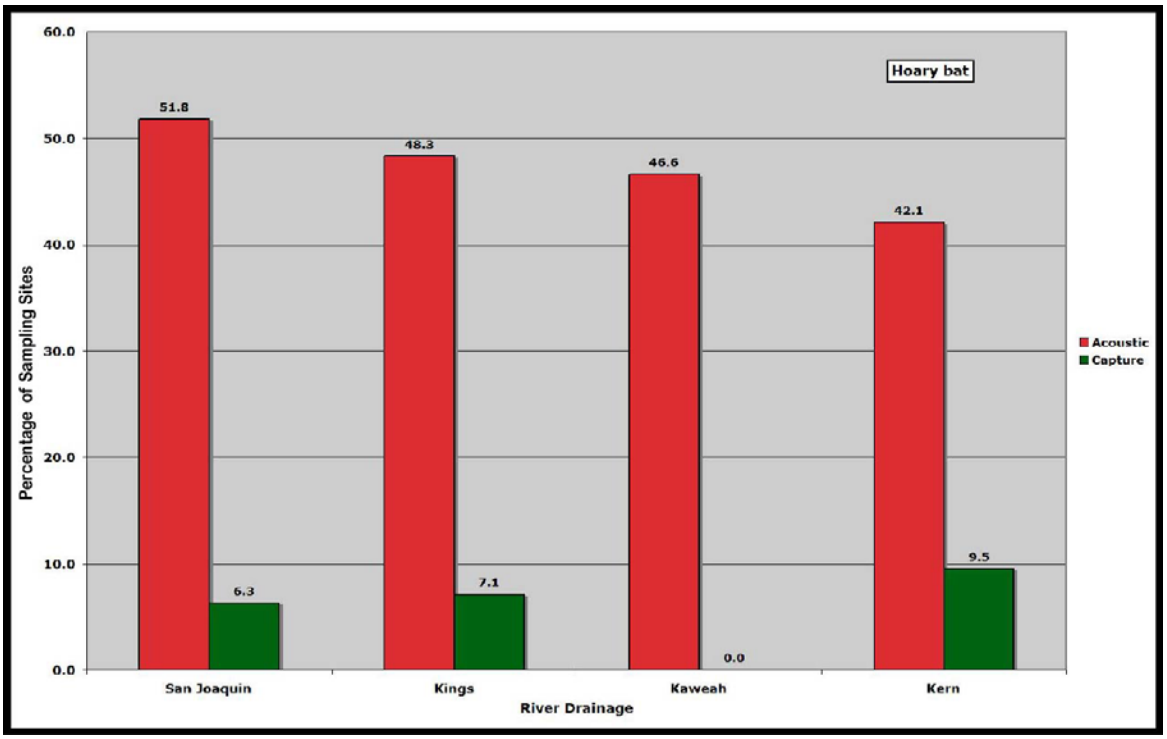


Figure 8.5. A bar graph comparing capture and acoustic records by river drainage as measured by the percentage of sampling sites at which hoary bats were detected.

Seasonal Distribution

A long-term detector at Shepherd's Saddle documented four years of seasonal activity for *L. cinereus*, showing pulses of activity in late April through May, consistent with northward spring migration (Figure 8.6). There is a less intense increase in activity in the late summer and fall, consistent with fall migration. There is very little activity in the summer, and some during the winter, suggesting that some individuals hibernate or over-winter at lower elevation in the Sierra Nevada.

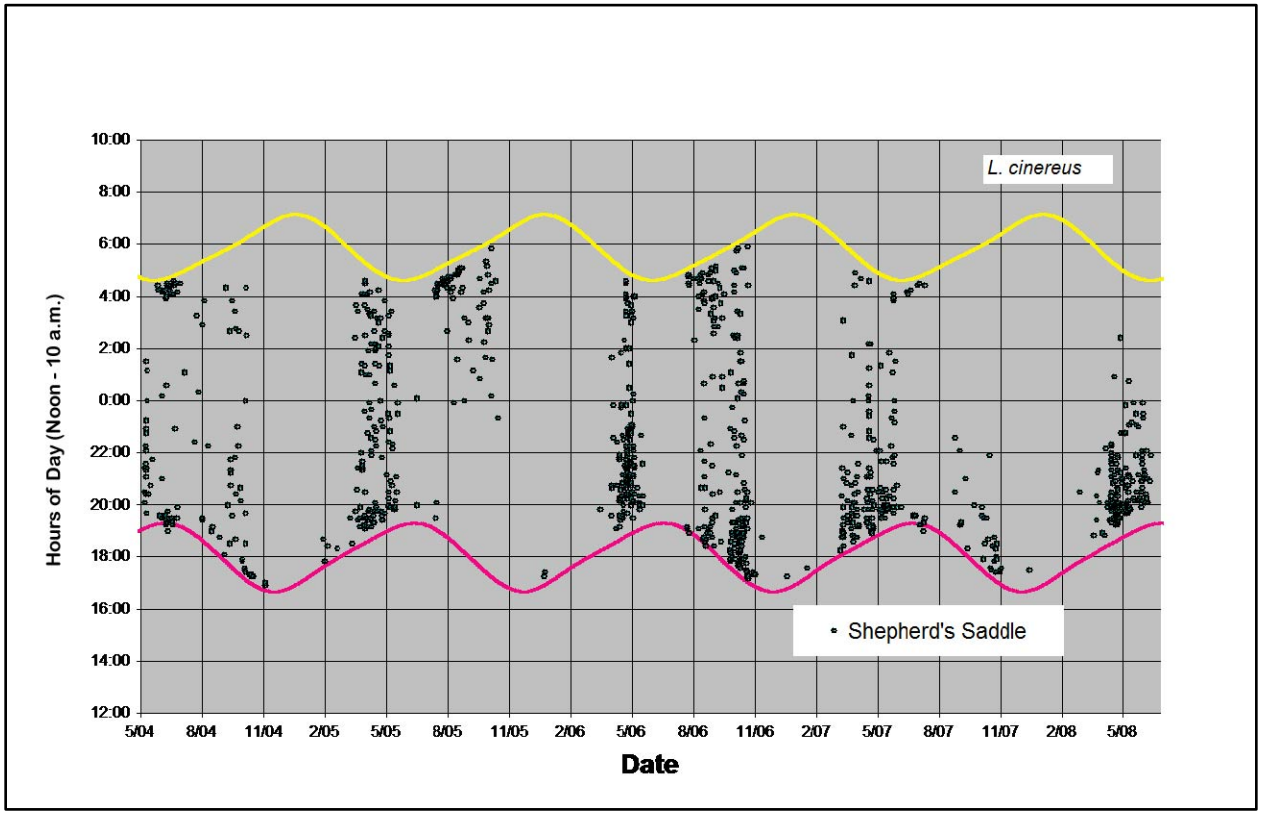


Figure 8.6. Seasonal pattern of hoary bat acoustic activity at Shepherd's Saddle. Symbols indicate 5 minute intervals with at leas one identified call. Curved lines show calculated local sunrise and sunset.

8.3. Habitat Associations

Vegetative Communities

L. cinereus was detected in the full range of plant communites from the lowest to highest elevations.

Roosting

L. cinereus roosts non-colonially, primarily in foliage in both coniferous and deciduous trees. Some unusual roosting situations have been reported in caves, beneath a rock ledge, in a woodpecker hole, and in a squirrel's nest (Tenaza 1966, Shump and Shump 1982b, van Zyll de Jong 1985), but the species is generally found in trees. In a radio-tracking study in Alberta (Barclay 1984), family groups, consisting of an adult female and two young, roosted high in trees (8-12 m above the ground), predominantly in green ash (*Fraxinus pennsylvanicus*). Roosts were generally near the tips of branches, in locations offering an unobstructed flight path. One family group used the same roost for 41 days, while another moved between two trees that were 10 m apart. In the southwestern U.S.

this species is frequently associated with riparian habitats (Hoffmeister 1986, Pierson et al. 2000), and is presumed to roost in trees such as cottonwood, sycamore and mature willow.

Foraging

L. cinereus forages along river and stream corridors, over open bodies of water, over meadows, in open forest habitat, and above forest canopies (Kalcounis *et al*.1999). In a radio-tracking study conducted in southern Canada, this species travelled up to 40 km and foraged in four habitats: lakeshore, forested ridge, meadows and marsh, with highest activity was in the lee of a forested ridge (Barclay 1984). It feeds primarily on 6-30 mm moths (Black 1974, Ross 1967), but is also known to consume Coleoptera, Hymenoptera, Isoptera, and Odonata. Rolseth et al. (1994) found that newly volant juveniles foraged primarily on smaller insects like chironomids. In a study in the upper Sacramento River drainage, the diet of this species was dominated by Lepidoptera (Rainey and Pierson 1996).

8.4. Management Issues

Status. *L. cinereus* has no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we ranked it as common, widely distributed, and occurring in a wide range of habitats.

Roosts. We have no information on the roosting requirements of this species in the Sierra Nevada.

Foraging. The acoustic data suggests a very broad habitat niche for foraging. Nevertheless, management activities that affect meadows or water sources should include consideration of this species.

Fire. Because other lasiurines (*L. blossevillii* and *L. noctivagans*) have been found hibernating in leaf litter, it should be presumed that this species could also engage in this behavior. Under that assumption, prescribed burns that occur between the late fall and the early spring are of potentially serious concern for this species.

Climate Change. The impact of climate change on this species is unknown.

9. *Myotis californicus*, California Myotis

9.1. Identification

Myotis californicus is a small bat (forearm 29-36 mm) with a pointed tragus, a keeled calcar, and a tiny foot (Barbour and Davis 1969) (Figure 9.1). Although its pelage color is highly variable throughout its range, in the Sierra Nevada it tends to be dark brown. It is most readily confused with *M. ciliolabrum*, which tends to be slightly bigger, have the last 1.5-2.5 mm of its tail exposed (Constantine 1998a), and have a dark mask that contrasts with somewhat lighter pelage. The safest way, however, to distinguish the two is to record echolocation calls upon release, since *M. ciliolabrum* is a 40 kHz bat and *M. californicus* is a 50 kHz bat. Its echolocation call is difficult to distinguish from that of the other 50 kHz species, *M. yumanensis*. We made no attempt in our acoustic analyses to distinguish this species acoustically from *M. yumanensis*.



Figure 9.1. Photograph of California myotis. (Credit: William E. Rainey)

9.2. Distribution

Geographic Range

M. californicus has a broad distribution in the North American west, ranging from southeastern Alaska, through southern British Columbia, most western United States to Baja California and Mexico (Simpson 1993).

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for the California myotis are mapped in Figure 9.2, and detailed in Tables 9.1-9.3.

There are 15 museum records for *M. californicus*, one from Cedar Grove, and the remainder for several localities in Sequoia National Park. The majority come from Giant Forest Highlands and the Colony Mill Ranger Station (the von Bloeker collection at the Santa Barbara Museum of Natural History) (Table 9.1). There are also multiple records for this species in the WODB (Table 9.2), two from Cedar Grove and the remainder from various sites in Sequoia NP.

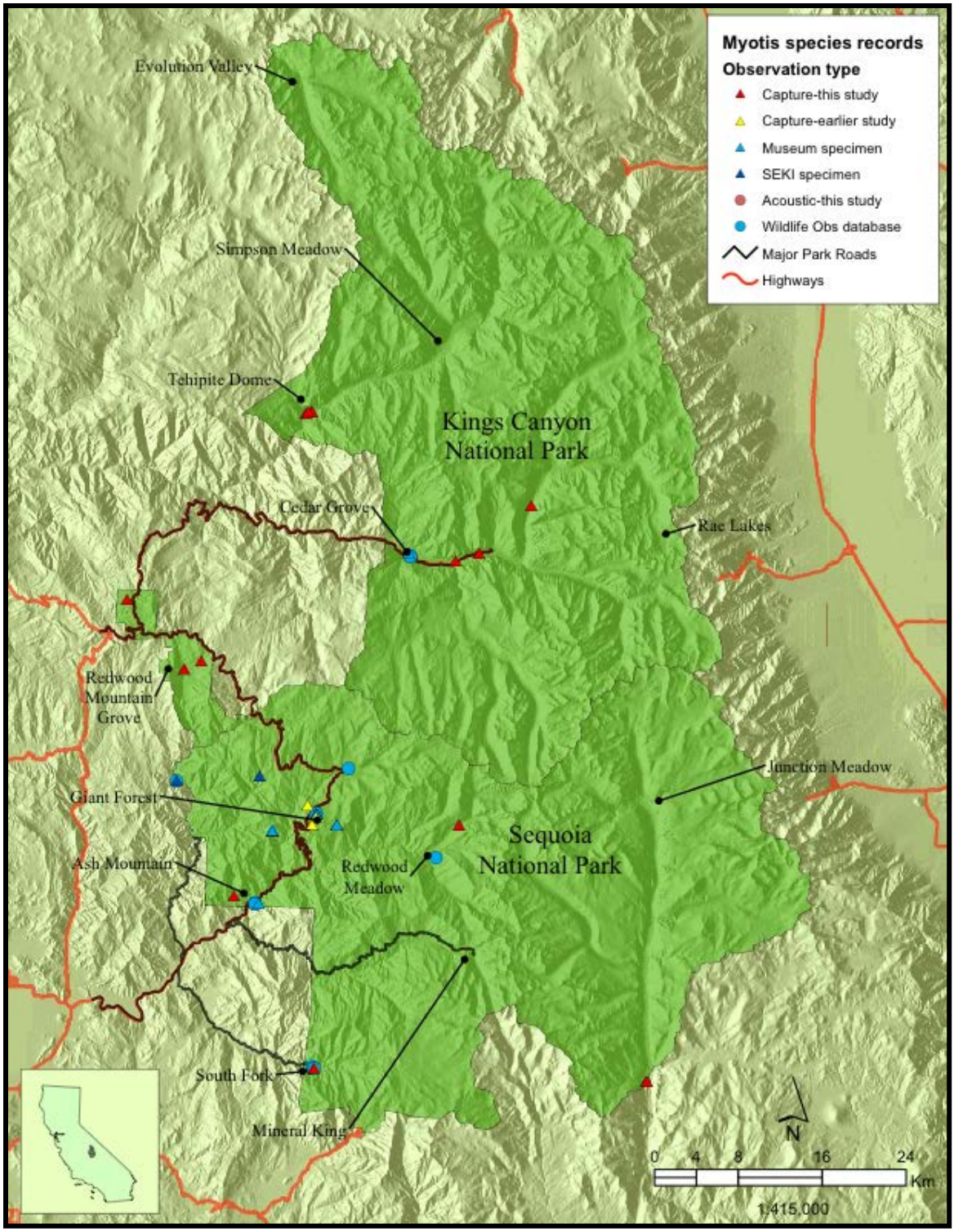


Figure 9.2. Map showing records for *Myotis californicus* (California myotis) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 9.1. Museum records for *M. californicus* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector
SQNP	NFK Kaweah	Burnt Point	36.59356	-118.91399	731	27-May-88	U/U	SEKI-8355	45180	Petterson, J.
SQNP	Marble Kaweah	Cascade Ck, blw Crystal Cave	36.59912	-118.82575	1386	18-Aug-88	M/A	SEKI-8316*	NA	Petterson, J.
KCNP	SFK Kings	Cedar Grove	36.79288	-118.67071	1407	8-May-42	F/U	MVZ-108985		Dixon, J.S.
SQNP	Marble Kaweah	Colony Mill Ranger Station	36.55236	-118.81109	1653	8-Aug-54	F/U	SBMNH-VB54-40		von Bloeker,J.
SQNP	Marble Kaweah	Colony Mill Ranger Station	36.55236	-118.81109	1653	8-Aug-54	M/U	SBMNH-VB54-41		von Bloeker,J.
SQNP	Marble Kaweah	Colony Mill Ranger Station	36.55236	-118.81109	1653	25-Jul-55	M/U	SBMNH-VB55-14		von Bloeker,J.
SQNP	Marble Kaweah	Colony Mill Ranger Station	36.55236	-118.81109	1653	25-Jul-55	M/U	SBMNH-VB55-15		von Bloeker,J.
SQNP	Marble Kaweah	Colony Mill Ranger Station	36.55236	-118.81109	1653	25-Jul-55	U/U	SBMNH-VB55-16		von Bloeker,J.
SQNP	Marble Kaweah	Colony Mill Ranger Station	36.55236	-118.81109	1653	18-Aug-54	F/U	SBMNH-VB54-71		von Bloeker,J.
SQNP	Marble Kaweah	Giant Forest Highland	36.56669	-118.76453	1979	31-Jul-55	M/U	SBMNH-VB54-33		von Bloeker,J.
SQNP	Marble Kaweah	Giant Forest Highland	36.56669	-118.76453	1979	10-Aug-54	M/U	SBMNH-VB54-42		von Bloeker,J.
SQNP	Marble Kaweah	Giant Forest Highland	36.56669	-118.76453	1979	22-Aug-55	F/U	SBMNH-VB55-111		von Bloeker,J.
SQNP	Marble Kaweah	Giant Forest, Huckleberry Mdw	36.55833	-118.74240	2061	24-Mar-05	M/U	CAS-3666		NA
SQNP	Marble Kaweah	Giant Forest, Huckleberry Mdw	36.55833	-118.74240	2061	24-Mar-05	F/U	CAS-3667		NA
SQNP	MFK Kaweah	Ash Mt C.C.C. Camp	36.48992	-118.82395	507	5-May-35	M/U	MVZ-70368		Garrison, L.

* Incorrectly identified in SEKI records as *M. yumanensis*

Table 9.2. Records for *M. californicus* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
KCNP	SFK Kings	Cedar Grove	36.79005	-118.66864	1405	9-Sep-16	43174	DixonJ
SQNP	Marble Kaweah	Giant Forest	36.56752	-118.76453	1982	6-Jul-33	43175	DixonJ
SQNP	MFK Kaweah	Ash Mtn	36.48985	-118.82811	509	Apr-35	43176	CarrisonL
SQNP	Marble Kaweah	Lodgepole Residence	36.60618	-118.73073	2048	1981	43177	HolserB
SQNP	SFK Kaweah	SFK Campground	36.34992	-118.76331	1114	28-Aug-86	43178	PiersonD
SQNP	SFK Kaweah	SFK Campground	36.34992	-118.76331	1114	28-Aug-86	43179	JeffreyT
SQNP	SFK Kaweah	SFK Campground	36.34992	-118.76331	1114	9-Jun-87	44293	JeffreyT
SQNP	SFK Kaweah	SFK Campground, Lady Bug Tr	36.34992	-118.76331	1114	16-Jul-87	44294	JeffreyT
SQNP	SFK Kaweah	SFK Campground, Lady Bug Tr	36.34992	-118.76331	1114	22-May-88	45173	PettersonJ
SQNP	N. Fk. Kaweah	N. Fk. Kaweah, nr. Burnt Point[a]	36.59356	-118.91399	731	27-May-88	45180	PettersonJ
SQNP	SFK Kaweah	SFK Campground, Lady Bug Tr	36.34992	-118.76331	1114	29-Jun-88	46443	JeffreyT
SQNP	SFK Kaweah	Campground, Lady Bug Trail[b]	36.34977	-118.76162	1-118	27-Jul-88	46470	JeffreyT
SQNP	MFK Kaweah	Ash Mtn Hdqrts FMO	36.48985	-118.82811	509	10-Apr-92	51929	WernerH
SQNP	Marble Kaweah	Giant Forest[c]	36.56488	-118.76477	1962	27-Jun-95	53107	Pierson, E.
SQNP	MFK Kaweah	Redwood Meadow	36.53111	-118.63590	1837	28-Jul-95	59633	KoshearJ
SQNP	MFK Kaweah	Ash Mtn. Headquarters	36.48985	-118.82811	509	2-Oct-96	53894	GraberD
KCNP	SFK Kings	Cedar Grove Residence	36.79005	-118.66864	1405	May-00	59098	SessionsR

[a] Also SEKI Museum specimen #8355 (Table 9.1)

[b] Also as Pierson and Rainey capture record (Table 9.3)

[c] Also as Pierson and Rainey capture record (Table 9.3)

Table 9.3. Capture records for *M. californicus* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
KCNP	MFK Kings	Tehipite, Side Channel #1	36.91227	-118.77769	1265	21-Jul-06				1		1				2
KCNP	MFK Kings	Tehipite, Side Channel #2	36.91243	-118.77670	1270	22-Jul-06						1	1			2
KCNP	MFK Kings	Tehipite, nr. Crown Creek	36.91012	-118.78315	1260	23-Jul-06		2				1				3
KCNP	MFK Kings	Tehipite, nr. Camp	36.9-1193	-118.78076	1266	24-Jul-06		1								1
KCNP	SFK Kings	Cedar Grove, River @ Zumwalt	36.79312	-118.59533	1527	10-Jul-02						1				1
KCNP	SFK Kings	Cedar Grove, River Side	36.78673	-118.62043	1483	11-Jul-02						1				1
KCNP	SFK Kings	Lower Paradise Valley	36.83484	-118.54026	2011	19-Jul-04				1						1
KCNP	SFK Kings	Fallen Monarch, Grant Grove	36.74858	-118.97085	1945	30-Jun-05		2				1				3
KCNP	NFK Kaweah	Redwood Creek, Low Trail Xing	36.68922	-118.90831	1706	1-Jul-05										0
KCNP	NFK Kaweah	East FK Redwood Ck, Trail Xing	36.69677	-118.89008	1914	2-Jul-05						2				2
SQNP	MFK Kaweah	Sycamore Ck, abv road	36.49556	-118.85039	651	28-Jun-05		1								1
SQNP	MFK Kaweah	River blw Bearpaw, Pool #6	36.55938	-118.61206	1940	31-Aug-06						1				1
SQNP	SFK Kaweah	River abv Campground	36.34903	-118.76219	1134	13-Jul-02						1				1
SQNP	Kern	Coyote Creek, Kern RS	36.34200	-118.40837	1970	27-Aug-05							1	1		2
SQNP	Kern	Coyote Creek, Kern RS	36.34266	-118.40793	1970	28-Aug-05						1				1
						TOTALS	**0**	**6**	**0**	**2**	**0**	**11**	**2**	**1**	**0**	**22**

Table 9.3. Capture records for M. californicus from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument. (continued)

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
THIS STUDY							Adult Females					Adult	Juv	Juv	Unk	Totals
							Preg	Lact	Plac	Null	Par	Male	Female	Male		
SQNP	Marble Kaweah	Giant Forest, Hazelwood Trail[a]	36.56488	-118.76477	1962	28-Jun-99						1				1
SQNP	Marble Kaweah	Giant Forest, Crescent Mdw Rd	36.55843	-118.76870	2000	13-Sep-99						1				1
SQNP	Marble Kaweah	Giant Forest, Sunset Rock	36.57524	-118.77367	1953	14-Sep-99						2				2
SQNP	SFK Kaweah	Campground, Lady Bug Trail[b]	36.34977	-118.76162	1118	28-Jul-92						1				1
						TOTALS	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**5**

[a] Also appears as REC NUM 53107 in WODB

[b] Also appears as REC NUM 46470 in WODB

In the current surveys, *M. californicus* was one of the least frequently encountered species overall, accounting for only 3.35% of all net captures (Figure 7 in main report). Figure 8 (main report) indicates while we detected this species at 15 out of 68 (22%) sites, we captured fewer than expected per site. It was quite uncommon in both Kings Canyon and Sequoia, and not encountered at all in Devils Postpile (Figure 9.3). It was, nevertheless, quite widely distributed in Kings Canyon, being detected in 41.7% of all netting sessions.

We captured this species in all the river drainages except the San Joaquin (Figure 9.4), detecting it in 50% of the sampling sessions in the Kings drainage. Its absence from Devils Postpile and all the San Joaquin River sites, and its occurrence at only one site on the Kern (Kern Ranger Station), is likely explained by its apparent restriction to elevations below about 2,000 m (Figure 48 in main report). Its absence from high elevations is consistent with studies conducted in Yosemite National Park where the highest elevation record is 2128 m (Pierson et al. 2006). Records obtained in this study, prior studies we conducted in Giant Forest, museum records, and a study conducted in Yosemite National Park (Pierson et al. 2006) all suggest an association for this species with giant sequoia groves.

Of the 27 individuals we captured in this and prior studies, 16 (59%) were adult males, and six (22%) were reproductively active females. Four of the reproductive females were captured at relatively low elevation sites (Tehipite Valley and Ash Mountain), and two in Grant Grove (Table 9.3). Two juveniles, captured at Kern Ranger Station, provided the first records for the Kern drainage, and suggested reproductive populations occur in that area.

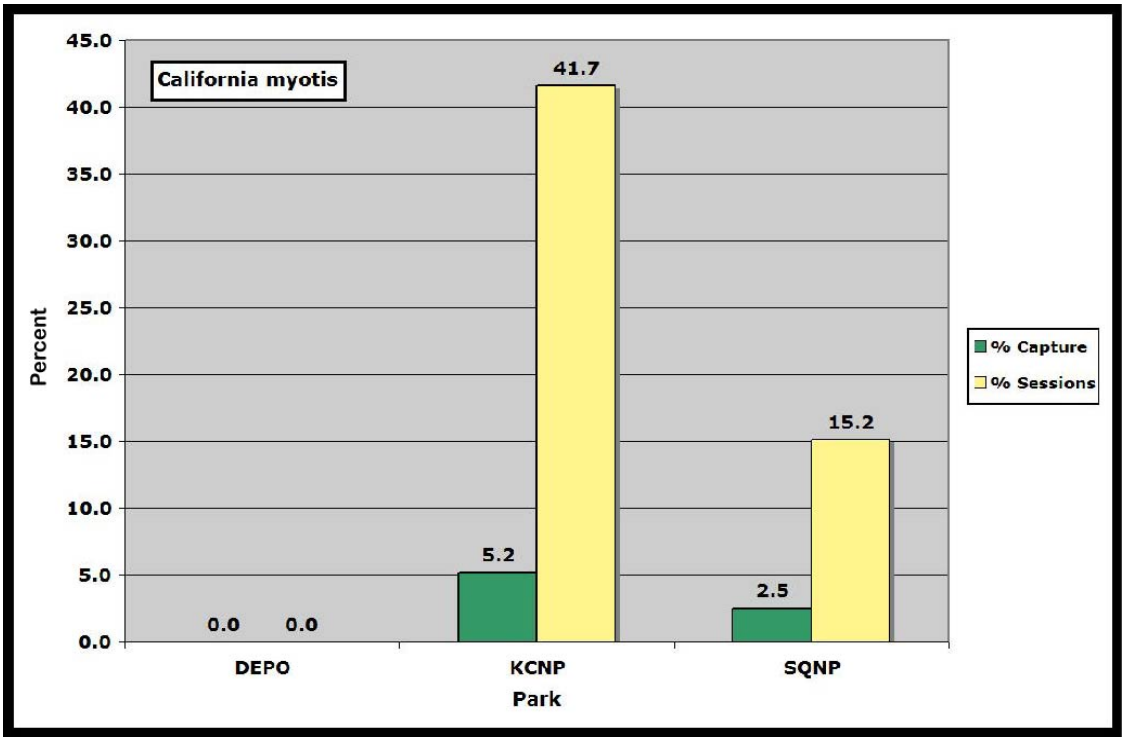


Figure 9.3. A bar graph comparing capture records by park as measured by the percentage of total captures and percentage of sampling sessions in which California myotis were detected.

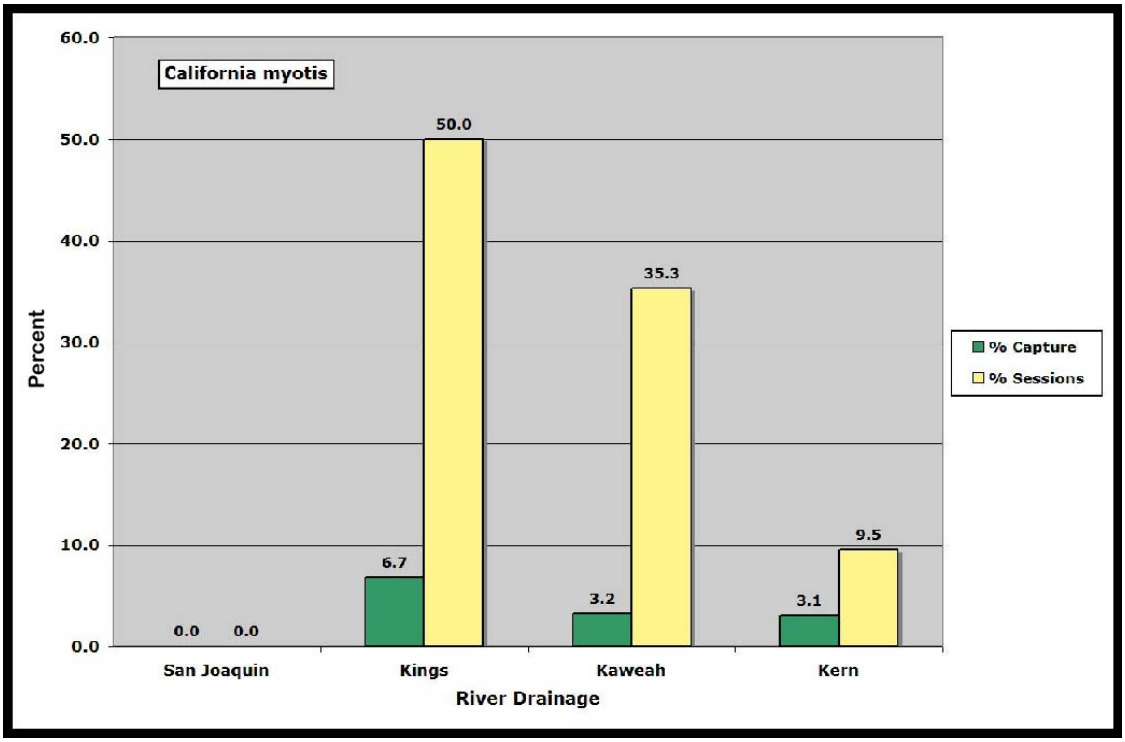


Figure 9.4. A bar graph comparing capture records by river drainage as measured by the percentage of total captures and percentage of sampling sessions in which California myotis were detected.

An analysis of our netting data using a univariate model indicates that elevation is by far the strongest indicator for the capture of *M. californicus* (Table 9.4).

Table 9.4. Univariate Model Selection

	df	**AIC**
Meadow_Scrub	4	121.7973
Forest	2	120.4802
Elev_m	2	101.8524
Water	7	-119.1157
Rock	4	117.9206

An analysis of the distribution of captures of *M. californicus* over the elevational range shows that numbers declined with increase in elevation, and none were captured above about 2,000 m (Table 9.5, Figure 9.5).

Table 9.5. Terms of the model for elevation.

Coefficients:	**Estimate**	**Std. Error**	**Z Value**	**Pr(>|z|)**
(Intercept)	0.8614384	0.5031868	1.712	0.0869
Elev_m	-0.0013163	0.0002974	-4.426	9.59e-06 ***

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Null deviance: 81.698 on 102 degrees of freedom

Residual deviance: 63.019 on 101 degrees of freedom

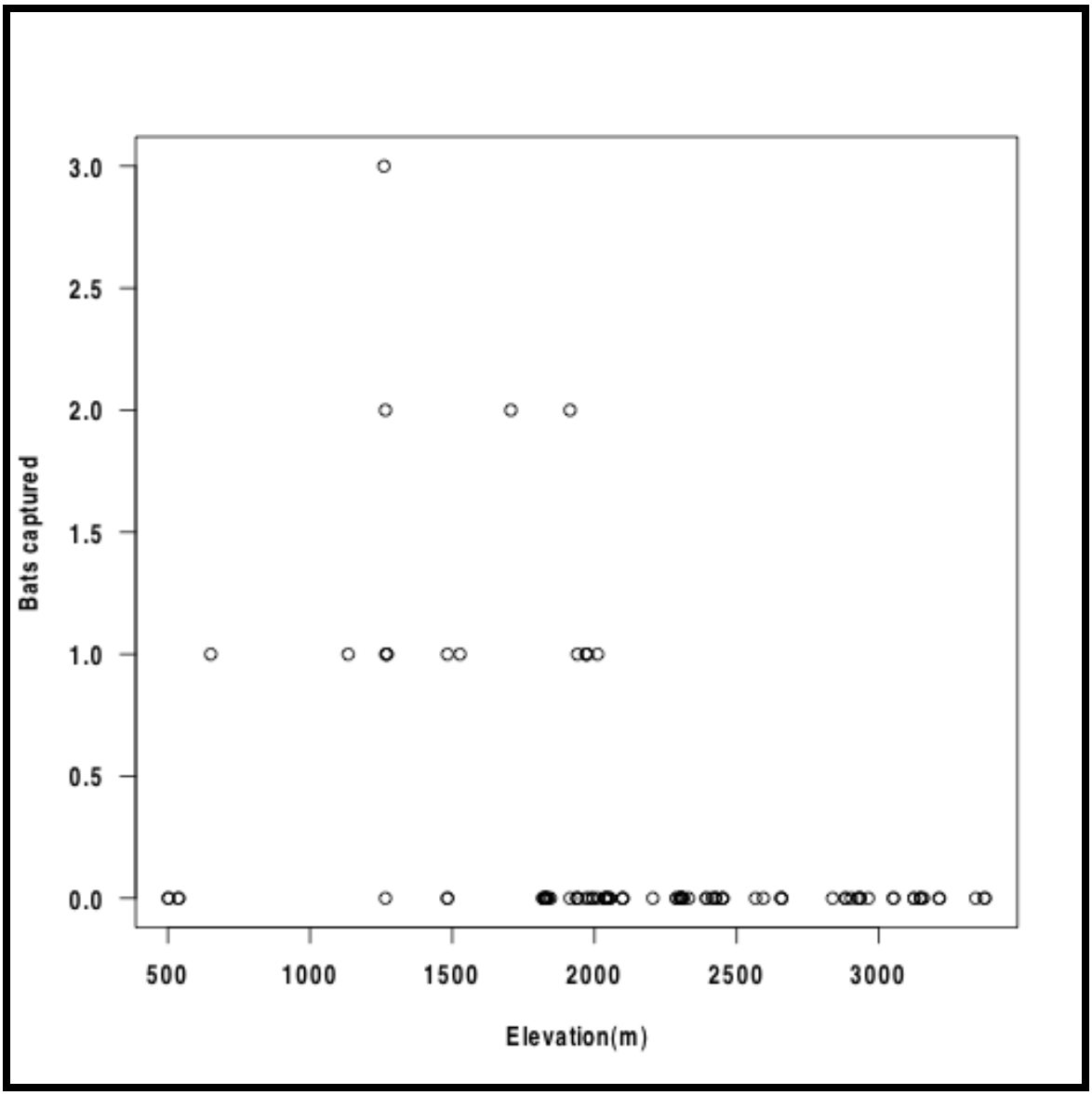


Figure 9.5. Graph showing the distribution of captures for *M. californicus* by elevation.

9.3. Habitat Associations

Vegetative Communities

This species is found in most, if not all, plant communities below 2,000 m. Historically, it has been associated with lower elevation plant communities (e.g., oak, willow, cottonwood) (Barbour and Davis 1969), but is also found in desert canyons, and was one of the species most frequently encountered in the giant sequoia groves in Yosemite National Park (Pierson et al. 2006).

Roosting

M. californicus is a crevice roosting species that uses a wide variety of both natural and anthropogenic roosts. It tends to roost alone or in small, loosely aggregated colonies. In natural settings it is found in rock crevices (including boulders close to the ground), in crevices inside caves,

inside hollow trees, and beneath loose bark. It is also frequently associated with man-made structures, being found in buildings, bridges, and mine tunnels. It is sometimes even found under signboards (Barbour and Davis 1969, Brigham et al. 1997, van Zyll de Jong 1985). Solitary individuals and small groups have been found in caves, mines, and buildings in the winter in southern California (Krutzsch 1954).

Foraging

M. californicus emerges prior to dark. Its diet is dominated by Lepidoptera, but also includes Diptera, Hemiptera, Trichoptera, and Coleoptera (Simpson 1993, Whitaker et al. 1977 & 1981b). In a study in the upper Sacramento River drainage the diet of this species was dominated by Hymenoptera, Lepidoptera and Trichoptera (Rainey and Pierson 1996). It is often detected feeding around the canopy of oak trees or along riparian corridors in association with cottonwood, sycamore and willow. Individuals are known to be active periodically in the winter, even at temperatures below freezing (O'Farrell and Bradley 1970).

9.4. Management Issues

Status. California myotis have no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we characterized this species as locally abundant and occurring in multiple habitats, but within a restricted elevation range. Although it was nowhere abundant, its distribution in so many habitats suggests a robust population.

Roosts. This species was netted night-roosting in the Fallen Monarch giant sequoia log in Grant Grove, and records in the WODB indicate it is found occasionally in park buildings. Although information on roosting behavior for this species within Sequoia and Kings Canyon is limited, data from elsewhere documents that this species uses a variety of roost sites. While it is likely that use of natural roosts predominates in the parks, this species should be considered whenever alterations are proposed to any potential roost sites. This would include, but not be limited to, closures of abandoned mines, alteration of rock/cliff areas (*e.g.*, blasting for road construction or repair), hazard tree removal, bridge construction or repair, and removal of or major modifications of buildings. While this species can also use caves, there is no indication that current recreational use of caves within the parks threatens this species.

Foraging. This species generally forages around tree canopies, often well away from aquatic settings. Any management activities that would alter the prey base in forested habitats should trigger consideration of this species.

Fire. Prescribed burns are not likely to pose problems. Crown fires would be expected to destroy some tree roosting habitat in the short-term, and generate tree roosting habitat and enriched foraging habitat in the longer-term, depending on fire severity and extent and how various forest types respond post-fire.

Climate Change. We would expect the range of this species to expand up in elevation with a warming climate. This species occurs in xeric habitats in other parts of its range and thus may adapt better than some other to drier conditions anticipated with global warming.

10. *Myotis ciliolabrum*, Small-footed Myotis

10.1. Identification

Myotis ciliolabrum is a small bat (forearm 30-36 mm) with a pointed tragus, a keeled calcar, and a tiny foot (Barbour and Davis 1969, Holloway and Barclay 2001) (Figure 10.1). Although its pelage color is somewhat variable throughout its range, in the Sierra Nevada it tends to be light brown, and have a dark mask. It is most readily confused with *M. californicus*, although it tends to be slightly larger, and usually has the last 1.5-2.5 mm of its tail exposed (Constantine 1998a). The surest way, however, to distinguish the two is to record echolocation calls upon release, since *M. ciliolabrum* is a 40 kHz bat and *M. californicus* is a 50 kHz bat. Its echolocation call is difficult to distinguish from that of other 40 kHz species, *M. lucifugus,* and *M. volans*. We made no attempt in our acoustic surveys to distinguish this species acoustically from other 40 KHz *Myotis.*



Figure 10.1. Photograph of Small-footed myotis. (Credit: William E. Rainey)

10.2. Distribution

Geographic Range

M. ciliolabrum is a western species, with a distribution extending from southern Canada to Central Mexico (Holloway and Barclay 2001). In California it appears to be more common in the White and Inyo mountains (Szewczak et al. 1998) than it is in the Sierra Nevada, and occurs along the coast only in southern California, south of the Los Angeles basin.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known localities for *M. ciliolabrum* are mapped in Figure 10.2 and detailed in Table 10.1.

Prior to this inventory there were no records for this species in any of the parks. While it was one of the least frequently encountered species (Figure 7 in main report narrative), and no site yielded more than one individual per sampling effort, it did occur at 10 sites– five in Kings Canyon and five in Sequoia (Table 10.1). We obtained no records for Devils Postpile or the San Joaquin drainage. Despite its apparent rarity, it covered a greater elevation range than any other species (Figure 48 in main report narrative), being detected from the lowest elevation area (Ash Mountain) to one of our highest elevation sites, a hanging meadow above Mitochondria Lakes in the Kern drainage at 3,340 m (a high elevation record for this species). Despite its rarity, it appears to have a fairly broad distribution in both Kings Canyon and Sequoia, and in all the river drainages except the San Joaquin (Figures 10.3 and 10.4). Its absence from our sampling in Devils Postpile and the San Joaquin is somewhat surprising, and it is our expectation that the species does occur there. Nevertheless, it appears to be more prevalent in Kings Canyon and Sequoia than it is in Yosemite, suggesting that it increases in abundance with decline in latitude.

Eight of the 10 individuals captured were adult males. The other two individuals were juveniles captured on the river at Ash Mountain and Lower Paradise Valley, indicating that there are reproductive populations of this species at lower elevations in both Sequoia and Kings Canyon.

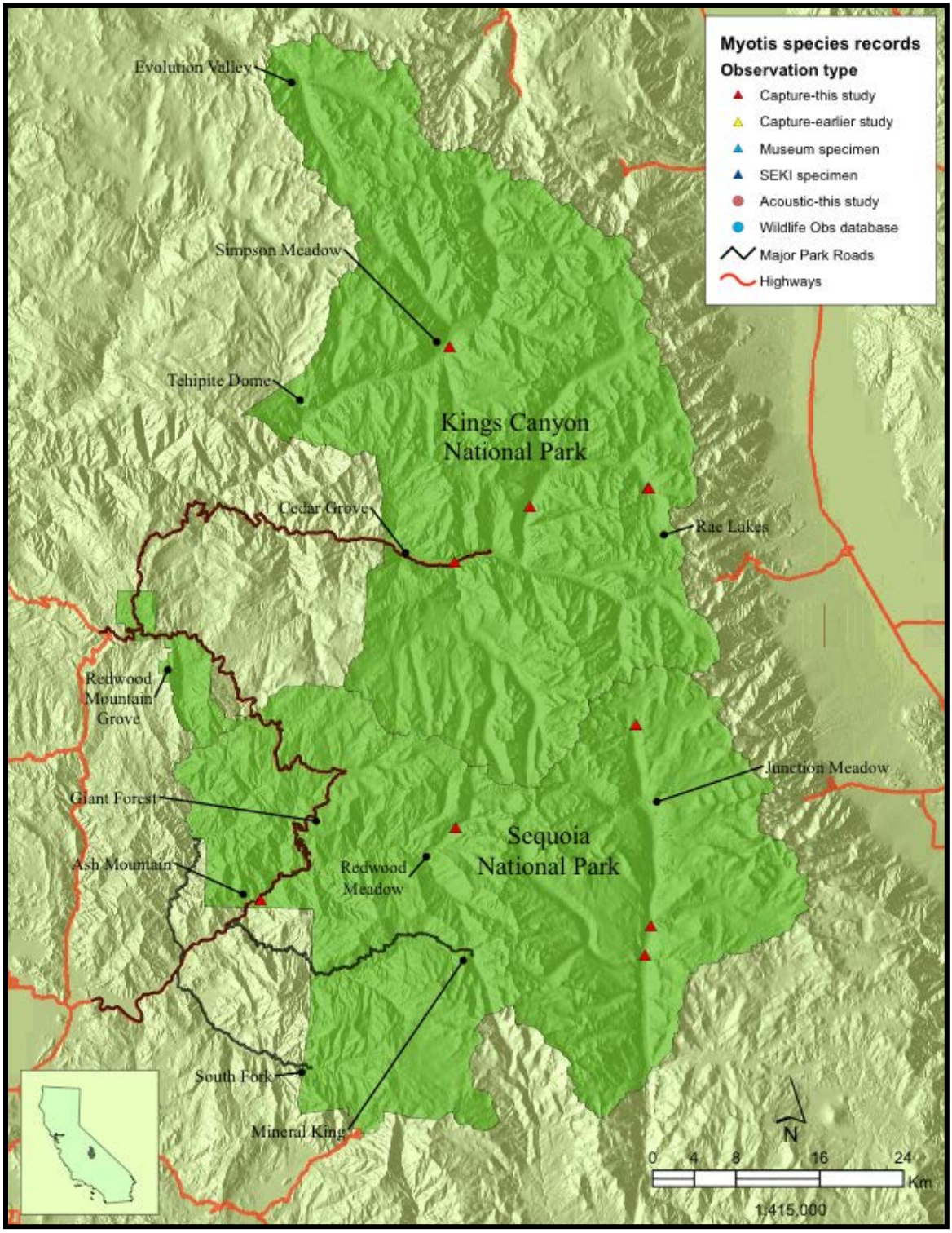


Figure 10.2. Map showing records for *Myotis ciliolabrum* (small-footed myotis) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 10.1. Capture records for *M. ciliolabrum* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
THIS STUDY							Adult Females					Adult	Juv	Juv	Unk	Totals
							Preg	Lact	Plac	Null	Par	Male	Female	Male		
KCNP	MFK Kings	Simpson Mdw, Deep Pool	36.97109	-118.62931	1831	28-Jul-06						1				1
KCNP	SFK Kings	Cedar Grove, River Side Channel	36.78673	-118.62043	1483	11-Jul-02						1				1
KCNP	SFK Kings	Lower Paradise Valley	36.83484	-118.54026	2011	19-Jul-04							1			1
KCNP	SFK Kings	Baxter Meadow, wet	36.85190	-118.41382	2882	21-Jul-04						1				1
KCNP	SFK Kings	Baxter Meadow, near camp	36.85191	-118.41282	2902	22-Jul-04						1				1
SQNP	MFK Kaweah	River abv Ash Mountain	36.49378	-118.82102	502	14-Jul-02							1			1
SQNP	MFK Kaweah	River blw Bearpaw, Pool #3	36.55901	-118.61414	1938	30-Aug-06						1				1
SQNP	Kern	Rock Ck, blw Kern Hot Springs	36.47710	-118.40388	2099	29-Aug-04						1				1
SQNP	Kern	Upper Funston Mdw @ River	36.45207	-118.40990	2040	30-Aug-04						1				1
SQNP	Kern	Kern Cut-Off, abv Mitochondria Lk	36.64920	-118.42295	3340	20-Aug-05						1				1
						TOTALS	**0**	**0**	**0**	**0**	**0**	**8**	**2**	**0**	**0**	**10**

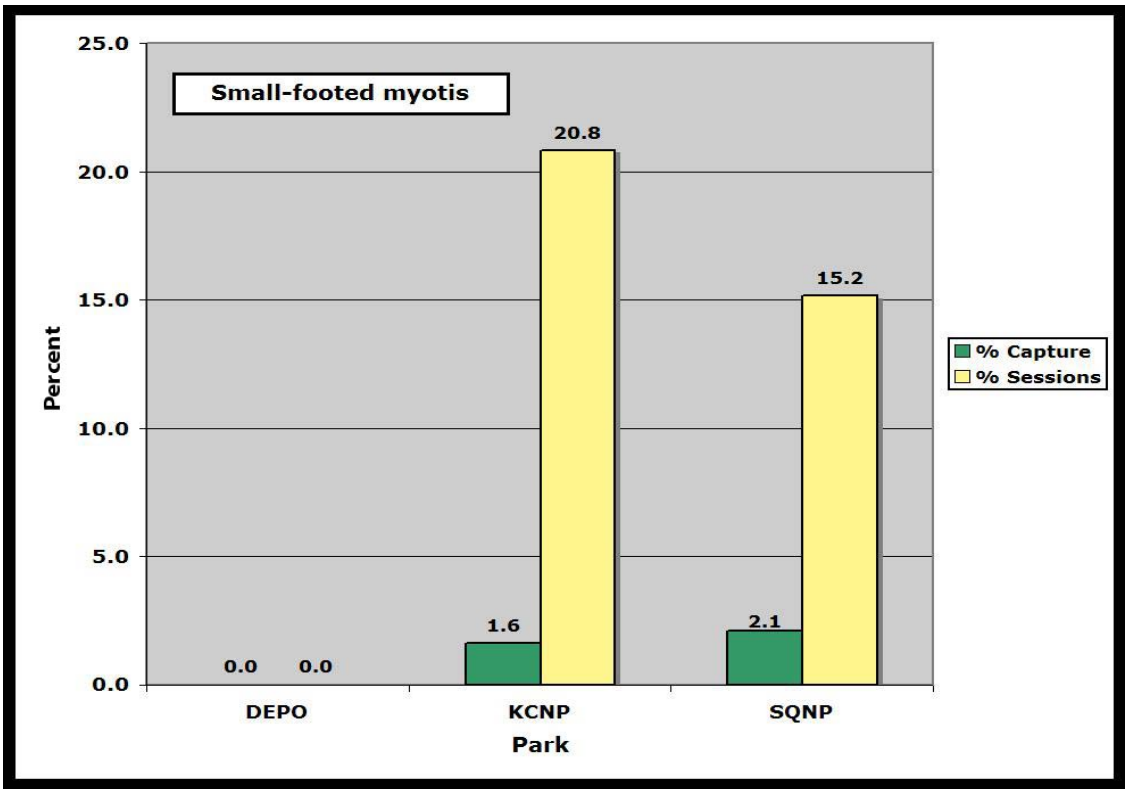


Figure 10.3. A bar graph comparing capture records by park as measured by the percentage of total captures and percentage of sampling sessions in which the small-footed myotis were detected.

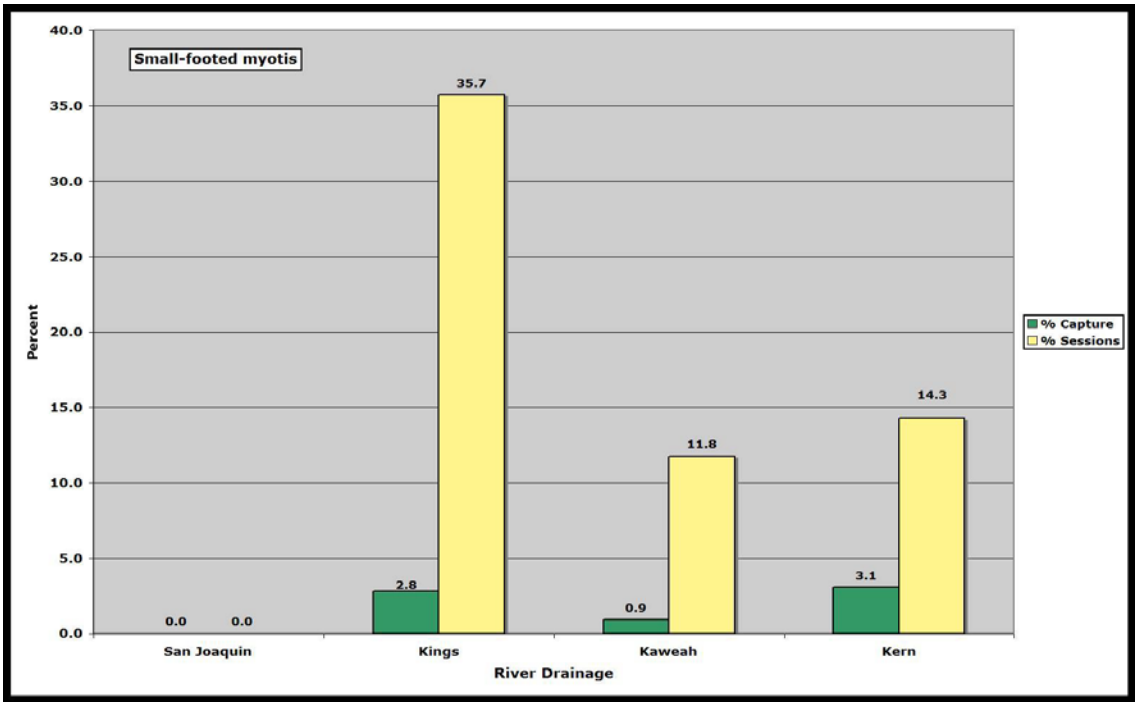


Figure 10.4 A bar graph comparing capture records by river drainage as measured by the percentage of total captures and percentage of sampling sessions in which small-footed myotis were detected.

An analysis of our limited netting data using a univariate model indicates that forest and elevation are associated with the capture of *M. ciliolabrum*, and water is a poor explainer of its distribution (Table 10.2).

Table 10.2. Univariate Model Selection

	df	AIC
Meadow_Scrub	4	72.66541
Forest	2	70.57643
Elev_m	2	70.52792
Water	7	75.16749
Rock	4	73.43647

10.3. Habitat Associations

Vegetative Communities

This species was found in a wide range of habitats from blue oak savannah in Ash Mountain to lodgepole-foxtail pine habitat above Mitochondria Lake.

Roosting

This species is thought to roost primarily in rock crevices, caves, and tunnels, and occasionally in buildings and trees (Holloway and Barclay 2001). Its habits in California are poorly known, but it is thought to form small, loosely aggregated nursery colonies, and records appear to be most highly associated with rocky habitat, suggesting rock roosting predominates.

Foraging

M. ciliolabrum flies in irregular patterns, between ca. one meter above the ground to tree canopy height, and have been observed foraging both over water and along rocky bluffs (Holloway and Barclay 2001). In several diet studies, *M. ciliolabrum* has been shown to eat a variety of insects, including Lepidoptera, Diptera, Hemiptera, Coleopteran ad Tricoptera. The diet of three individuals captured in Yosemite National Park was dominated by Trichoptera and scarab beetles, but also included Ditpera and Lepidoptera (Pierson et al. unpublished data).

10.4. Management Issues

Status. Small-footed myotis have no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we characterized this species as being everywhere rare, covering a large elevation range, and given its presumed strong preference for rocks for roosting, being somewhat restricted in its habitat requirements.

Roosts. This species is so poorly known it is difficult to identify particular issues related to roosts. Because it is thought to roost in small colonies, it likely has a dispersed distribution, making disturbance of roost sites less of an issue for this species that those that form larger aggregations. Nevertheless, this species should be considered in any activities that alter or impact rock habitat.

Foraging. Data from Yosemite suggests this species forages in both terrestrial and aquatic habitats. Thus any activities that would alter its prey base, particularly aquatic emergent insects (Diptera or Trichoptera) or small Coleoptera or Lepidoptera could have negative impacts on this species.

Fire. Prescribed burns are not likely to pose problems for this species.

Climate Change. We would expect the range of this species to expand up in elevation with a warming climate. This species occurs in xeric habitats in other parts of its range and thus may adapt better than some other to drier conditions anticipated with global warming.

11. *Myotis evotis*, Long-eared Myotis

11.1. Identification

Myotis evotis is a medium-sized myotis with a forearm of 36-41 mm (Figure 11.1). It is generally recognizable by its very long ears (22-25 mm), which are longer than those of any other myotis species (Barbour and Davis 1969). Its ear and wing membranes are generally black, and contrast sharply with relatively light brown fur.



Figure 11.1. Photograph of Long-eared Myotis. (Credit: William E. Rainey)

11.2. Distribution

Geographic Range

Myotis evotis ranges across western North America from southwestern Canada (British Columbia, Alberta and Saskatchewan) to Baja California and eastward in the United States to the western Great Plains (Manning and Jones 1989). In California, it is found from the foothills to high elevation in all the mountain ranges. An altitudinal transect in the central Sierra Nevada and Yosemite National Park documented this species from the foothills to 2,900 m (Pierson et al. 2001).

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for the long-eared myotis are mapped in Figure 11.2, and detailed in Tables 11.1-11.3.

There are prior records for this species from Cedar Grove and Grant Grove in Kings Canyon, and from multiple localities in Sequoia. The majority of specimens and observations are from giant sequoia groves: Giant Forest and Redwood Meadow. A museum specimen from Crystal Cave documents cave use. A specimen in the park collection from Treehouse Meadow was misidentified until recently as a pallid bat. Although we would expect J. Dixon to be a reliable observer we question the identification of a *M. evotis* from Ash Mountain. This locality is 700 m. below any other known locality for this species in the parks, and is a place where pallid bats, which can be mistaken for long-eared myotis, are relatively common.

Recently improved acoustic filters would make it possible to evaluate our acoustic records for *M. evotis*. For this report, however, we confined our analysis to capture records which likely give a reliable indication of this species distribution and relative abundance. Overall, it was the fourth most commonly encountered species (Figure 7 in main report narrative), and third to fifth in relative abundance in all three parks. It was widely and somewhat sparsely distributed (Figure 8 in main report narrative), being captured at 31 of 68 (46%) sampling sites, more sites than any other species except *E. fuscus.* It was captured in all the river drainages, the records from Devils Postpile being the first for that park and first for the upper San Joaquin drainage. A closer examination of capture records for each of the parks (Figure 11.3) and each of the drainages (Figure 11.4) also suggests that this species has a broadly distributed, somewhat dispersed, population. It represented the highest percentage of captures in Sequoia National Park, particularly in the Kern drainage. It was detected during the largest percentage of sampling sessions in the San Joaquin drainage.

The elevation range provided by our capture records and other records (excluding one from 1935 in Ash Mt, which was excluded because it was not supported by a specimen and differed substantially from the elevation range provided by all other specimens) was from 1260 m in Tehipite Valley to 3156 m in the vicinity of Treehouse Meadow on the Chagoopa Plateau (where we captured more individuals per site than at any other locality).

Of the 75 individuals we captured in this and prior studies, 28 (37%) were adult males, 13 (17%) were lactating females, 9 (12%) were post-lactating females, 12 (16%) were nulliparous females, and 7 (9%) were juveniles. Records for reproductive females covered the entire elevation band from Tehipite Valley to Treehouse Meadow. These included other high elevation sites (*e.g.*, Franklin Meadow in Goddard Canyon at 2657 m) and records from both Giant Forest and Redwood Meadow (Table 11.3).

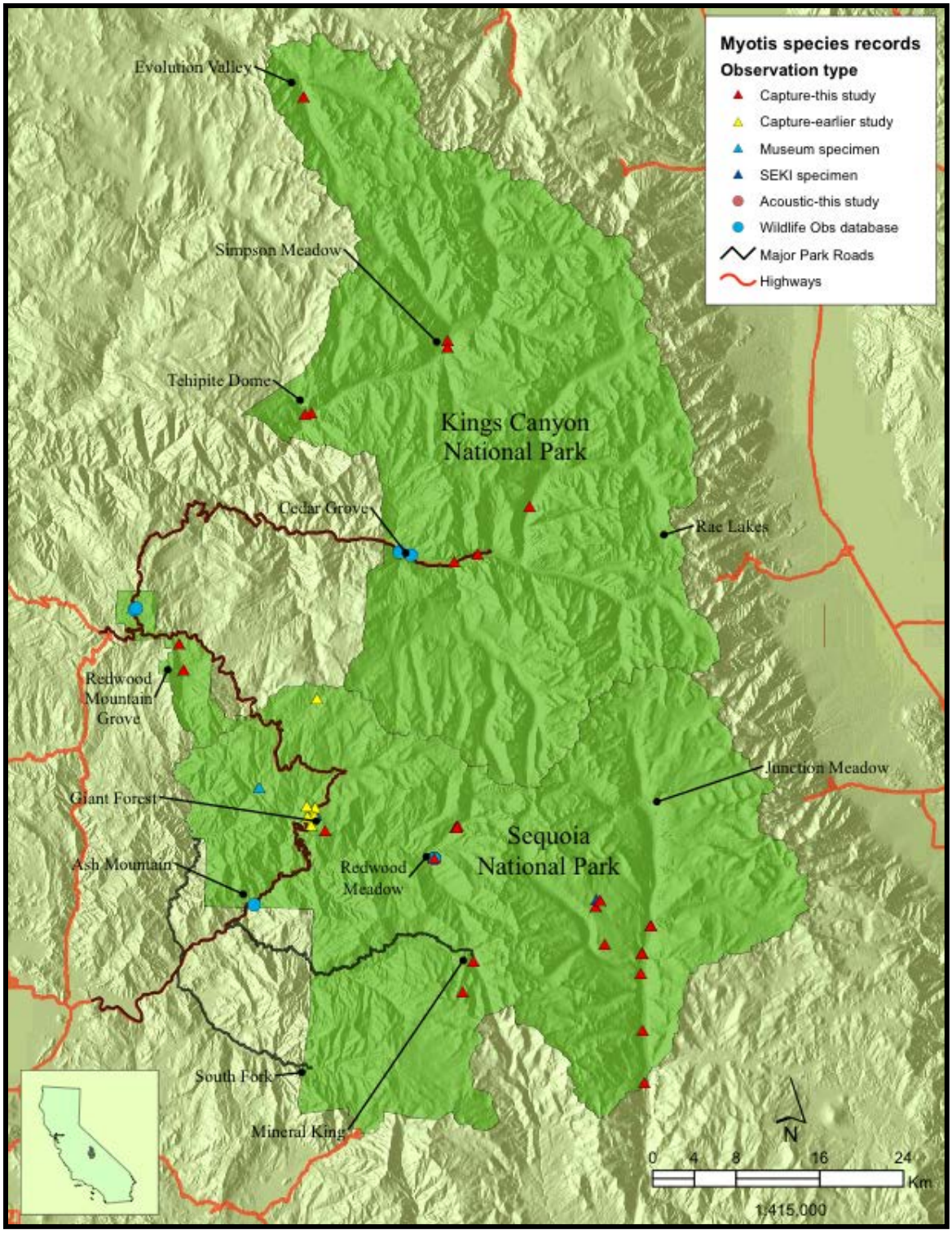


Figure 11.2. Map showing records *Myotis evotis* (long-eared myotis) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 11.1. Museum records for *M. evotis* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector
SQNP	Kern	Chagoopa, Treehouse Mdw	36.49831	-118.46241	3157	14-Jul-88	F/A	SEKI-8310*	45204*	Petterson, J.
SQNP	Marble Kaweah	Crystal Cave, Curtain Room	36.58941	-118.82502	1397	23-Jul-55	M/U	SBMNH-VB-55-12		von Bloeker,J.
SQNP	Marble Kaweah	Giant Forest Highland	36.56669	-118.76453	1979	25-Jun-54	F/U	SBMNH-VB-54-1		von Bloeker,J.
SQNP	Marble Kaweah	Giant Forest Highland	36.56669	-118.76453	1979	6-Aug-60	M/U	SBMNH-VB-56-2		von Bloeker,J.

* Incorrectly identified in SEKI records as *A. pallidus*

Table 11.2. Records for *M. evotis* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
KCNP	SFK Kings	Cedar Grove Visitor Center	36.79132	-118.66639	1423	8-Jul-99	58488	Sessions, R.
KCNP	SFK Kings	Cedar Grove Amphitheater	36.79386	-118.67916	1395	2-Sep-99	58436	Sessions, R.
KCNP	SFK Kings	Grant Grove Visitor Center	36.74039	-118.96216	2011	4-Aug-00	60252	Nolter, L.
KCNP	SFK Kings	Grant Grove Village	36.74107	-118.96028	2013	4-Aug-87	45029	Durniak, C.
SQNP	Marble Kaweah	Giant Forest Lodge	36.56581	-118.76552	1957	13-Jul-95	53105	Pierson, E
SQNP	MFK Kaweah	Redwood Meadow	36.53164	-118.63657	1836	28-Jul-95	59630	Koshear, J.
SQNP	MFK Kaweah	Redwood Meadow	36.53164	-118.63657	1836	28-Jul-95	59631	Koshear, J.
SQNP	MFK Kaweah	Redwood Meadow	36.53164	-118.63657	1836	28-Jul-95	59634	Koshear, J.
SQNP	MFK Kaweah	Redwood Meadow	36.53164	-118.63657	1836	28-Jul-95	59639	Koshear, J.
SQNP	MFK Kaweah	Ash Mt HQ*	36.48985	-118.82811	509	12-Mar-35	43180	Dixon, J.

* Too low in elevation for *M. evotis*; more likely misidentified *A. pallidus*

Table 11.3. Capture records for *M. evotis* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
THIS STUDY							Adult Females					Adult	Juv	Juv	Unk	Totals
							Preg	Lact	Plac	Null	Par	Male	Female	Male		
DEPO	MFK San Joaquin	San Joaquin @Meadow	37.62911	-119.08447	2304	23-Aug-01			1	1					1	3
DEPO	MFK San Joaquin	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	28-Jul-04									1	1
DEPO	MFK San Joaquin	Kings Ck, abv. river confluence	37.59951	-119.09087	2205	29-Jul-04				1						1
DEPO	MFK San Joaquin	San Joaquin, blw Muir Trail	37.61297	-119.08223	2288	29-Jul-04				2						2
KCNP	SFK San Joaquin	Franklin Meadow	37.18255	-118.79134	2657	31-Jul-05		4				2				6
KCNP	MFK Kings	Tehipite, Side Channel #2	36.91243	-118.77670	1270	22-Jul-06		1				2				3
KCNP	MFK Kings	Tehipite, nr. Crown Creek	36.91012	-118.78315	1260	23-Jul-06		1		1		1			1	4
KCNP	MFK Kings	Simpson Mdw, Side Channel #1	36.97563	-118.63169	1819	26-Jul-06						1				1
KCNP	MFK Kings	Simpson Mdw, Horsehoe Creek	36.96994	-118.63170	1824	29-Jul-07						1				1
KCNP	SFK Kings	Cedar Grove, River @ Zumwalt	36.79312	-118.59533	1527	10-Jul-02				1						1
KCNP	SFK Kings	Cedar Grove, River Side Channel	36.78673	-118.62043	1483	11-Jul-02		1		1						2
KCNP	SFK Kings	Lower Paradise Valley	36.83484	-118.54026	2011	19-Jul-04				1						1
KCNP	NFK Kaweah	Redwood Creek, Low Trail Xing	36.68922	-118.90831	1706	1-Jul-05						1				1
KCNP	NFK Kaweah	Log Cabin, Redwood Creek	36.71150	-118.91361	1837	3-Jul-05						2				2
SQNP	Marble Kaweah	Huckleberry Ck, nr. Crescent Mdw	36.55432	-118.75354	2054	31-Jul-02		1				1		2		4

Table 11.3. Capture records for *M. evotis* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument (continued).

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
THIS STUDY							Adult Females					Adult	Juv	Juv	Unk	Totals
							Preg	Lact	Plac	Null	Par	Male	Female	Male		
SQNP	EFK Kaweah	River abv Mineral King	36.44421	-118.59245	2393	2-Aug-02						1				1
SQNP	EFK Kaweah	Eagle Lake	36.41723	-118.60369	3051	4-Aug-02						1				1
SQNP	MFK Kaweah	River blw Bearpaw, Pool #3	36.55901	-118.61414	1938	30-Aug-06						3				3
SQNP	MFK Kaweah	River blw Bearpaw, Pool #6	36.55938	-118.61206	1940	31-Aug-06						1				1
SQNP	MFK Kaweah	River blw Bearpaw, Pool #5	36.55899	-118.61271	1940	1-Sep-06						1				1
SQNP	MFK Kaweah	Basal Hollow, Redwood Grove	36.53155	-118.63629	1830	2-Sep-06		1								1
SQNP	Kern	Rock Ck, blw Kern Hot Springs	36.47710	-118.40388	2099	29-Aug-04						1	1			2
SQNP	Kern	Upper Funston Mdw, Side Channel	36.45295	-118.41235	2045	31-Aug-04			2	1						3
SQNP	Kern	Upper Funston Mdw, Meadow	36.45274	-118.41297	2049	31-Aug-04			1							1
SQNP	Kern	Lower Funston, Laurel Ck	36.38678	-118.41097	1994	2-Sep-04			1			1				2
SQNP	Kern	Rock Ck, blw Kern Hot Springs	36.47710	-118.40388	2099	22-Aug-05						1				1
SQNP	Kern	Moraine Lake, Chagoopa	36.46093	-118.45296	2837	24-Aug-05			1							1
SQNP	Kern	Tarn, E Upper Trail Jct, Chagoopa	36.49267	-118.46293	3156	24-Aug-05		2	1	1		1				5
SQNP	Kern	Tarn, E Treehouse Mdw	36.49799	-118.45844	3146	25-Aug-05		1	1			3	2			7

Table 11.3. Capture records for *M. evotis* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument (continued).

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
SQNP	Kern	Kern, 1 Km blw Big Arroyo Br	36.43590	-118.41373	2037	26-Aug-05				1					1	2
SQNP	Kern	Coyote Creek, Kern RS	36.34200	-118.40837	1973	27-Aug-05			1			2				3
						TOTALS	**0**	**12**	**9**	**11**	**0**	**27**	**3**	**2**	**4**	**68**
EARLIER STUDIES																
SQNP	Marble Kaweah	Giant Forest Lodge, Cabin 91	36.56815	-118.76604	1965	19-Aug-95					1					1
SQNP	Marble Kaweah	Giant Forest, Pinewood Trailer	36.57382	-118.76477	2008	21-Aug-95					1					1
SQNP	Marble Kaweah	Giant Forest Lodge, Restaurant	36.56581	-118.76552	1957	28-Aug-95						1				1
SQNP	Marble Kaweah	Giant Forest, Crescent Mdw Rd	36.55843	-118.76870	2000	12-Sep-95				1						1
SQNP	Marble Kaweah	Giant Forest, Sunset Rock	36.57524	-118.77367	1953	13-Sep-95		1								1
SQNP	Marble Kaweah	Giant Forest Lodge, Dispensary	36.66690	-118.76513	1972	14-Sep-95								1		1
SQNP	Marble Kaweah	Giant Forest, Kaweah Motel	36.56561	-118.77276	1966	14-Sep-95								1		1
						TOTALS	**0**	**1**	**0**	**1**	**2**	**1**	**0**	**2**	**0**	**7**

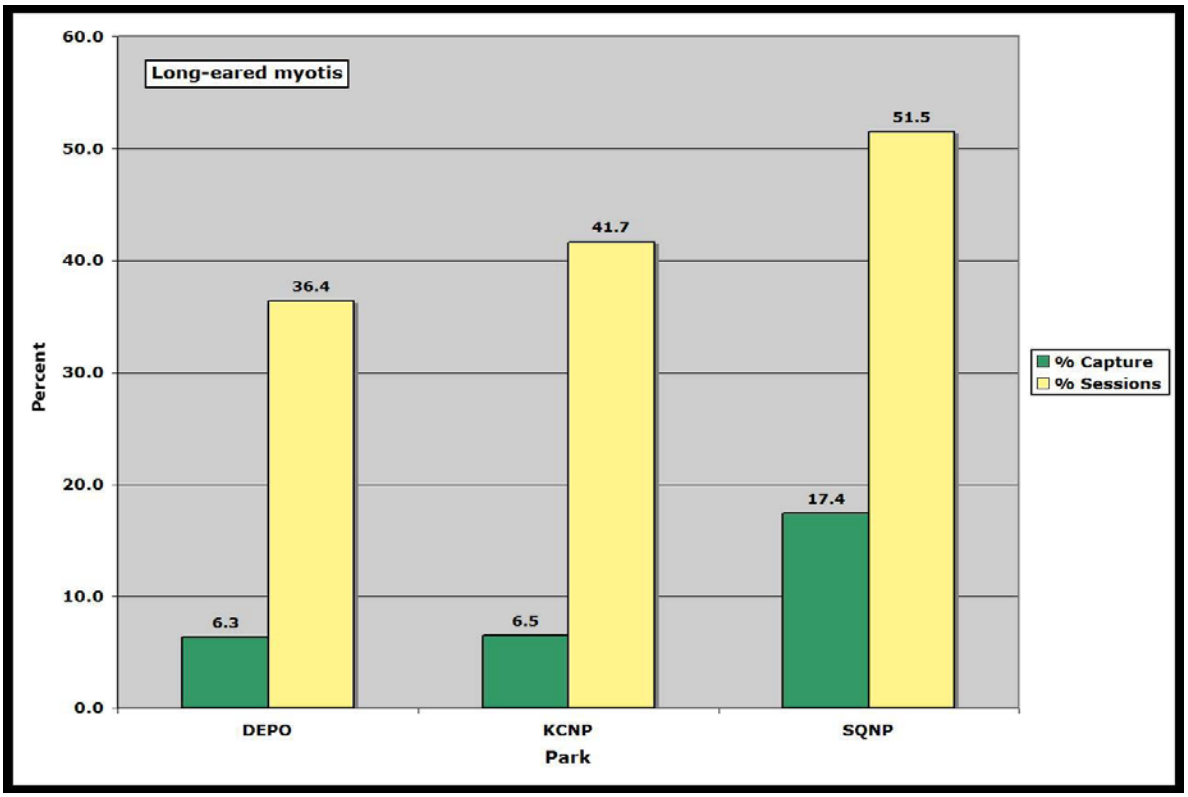


Figure 11.3. A bar graph comparing capture records by park as measured by the percentage of total captures and the percentage of sampling sessions in which long-eared myotis were detected.

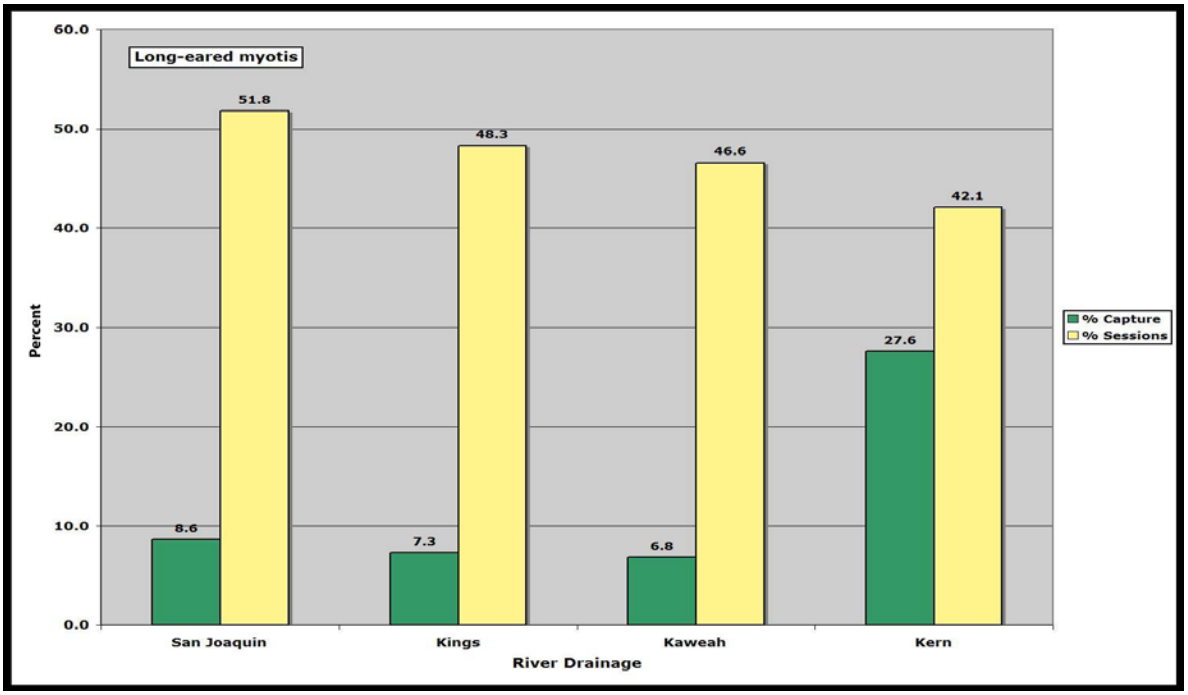


Figure 11.4. A bar graph comparing capture records by river drainage as measured by the percentage of total captures and percentage of sampling sessions in which long-eared myotis were detected.

An analysis of our netting data using a univariate model indicates that water is the strongest indicator for the capture of *M. evotis* (Table 11.4).

Table 11.4. Univariate Model Selection.

	df	**AIC**
Meadow_Scrub	4	264.0466
Forest	2	263.9449
Elev_m	2	265.4180
Water	7	239.0228
Rock	4	260.9997

An analysis of captures at water sites shows that we captured more *M. evotis* at creeks than at non-water sites, and were more likely to capture *M. evotis* at ponds than at creeks (Table 11.5, Figure 11.5).

Table 11.5. Terms of the model for water categories.

Coefficients:	**Estimate**	**Std. Error**	**Z Value**	**Pr(>|z|)**
Creek(Intercept)	-0.2007	0.1925	-1.043	0.29708
Flooded Meadow	0.4238	0.4869	0.870	0.38403
Lake	-0.8979	1.0184	-0.882	0.37791
Marsh	-0.4925	1.0184	-0.484	0.62867
Not Water	-1.1150	0.3577	-3.117	0.00183 **
Pond	1.379	0.3376	4.086	4.39e-05 ***
River	-0.3747	0.3849	-0.973	0.33031

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Null deviance: 180.51 on 102 degrees of freedom

Residual deviance: 143.73 on 96 degrees of freedom

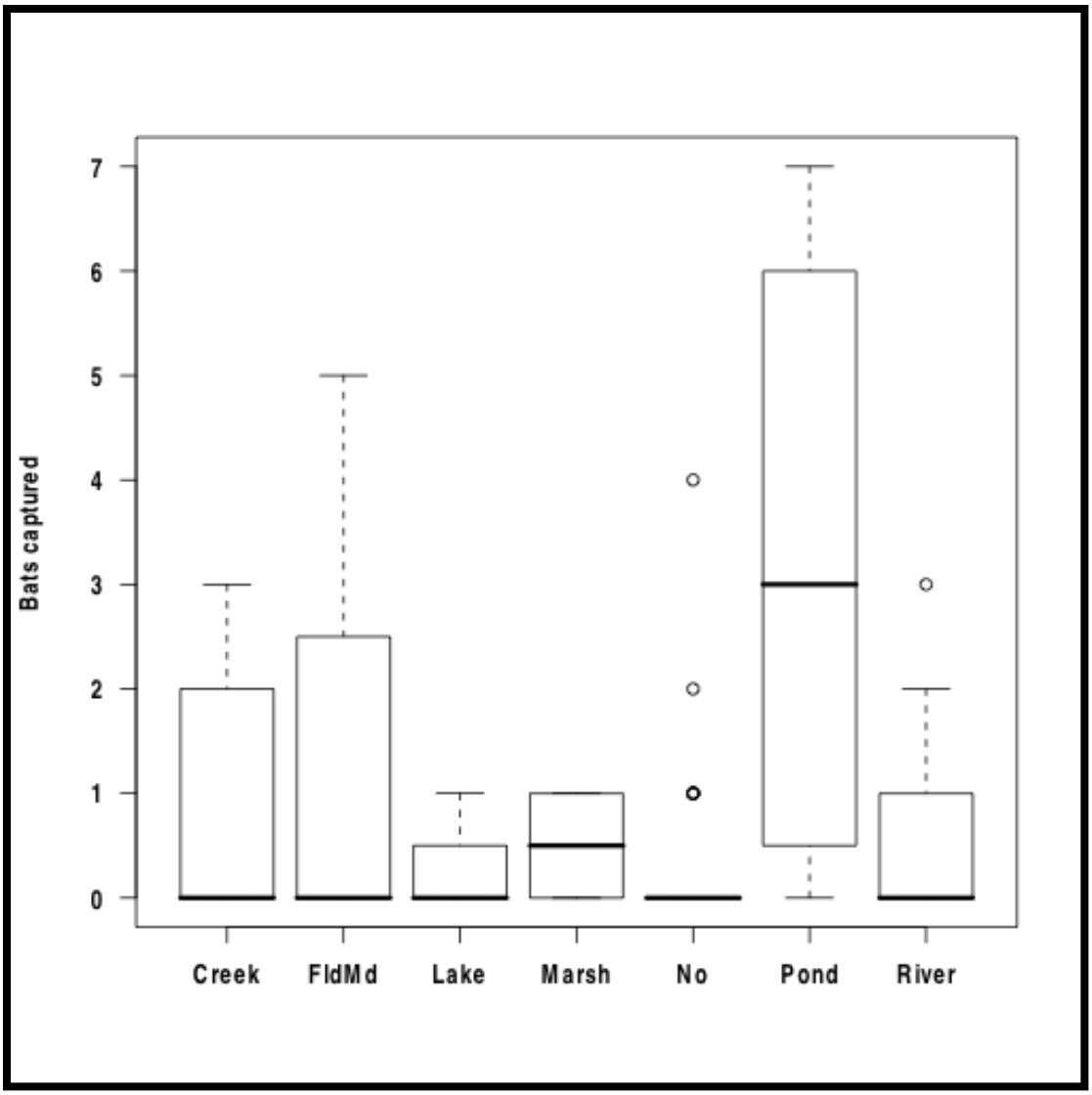


Figure 11.5. Graph showing the quartiles (with median values in bold) for number of *M. evotis* captured at six types of water sites, and sites that were not at water.

11.3. Habitat Associations

Vegetative Communities

M. evotis occurs in a wide variety of habitats, but is generally forest-associated, occurring in both mixed deciduous and predominantly coniferous forest. Earlier surveys in Giant Forest suggested a strong association with giant sequoia (Pierson and Heady 1996).

Roosting

This species roosts in hollow trees, behind loose bark, in caves, mines, and other manmade structures (bridges, buildings), and sometimes in cliff fissures and sink holes (Manning and Jones 1989, Marcot 1984, Pierson et al. 1996). In a radio-tracking study on the upper Sacramento River, it roosted in black oak and in highway rip-rap (Pierson and Rainey 1997). Another radiotracking study identified roosts under loose bark in tree stumps (Vonhof and Barclay 1997). It was one of the species most

commonly encountered in giant sequoias in Giant Forest, Sequoia National Park (Pierson and Heady 1996). It is also found in red fir-lodgepole habitat (Ingles 1949). A study on the Plumas National Forest suggested it was ubiquitous, and found in most habitats (P.A. Heady and W.F. Frick personal communication). It forms relatively small maternity colonies, generally 20-30 females.

Foraging

This species is a slow flier that often forages in cluttered under-storey, along streams, and among trees. It feeds both by aerial hawking and substrate gleaning (Faure and Barclay 1994). It feeds primarily on Lepidoptera, but also takes Coleoptera, Diptera, Hymenoptera, and Hemiptera (Black 1974, Whitaker et al. 1977 & 1981). In a study in the upper Sacramento River drainage the diet of this species was dominated by Coleoptera, Hymenoptera, Lepidoptera and Trichoptera (Rainey and Pierson 1996).

11.4. Management Issues

Status. Long-eared myotis have no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we characterized this species as having a sparse population that was distributed over a large geographic range (even though it appears to occur only above about 1100 m) and found in multiple habitats.

Roosts. Any management activities that involve caves, human structures, or giant sequoia groves should trigger concern for this species. Cave roosting has been documented at Crystal Cave (Table 11.1), and at Clough Cave (photograph of a cluster provided to current investigators by a park employee). *M. evotis* was the primary species found in buildings in Giant Forest (Pierson and Heady 1996), and several of the WODB records are from human structures. Roosting in giant sequoia trees was documented in the earlier surveys in Giant Forest (Pierson and Heady 1996), and in the current study (Log Cabin in Redwood Mountain Grove and a fire-scarred basal hollow in Redwood Meadow (Table 11.3).

Foraging. Although this species has a diverse diet, and forages in both aquatic and terrestrial habitats, it was one of the species most frequently encountered at high elevation lakes and ponds (e.g., Moraine Lake, Treehouse Meadow tarn, flooded Franklin Meadow).

Fire. Prescribed burns are not likely to pose problems for this species.

Climate Change. This is one of the species most likely to be negatively impacted by climate change. Given that it is not found below ca. 1100 m in Sequoia and Kings Canyon, we would expect its range to contract with climate change.

12. *Myotis lucifugus*, Little Brown Bat

12.1. Identification

M. lucifugus is a small myotis species with a forearm of 33-41 mm (Figure 12.1). It has large feet (10 mm), and an unkeeled calcar (Barbour and Davis 1969). Although its color can vary, in the Sierra Nevada it tends to be a golden brown. It is most readily confused with *M. yumanensis*. Generally, *M. lucifugus* is slightly larger than *M. yumanesis*, and has glossier fur, but these characteristics are subtle and somewhat unreliable. The two species can be most confidently distinguished from each other by their echolocation calls. *M. lucifugus* is a 40 kHz species, and *M. yumanensis* is a 50 kHz species. It is, however, difficult to distinguish acoustically from *M. ciliolabrum* and *M. volans*, but can be distinguished morphologically. In *M. lucifugus* the calcar is unkeeled and in *M. ciliolabrum* and *M. volans* it is keeled. This species can also be identified genetically.



Figure 12.1. Photograph of little brown bat,Tyndall Frog Ponds. (Credit: William E. Rainey).

12.2. Distribution

Geographic Range

M. lucifugus is one of the most widely distributed species in North America, but there is some question about the taxonomic identification of the Sierra Nevada form. Recent genetic work comparing populations from Yosemite with populations elsewhere in North America, showed the Sierran population to be as genetically differentiated from a California population in Siskiyou County as it was from poulations in Kentucky and New York (Pierson et al. 2001). It is most likely allied with *M. l. carissima* of the inter-mountain west. From the perspective of California, the populations in the Sierra Nevada should be considered as separate from any other in the state.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for *M. lucifugus* are mapped in Figure 12.2, and detailed in Tables 12.1-12.2. Given the challenges with distinguishing *M. lucifugus* from *M. yumanensis*, it is likely that all the lower elevation regards in the WODB (Table 12.1) are *M. yumanensis*.

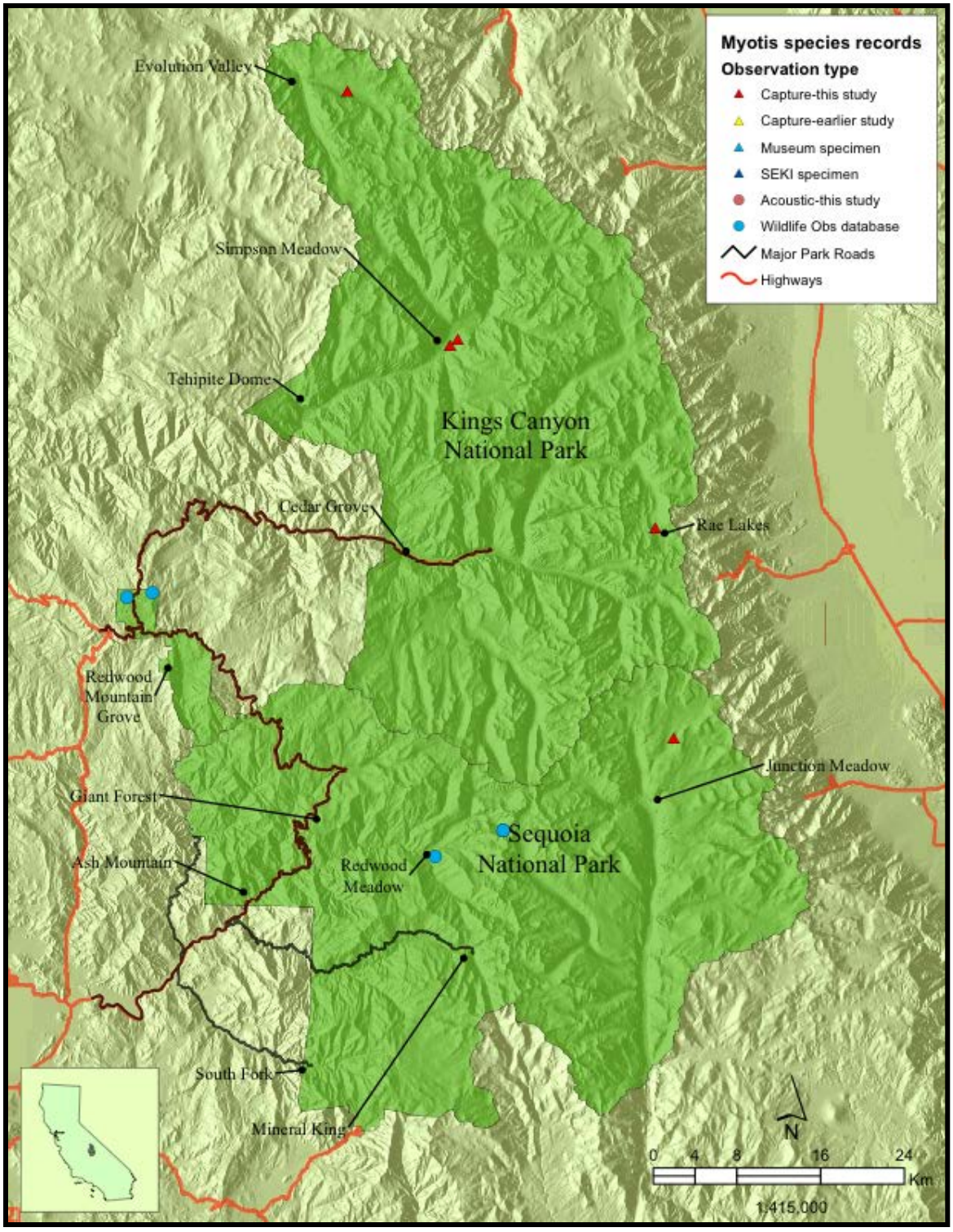


Figure 12.2. Map showing records for *Myotis lucifugus* (little brown bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 12.1. Records for *M. lucifugus* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
KCNP	Kings	Kings River*	36.78969	-118.62604	1463	12-Jul-65	46273	StockingS
KCNP	SFK Kings	Lewis Crk Cedar Grove*	36.80156	-118.69451	1393	20-Jul-66	46274	StockingS
KCNP	SFK Kings	Panoramic Point	36.75358	-118.94344	2272	29-Jun-88	46292	SampsonD
KCNP	SFK Kings	Inside CGVC*	36.79122	-118.66681	1421	15-Jun-94	52842	SchulmanM
KCNP	SFK Kings	Cedar GroveVC*	36.79122	-118.66681	1421	24-May-00	59398	SessionsR
KCNP	SFK Kings	Fallen Monarch	36.74858	-118.97085	1945	9-Jun-00	59538	O'BrienK
SQNP	MFK Kaweah	Ash Mountain HQ*	36.48985	-118.82811	509	9-Jan-91	50422	MasonD
SQNP	MFK Kaweah	Lwr Precipice Lake	36.55442	-118.56378	2993	17-Aug-93	60023	KoshearJ
SQNP	MFK Kaweah	Lwr Precipice Lake	36.55442	-118.56378	2993	17-Aug-93	60025	KoshearJ
SQNP	MFK Kaweah	Redwood Meadow	36.53111	-118.63590	1837	28-Jul-95	59637	KoshearJ
SQNP	MFK Kaweah	Ash Mountain HQ*	36.48985	-118.82811	509	3-Jun-00	59967	Jeffrey,T.
SQNP	MFK Kaweah	Buckeye Flat/Camp*	36.52236	-118.56378	2993	7-Jul-01	58664	Herrera,F

* Based on elevation, this observation is more likely *M. yumanensis* – so not included on map (Figure 12.2).

Table 12.2. Capture records for *M. lucifugus* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
THIS STUDY							Adult Females					Adult	Juv	Juv	Unk	Totals
							Preg	Lact	Plac	Null	Par	Male	Female	Male		
DEPO	MFK San Joaquin	San Joaquin, nr. Ranger Station	37.63028	-119.08516	2304	23-Aug-01						1	2	1		4
DEPO	MFK San Joaquin	San Joaquin, nr. Ranger Station	37.63028	-119.08516	2304	30-Jul-04		2								2
DEPO	MFK San Joaquin	San Joaquin @ Meadow	37.62911	-119.08447	2304	23-Aug-01			1			1				2
DEPO	MFK San Joaquin	San Joaquin @Meadow	37.62911	-119.08447	2304	30-Jul-04				1						1
DEPO	MFK San Joaquin	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	28-Jul-04			2					1		3
KCNP	SFK San Joaquin	McClure Meadow	37.18724	-118.74464	2933	2-Aug-05		1								1
KCNP	MFK Kings	Simpson Mdw, Side Pool	36.97580	-118.62123	1830	27-Jul-06				1						1
KCNP	MFK Kings	Simpson Mdw, Deep Pool	36.97109	-118.62931	1831	28-Jul-06				1	1	1				3
KCNP	MFK Kings	Lower Rae Lake	36.81680	-118.40611	3212	22-Jul-04		1								1
SQNP	Kern	Tyndall Frog Ponds	36.63628	-118.38290	3372	19-Aug-05						1				1
						TOTALS	**0**	**4**	**3**	**3**	**1**	**4**	**2**	**2**	**0**	**19**

In this inventory, *M. lucifugus* was one of the rarest species in our net captures, representing only 3.05% of total captures. We obtained records for all three parks, and in the San Joaquin, Kings, and Kern drainages. There were no records from the Kaweah drainage. This species represented the largest percentage of captures and was detected at the largest percentage of sampling sites in Devils Postpile (Figures 12.3) and the San Joaquin drainage (Figure 12.4). This is consistent with the finding that this species is confined to higher elevations, with no records below 1,800 m. We captured reproductive females at McClure Meadow (2,933 m) and Lower Rae Lake (3,212 m), both very high elevation sites.

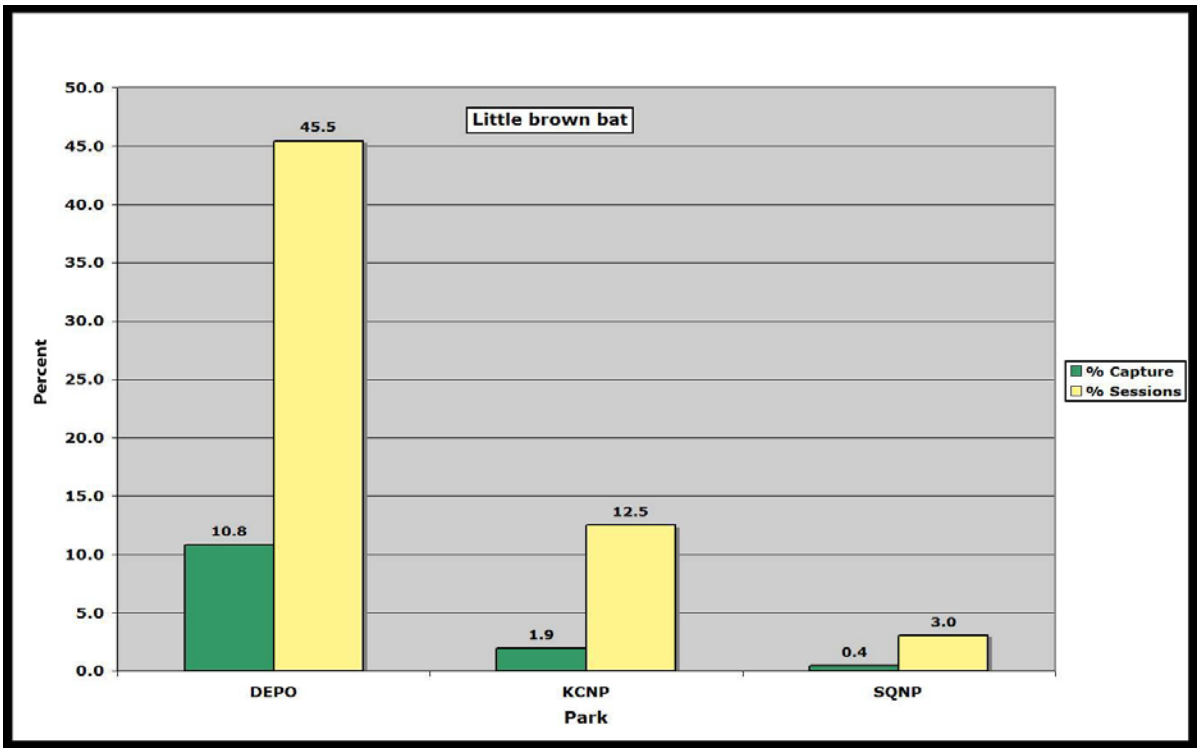


Figure 12.3. A bar graph comparing capture records by park as measured by the percentage of total captures and the percentage of sampling sessions in which little brown bats were detected

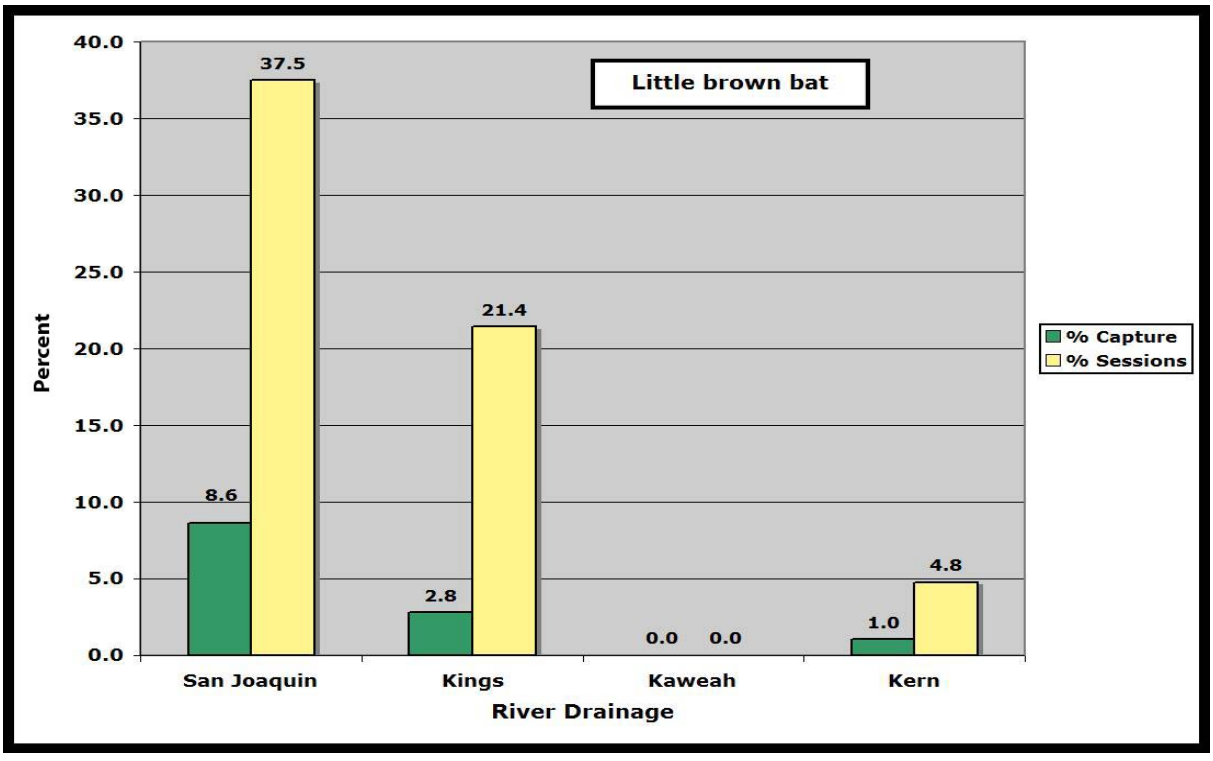


Figure 12.4. A bar graph comparing capture records by river drainage as measured by the percentage of total captures and the percentage of sampling sessions in which little brown bats were detected.

An analysis of our netting data using a univariate model indicates that water is the strongest indicator for the capture of *M. lucifugus* (Table 12.3).

Table 12.3. Univariate Model Selection

	df	AIC
Meadow_Scrub	4	121.3998
Forest	2	117.3998
Elev_m	2	120.8935
Water	7	104.2189
Rock	4	120.5459

An analysis of captures at water sites shows that we captured more *M. lucifugus* at ponds and rivers than at creeks, and the capture rate at creeks was significantly greater than zero (Table 12.4, Figure 12.5).

Table 12.4. Terms of the model for water categories.

Coefficients:	Estimate	Std. Error	Z Value	Pr(>|z|)
Creek(Intercept)	-1.8871	0.4472	-4.220	2.45e-05 ***
Flooded Meadow	0.5008	1.0954	0.457	0.6476
Lake	0.7885	1.0954	0.720	0.4717
Marsh	-17.4155	6665.6247	-0.003	0.9979
Not Water	-17.4155	1472.1903	-0.012	0.9906
Pond	1.5994	0.7303	2.190	0.0285 *
River	1.3117	0.5578	2.352	0.0187 *

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Null deviance: 94.050 on 102 degrees of freedom

Residual deviance: 65.742 on 96 degrees of freedom

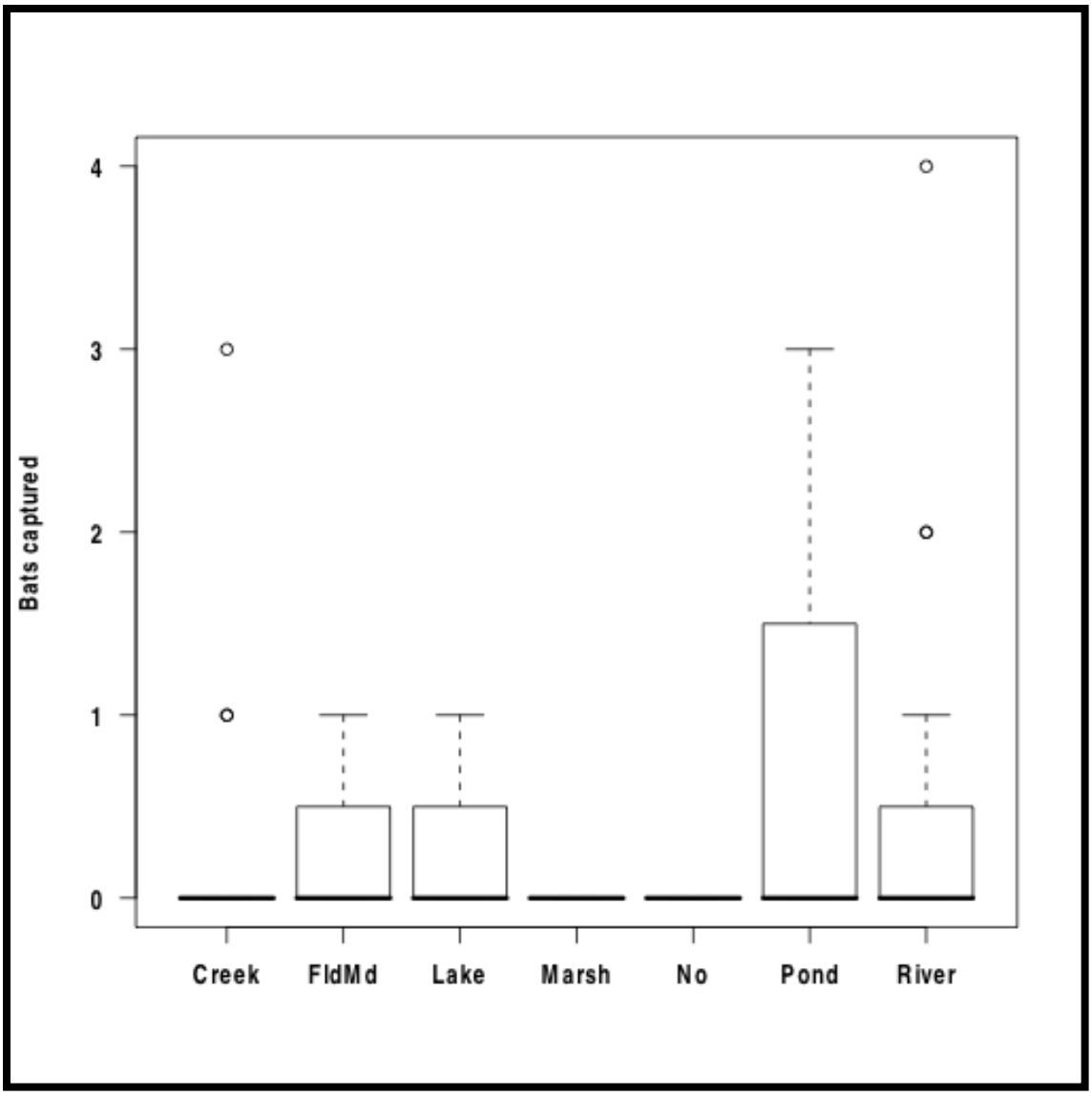


Figure 12.5. Graph showing the quartiles (with median values in bold) for number of *M. lucifugus* captured at six types of water sites, and sites that were not at water.

12.3. Habitat Associations

Vegetative Communities

This species occurs primarily in higher elevation coniferous forest, particularly areas dominated lodgepole and fox-tail pine.

Roosting

Although the species *M. lucifugus* is considered a "building bat" thoughout much of its range (Barbour and Davis 1969, Fenton and Barclay 1980), and occupies anthropogenic structures elsewhere in California (Rainey and Pierson 1996), its roosting habits in the Sierra Nevada are poorly known. A recent radio-tracking study in Yosemite National Park documented that both males and reproductive females roosted in rock crevices – males mostly in small crevices on granite domes, and

females in rock cavities on less accessible cliff faces (Pierson et al. unpublished data). There are very few human structures within the range of the Sierra Nevada population, so building roosting is unlikely. Although tree-roosting has been documented (Barbour and Davis 1969), there was no evidence of tree roosting in our pilot study in Yosemite.

Foraging

M. lucifugus is one of the species most reliant on aquatic emergent insects, and is known to forage predominantly over expanses of still water – ponds, lakes, or backwaters and meanders in low gradient rivers (Barbour and Davis 1969, Belwood and Fenton 1976, Fenton and Barclay 1980) Small aquatic dipterans are their primary food. Recent diet analysis for 27 individuals in Yosemite showed a diet dominated by dipterans and moths, with dipterans being preferred in July and lepidopterans in August, and more than 50% of the diet coming from aquatic sources (Pierson et al unpublished data).

12.4. Management Issues

Status. *M. lucifugus* has no special status, but when considering only the Sierra Nevada populations, was ranked by us as one of the species of primary concern. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we characterized this species as being rare, restricted in its range (because it occurs only at elevations > 1,800 m), and having specific habitat requirements (possibly exclusively rock roosting). We and others also consider this species to be at considerable risk of being impacted by climate change (Humphries et al. 2004).

Roosts. There is no information on roosting behavior of this species in Sequoia, Kings Canyon or Devils Postpile. Based on our radio-tracking study in Yosemite (Pierson et al. unpublished data), rock-roosting seems most likely. Given the potential importance of climate change issues for this species, obtaining more information on seasonal roosting behavior for this species is critically important. Any management activities or policies involving high elevation cliff habitat (e.g., recreational climbing) should consider this species. A particular emphasis should be placed on locating maternity roosts.

Foraging. This species forages most predictably over open water, and along adjacent riparian edges (e.g., over gravel bars). Any management activities that would alter the aquatic prey base should trigger consideration of this species.

Fire. Prescribed burns are not likely to pose problems for this species.

Climate Change. We would expect the already restricted range of this species to expand up in elevation with a warming climate. Because this is the only species that raises its young only at high elevation, a contracting range is potentially of grave concern. Humphries et al. (2004) also predict a contraction of hibernating range for this species with a warming climate. The reduction in reproductive success documented by R. Adams (2009) for some species of western bats raises concerns for *M. lucifugus*.

13. *Myotis thysanodes*, Fringed Myotis

13.1. Identification

Myotis thysanodes is a medium-sized myotis with a forearm of 39-48 mm, and relatively long ears (16-20 mm) (Figure 13.1). It can be distinguished from all other myotis species by a conspicuous fringe of hair of the posterior edge of the interfemoral membrane (Barbour and Davis 1969). Its pelage is often a cinnamon brown. It has a distinctive, very steep (slope > 250 o/s) echolocation call with a characteristic frequency of ca. 25 kHz (Figure 13.2).



Figure 13.1. Photographs of Fringed myotis, showing fringe on uropatagium. (Credit: William E. Rainey).

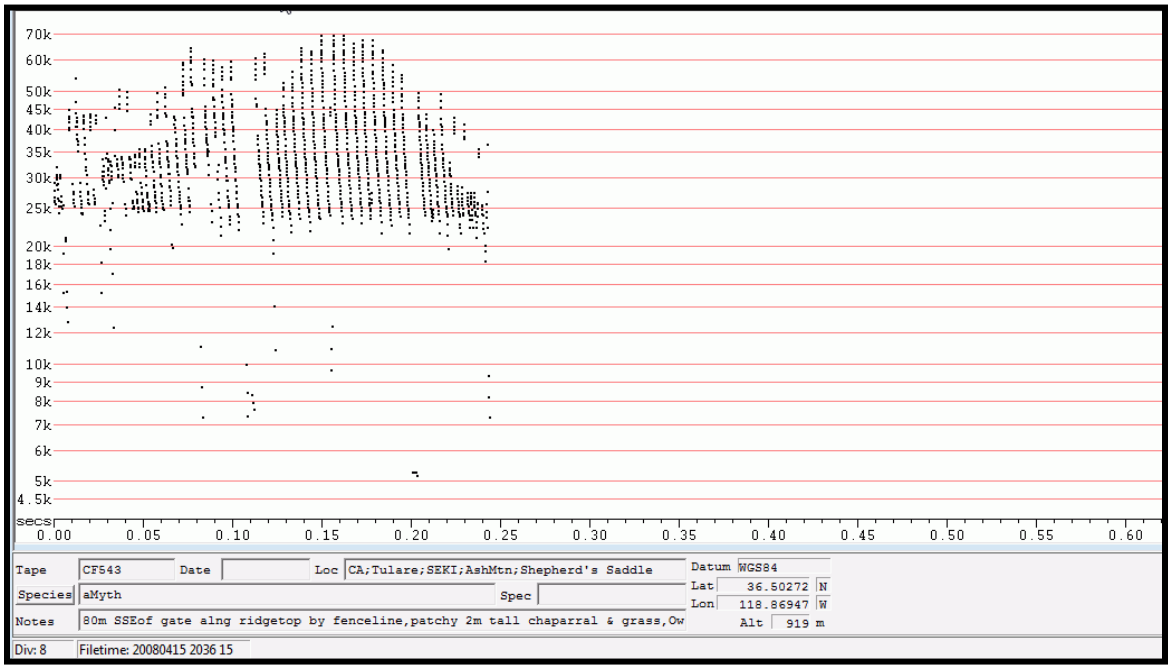


Figure 13.2. Echolocation call of fringed myotis, Shepherd's Saddle, Sequoia National Park, 15 April 2008.

13.2. Distribution

Geographic Range

Myotis thysanodes is widely distributed across the western third of the United States, is found in most of Mexico, and reaches into southern British Columbia. In California, the species is found the length of the state, from the coast (including Santa Cruz Island) to moderate elevations in the Sierra Nevada. Although records exist for the high desert and east of the Sierra Nevada (P. Brown personal communication), the majority of known localities are from the west side of the Sierra Nevada, ranging from the southern and central coast (Miner et al. 1996, Orr 1956), the transverse range in southern California (Dalquest and Ramage 1946, P. Brown personal communication), to the upper Sacramento River (Rainey and Pierson 1996), the Trinity Mountains (Pierson and Rainey 1998b, Weller and Zabel 2001) and the Sierra Nevada (Pierson and Heady 1996, Pierson et al. 2001). Although nowhere common, the species occurs as one of the rarer taxa in netting records from sea level to at least 1,950 m in the Sierra Nevada.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for the fringed myotis are mapped in Figure 13.3, and detailed in Tables 13.1-13.4. Prior records come mostly from collection or observation of animals at Clough and Crystal Caves, and from the survey efforts of J. Koshear in 1993 (Tables 13.1 and 13.2). Sixteen females were collected from Clough Cave in two collection efforts in 1950 and 1951, confirming that at one time there was a maternity colony of this species using Clough Cave. The three individuals removed from Crystal Cave were also females. We had netted a male *M. thysanodes* at Clough Cave in 1987, and two males in Giant Forest in 1995, one that was roosting in a giant sequoia tree (Table 13.3).

In the current inventory, *M. thysanodes* was relatively rare, being captured at only ten netting stations. The 24 individuals captured represented only 3.66% of all our captures (Figure 7 in main report document). Acoustic detections were also relatively rare, with this species being detected during only 40 (9.8 %) of the sampling sessions. Examining the distribution of detections (both capture and acoustic) by jurisdiction (Figure 13.4) and by drainage (Figure 13.5), it becomes evident that the detections are concentrated primarily in Kings Canyon, and in both the Kaweah and Kings drainages. The majority of the acoustic detections are in Giant Forest and the Redwood Mountain Grove, suggesting, as was found in Yosemite (Pierson et al. 2006) that this species is highly associated with giant sequoia habitat. It also was found, however, in other habitats such as those found in Tehipite Valley and Cedar Grove. It does appear to have a limited elevational distribution, with no records above ca. 2,500 m, which can explain its absence from Devils Postpile, all San Joaquin sites, and most of the Kern drainage that we sampled.

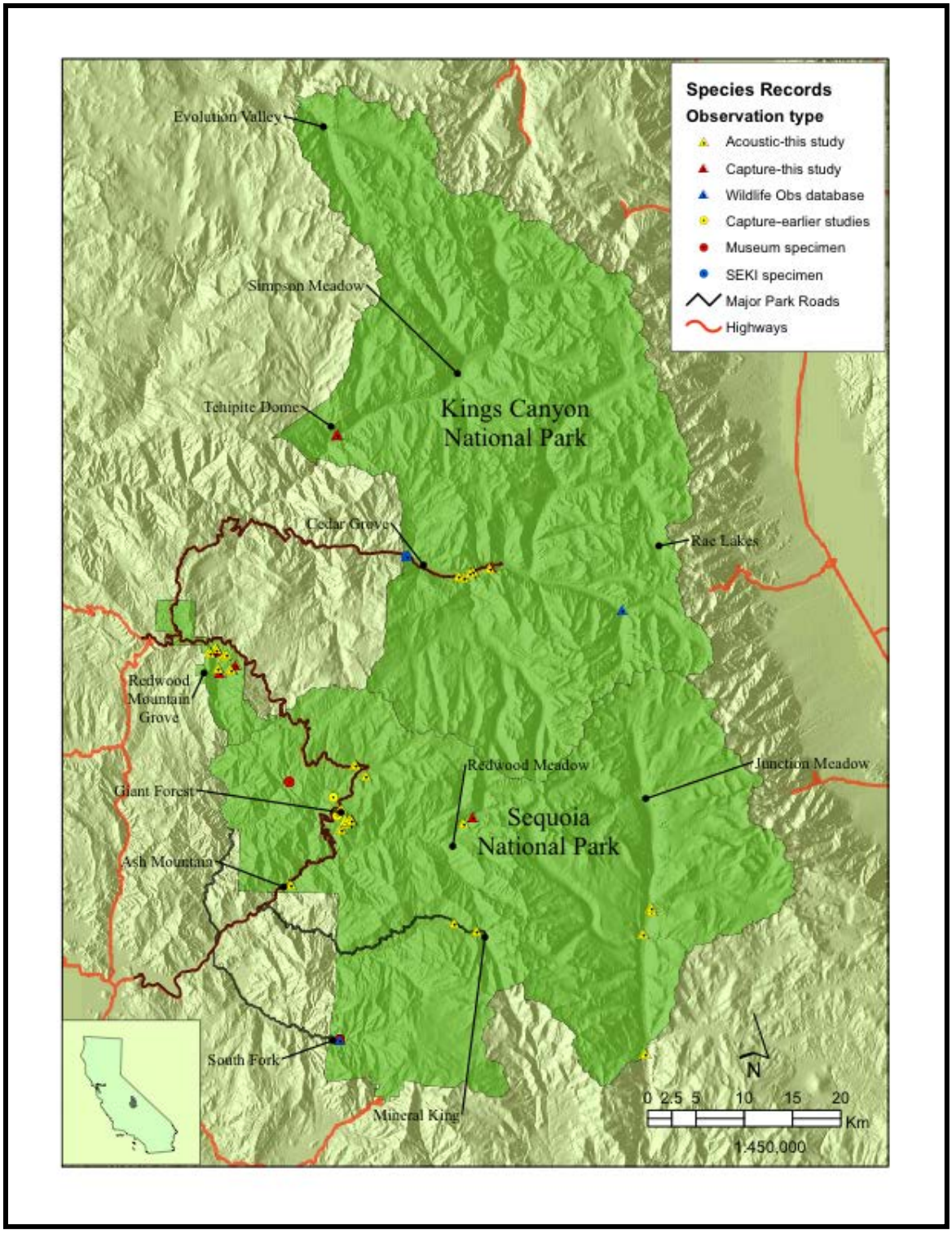


Figure 13.3. Map showing records for *Myotis thysanodes* (fringed myotis) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 13.1. Museum records for *M. thysanodes* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/ Age	MUS ID	REC NUM	Collector
KCNP	SFK Kings	Lewis Cr Bridge, Cedar Grove	36.80080	-118.69375	1390	26-Aug-93	F/A	SEKI-No Num	60049	Koshear, J.
SQNP	Marble Kaweah	Crystal Cave, Big Room	36.58941	-118.82502	1397	ND	F/U	SBMNH-VB-MT-2		von Bloeker,J.
SQNP	Marble Kaweah	Crystal Cave, Big Room	36.58941	-118.82502	1397	ND	F/U	SBMNH-VB-MT-3		von Bloeker,J.
SQNP	Marble Kaweah	Crystal Cave, Big Room	36.58941	-118.82502	1397	ND	F/U	SBMNH-VB-MT-4		von Bloeker,J.
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	8-May-50	F/A	SBMNH-VB-D1		von Bloeker,J.
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	8-May-50	F/A	SBMNH-VB-D3		von Bloeker,J.
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-494		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-495		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-496		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-497		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-498		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-499		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-500		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-501		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-502		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-503		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-504		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-505		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CM-83561		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CM-83562		

Table 13.2. Records for *M.thysanodes* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
KCNP	SFK Kings	Bubbs Ck, Junction Mdw	36.75413	-118.44224	2495	24-Aug-93	60048	Koshear, J.
KCNP	SFK Kings	Lewis Cr Bridge, Cedar Grove	36.80080	-118.69375	1390	26-Aug-93	60049	Koshear, J
SQNP	SFK Kaweah	Clough Cave*	36.35023	-118.76151	1141	9-Jun-87	44295	Jeffrey,T

*Record provided with more detail in Pierson and Rainey capture records (Table 13.3)

Table 13.3. Capture records for *M. thysanodes* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
KCNP	MFK Kings	Tehipite, Side Channel #1	36.91227	-118.77769	1265	21-Jul-06						1				1
KCNP	MFK Kings	Tehipite, Side Channel #2	36.91243	-118.77670	1270	22-Jul-06						1				1
KCNP	SFK Kings	Cedar Grove, River @ Zumwalt	36.79312	-118.59533	1527	10-Jul-02						1				1
KCNP	SFK Kings	Cedar Grove, River Side Channel	36.78673	-118.62043	1483	11-Jul-02		2		1		2				5
KCNP	NFK Kaweah	Redwood Creek, Low Trail Xing	36.68922	-118.90831	1706	1-Jul-05						2				2
KCNP	NFK Kaweah	East FK Redwood Ck, Trail Xing	36.69677	-118.89008	1914	2-Jul-05			1	1		1				3
KCNP	NFK Kaweah	Log Cabin, Redwood Creek	36.71150	-118.91361	1837	3-Jul-05		2		4						6
KCNP	NFK Kaweah	Rock Outcrop, abv Log Cabin	36.70893	-118.91356	1845	3-Jul-05		1								1
SQNP	Marble Kaweah	Huckleberry Ck blw Crescent Mdw	36.55432	-118.75354	2054	31-Jul-02				2		1				3
SQNP	MFK Kaweah	River blw Bearpaw, Pool #6	36.55938	-118.61206	1940	31-Aug-06						1				1
						TOTALS	**0**	**5**	**1**	**8**	**0**	**10**	**0**	**0**	**0**	**24**
EARLIER STUDIES																
SQNP	Marble Kaweah	Giant Forest, Crescent Mdw Rd	36.55843	-118.76870	2000	12-Sep-95						1				1
SQNP	Marble Kaweah	Giant Forest, Sunset Rock	36.57524	-118.77367	1953	13-Sep-95			1			1				2
SQNP	SFK Kaweah	Clough Cave*	36.35023	-118.76151	1141	9-Jun-87						1				1
						TOTALS	**0**	**0**	**1**	**0**	**0**	**3**	**0**	**0**	**0**	**4**

* WODB REC NUM 44295

Table 13.4. Acoustic records for *M. thysanodes* obtained in this study. "X" = present, files not counted.

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	SFK Kings	Cedar Grove	Sidebar River, W Roaring R Xing	36.78251	-118.62710	1471	9-Jul-02	4
KCNP	SFK Kings	Cedar Grove	Pool in side channel, near E end River Rd	36.78679	-118.62020	1481	10-Jul-02	9
KCNP	SFK Kings	Cedar Grove	River just E. Knapp's cabin	36.78369	-118.63337	1467	10-Jul-02	1
KCNP	SFK Kings	Cedar Grove	Talus at E end of River Rd	36.78809	-118.61687	1494	10-Jul-02	2
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,NW crnr	36.79158	-118.59697	1520	10-Jul-02	4
KCNP	SFK Kings	Cedar Grove	Pool in side channel, near E end River Rd	36.78679	-118.62020	1481	11-Jul-02	5
KCNP	NFK Kaweah	Redwood Mt. Grove	Btw. Hart Mdw & Goliath	36.69243	-118.89602	1955	30-Jun-05	7
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	1-Jul-05	9
KCNP	NFK Kaweah	Redwood Mt. Grove	Btw. Hart Mdw & Goliath	36.69243	-118.89602	1955	1-Jul-05	2
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	1-Jul-05	3
KCNP	NFK Kaweah	Redwood Mt. Grove	Redwood Ck, abv Lower Trail Crossing	36.69395	-118.91100	1955	1-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	1-Jul-05	5
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	2-Jul-05	11
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	2-Jul-05	9
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	2-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	Hart Meadow	36.70694	-118.90160	1966	3-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	3-Jul-05	6
SQNP	EFK Kaweah	Mineral King	Cottonwoods, W of Tar Gap Pkg	36.45376	-118.60579	2325	1-Aug-02	3
SQNP	EFK Kaweah	Mineral King	Highbridge Ck Rocks	36.46036	-118.63172	2234	5-Aug-02	1
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	30-Jul-02	10
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood meadow	36.56343	-118.76624	2039	30-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood trees	36.56419	-118.76451	2034	30-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-02	2
SQNP	Marble FK Kaweah	Giant Forest	Moro Rock, first rest area, 1/2 to top	36.54554	-118.76456	2003	30-Jul-02	5
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Pila snag	36.55230	-118.75900	2060	31-Jul-02	11
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	31-Jul-02	17
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock at edge of seep blw rd	36.55391	-118.75900	2072	31-Jul-02	4

Table 13.4. Acoustic records for *M. thysanodes* obtained in this study. "X" = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, bare rock below Rd	36.55355	-118.75900	2059	31-Jul-02	4
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	31-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	Mdw at Tunnel Tree	36.55376	-118.75900	2036	31-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	Net abv rd, Huckelberry Mdw Tr Xng	36.55459	-118.75301	2054	31-Jul-02	8
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	29-Jul-02	2
SQNP	Marble FK Kaweah	Lodgepole	Wet mdw nr. Wolverton Ck	36.59604	-118.73688	2211	29-Jul-02	2
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	30-Jul-02	3
SQNP	MFK Kaweah	Ash Mt	Gravel terrace, 100 m abv net site	36.49370	-118.82206	493	14-Jul-02	1
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Lower Terrace	36.55356	-118.62277	1910	1-Sep-06	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Bench, S. of ck	36.47541	-118.40348	2164	29-Aug-04	X
SQNP	Kern	Kern	Branch Rock Ck, S. Kern Hot Springs	36.47790	-118.40386	2111	29-Aug-04	X
SQNP	Kern	Kern Ranger Station	Coyote CK, nr. Trail Xing	36.34210	-118.40840	1966	3-Sep-04	X
SQNP	Kern	Upper Funston Meadow	Center of meadow, on log	36.45274	-118.41297	2049	30-Aug-04	X
				TOTAL SAMPLING SESSIONS				**40**

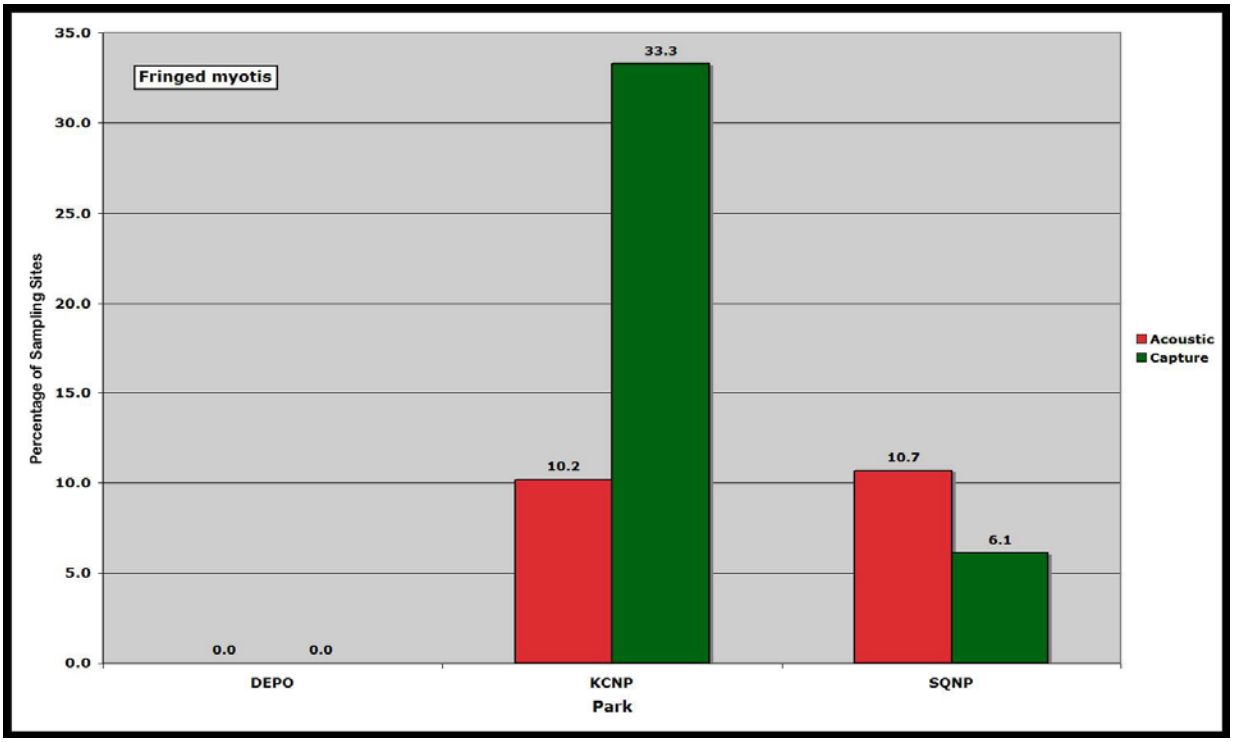


Figure 13.4. A bar graph comparing capture and acoustic records by park as measured by the percentage of sampling sites at which fringed myotis were detected.

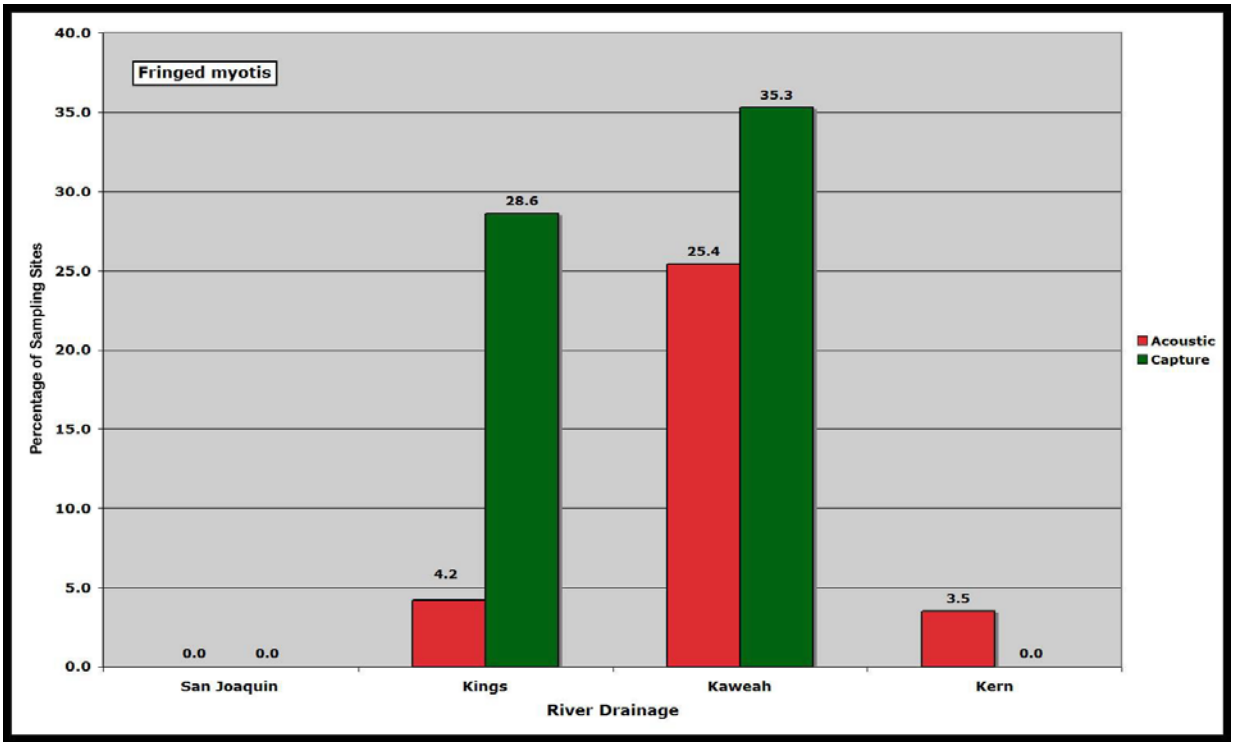


Figure 13.5. A bar graph comparing capture and acoustic records by river drainage as measured by the percentage of sampling sites at which fringed myotis were detected.

An analysis of our netting data using a univariate model indicates that elevation is the most important factor in explaining our captures of *M. thysanodes* (Table 13.5).

Table 13.5. Univariate Model Selection.

	df	**AIC**
Meadow_Scrub	4	-118.6272
Forest	2	-119.6746
Elev_m	2	110.7626
Water	7	113.5393
Rock	3	-119.8728

An analysis of captures for *M. thysanodes* in relation to elevation indicates that it occurs in a limited elevation range, and elevation is the best predictor regarding captures for this species (Table 13.6, Figure 13.6).

Table 13.6. Terms of the model for elevation.

Coefficients:	Estimate	Std. Error	Z Value	Pr(>|z|)
(Intercept)	0.2133661	0.5860087	0.364	0.71578
Elev_m	-0.0009771	0.0003161	-3.091	0.00199 **

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Null deviance: 89.551 on 102 degrees of freedom

Residual deviance: 80.560 on 101 degrees of freedom

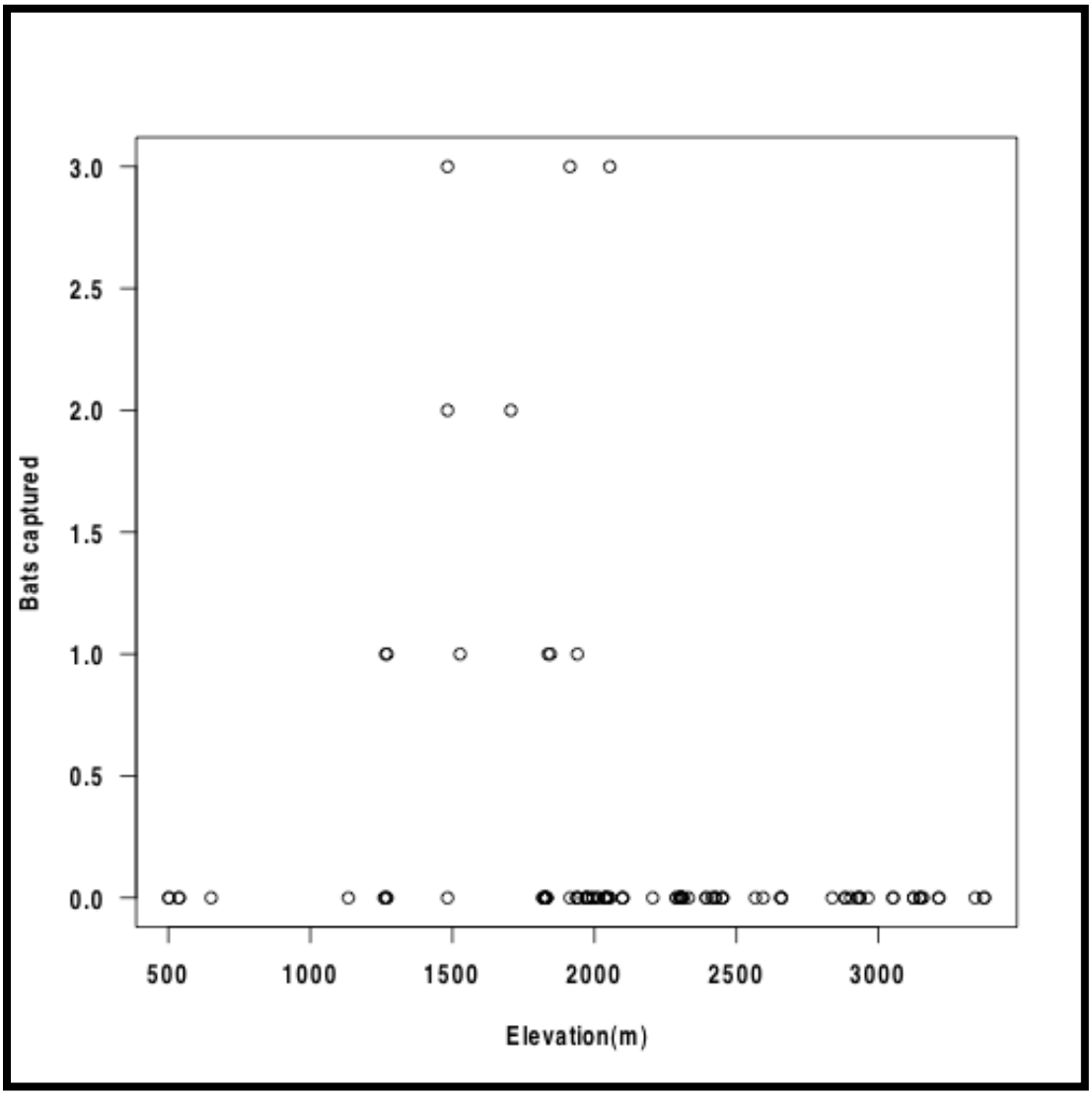


Figure 13.6. Graph of the distribution of captures of *M. thysanodes* by elevation.

13.3. Habitat Associations

Vegetative Communities

M. thysanodes is found in mixed deciduous/coniferous forest, Douglas-fir forest, and in both redwood and giant sequoia habitat (Pierson and Heady 1996, Pierson et al. 2006, Weller and Zabel 2001).

Roosting

This species is known to use a wide variety of roost sites, including rock crevices, caves, mines, buildings, and bridges (Barbour and Davis 1969, O'Farrell and Studier 1980). Recent radio-tracking studies in the forested regions of northern California have shown that this species also forms nursery colonies in predominantly early to mid-stage, large diameter snags (Weller and Zabel 2001). Likewise, studies conducted in Oregon and Arizona have also documented that *M. thysanodes* roosts in tree hollows, particularly in large conifer snags (Cross and Clayton 1995, Chung-MacCoubrey 1996). In California, a small colony was located in a hollow redwood tree in the Carmel Valley (Pierson and Rainey unpublished observation), and a moderately large colony (ca. 40) was located under flaking bark of a large sugar pine snag in the Mariposa Grove in Yosemite (Pierson et al. 2006). It is also one of the species thought to be most reliant on abandoned mines (Altenbach and Pierson 1995).

Prior records from Sequoia document roosting in both Clough and Crystal Caves, and in this study we captured six individuals roosting in the "Log Cabin", a hollow fallen giant sequoia in Redwood Mountain Grove. Also, one of the museum specimens is an animal taken from the bridge over Lewis Creek in Cedar Grove.

Foraging

This species often forages along secondary streams, in fairly cluttered habitat. It also has been captured over meadows (Pierson et al. 2001). Only limited information is available on diet in *M. thysanodes*. In a study conducted in New Mexico, Black (1974) concluded the species appeared to be a beetle strategist. In western Oregon (Whitaker et al. 1977), the dominant prey item in the diet of three out of four animals examined was lepidopterans (moths). The diet also included phalangids (harvestmen), gryllids (crickets), tipulids (crane flies), and araneids (spiders). The feces of one individual captured on the upper Sacramento River in California contained predominantly coleopterans (beetles) and hemipterans (bugs) (Rainey and Pierson 1996). Relatively heavy tooth wear on animals examined in a five year study on the Sacramento River would suggest that in this area the species feeds primarily on heavy bodied insects, such as coleopterans and hemipterans. The presence of non-flying taxa in the diet of the Oregon animals suggests a foraging style that relies at least partially on gleaning.

13.4. Management Issues

Status. *M. thysanodes* was granted high priority by the Western Bat Working Group. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we characterized this species in the highest risk category – having a small population size, being restricted in elevation, and having specific habitat requirements.

Roosts. Any management activities that involve caves, human structures (including bridges), or giant sequoia groves should trigger concern for this species.

Foraging. Although this species has a diverse diet, and forages in both aquatic and terrestrial habitats, it is most frequently captured over secondary streams. Thus this species should be considered for any management activities that impact secondary streams.

Fire. Prescribed burns could lead to a reduction in both roosting and foraging habitat in the short-term, and perhaps enhanced habitat in the longer-term.

Climate Change. The effect of climate change on this species is unknown. It might be expected to expand its range to higher elevation with warmer temperatures. Although this species occurs in xeric habitats, the populations in the Sierra Nevada appear to be associated with relatively mesic habitats. Whether or not this population will be able to adapt to drier conditions is unknown.

14. *Myotis volans*, Long-legged Myotis

14.1. Identification

M. volans is a medium-sized myotis with a forearm of 35-41 mm (Figure 14.1). It is the only relatively large western myotis with a keeled calcar (Barbour and Davis 1969). It also has somewhat rounded ears and a relatively long tibia (17.4-18.9 mm).



Figure 14.1. Photograph of long-legged myotis, (Credit: William E. Rainey).

14.2. Distribution

Geographic Range

M. volans is widely distributed across the western third of the United States, reaching the northern limits of its range in northern British Columbia and the southern limits in central Mexico (Hall 1981, Warner and Czaplewski 1984). In California, *M. volans* occurs in a variety of habitats throughout most of the state, and has been found from the coast, to high elevation in the Sierra Nevada and White Mountains. Records are absent for the low desert areas of southeastern California, but occur in the mountains of the Mojave Desert, central San Diego County, the Coast Range, and the transverse ranges between the Los Angeles basin and the Central Valley (Dalquest and Ramage 1946). A notable percentage of the records (from California and elsewhere in the range) are from relatively high elevations, although there are also records from the Sierran foothills foothills (*e.g.*, P.A. Heady and W.F. Frick personal communication, Pierson and Rainey 2002).

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for this species are mapped in Figure 14.2, and detailed in Tables 14.1 – 14.3. There are several museum records for this species which provide important distributional information − two records from Redwood Mountain Grove, one from Clough Cave, and a 1912 records from Kearsarge Pass (Table 14.1). The Kearsarge Pass specimen constitutes the highest

known elevation record for this species. The Clough Cave record provides important evidence of cave roosting. The WODB (Table 14.2) provides additional records from Clough Cave and giant sequoia groves (both Redwood Meadow and Giant Forest).

M. volans was overall the third most commonly encountered species on our net captures, constituting 12.35 % of all captures. If we examine this by park, the largest concentration of captures (both percent captures and percent sampling sessions) is in Kings Canyon (Figure 14.3). These numbers are heavily influenced by the fact we located a large night roost of this species in the Fallen Monarch in Grant Grove. In Devils Postpile all but one *M. volans* record was from the Sag Pond. In Kings Canyon, in addition to the 27 animals captured at the Fallen Monarch, we captured multiple animals on Redwood Creek in the Redwood Mountain Grove and at Franklin Meadow in Goddard Canyon. In Sequoia the largest number of animals was captured at the Lower Rock Creek crossing near Kern Hot Springs (Table 14.3).

If we examine the records by drainage, the most animals and widest distribution (= most sampling sessions) is in the Kings drainage, and the least in the Kaweah (Figure 14.4). This is consistent with a species that seems to prefer mid to higher elevations.

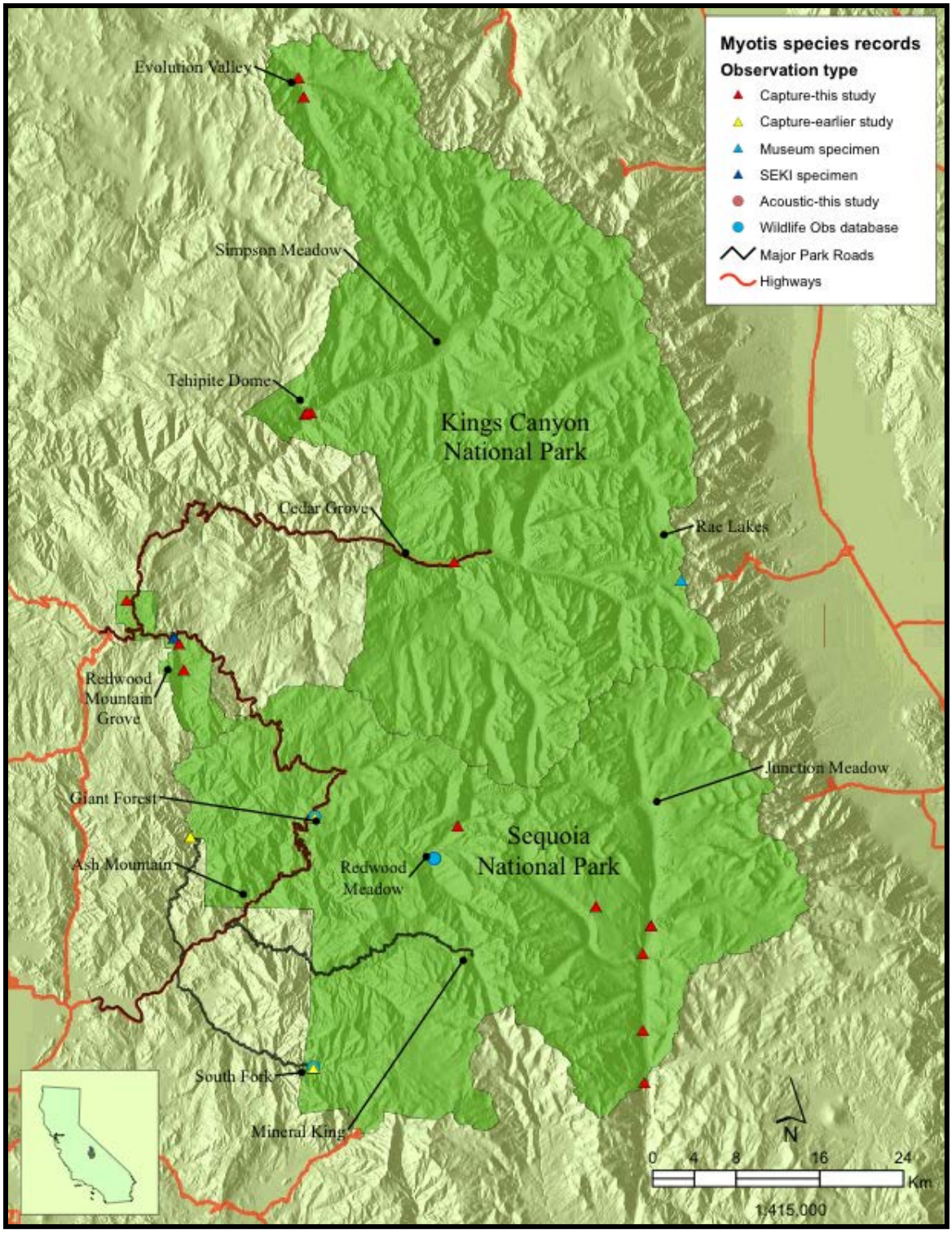


Figure 14.2. Map showing records for *Myotis volans* (long-legged myotis) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 14.1. Museum records for *M. volans* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector
KCNP	NFK Kaweah	Redwood Ck	36.71683	-118.91942	1951	28-Jun-88	F/A	SEKI-8358*	NA	Petterson, J.
KCNP	NFK Kaweah	Redwood Mt Grove	36.71683	-118.91942	1951	29-Jun-88	F/A	SEKI-8314*	NA	Petterson, J.
KCNP	Kings	Kearsarge Pass	36.77328	-118.37654	3574	2-Jul-09	M/U	MVZ-17791		
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	5-May-51	F/U	CSUN-531		

* Misidentified in museum records as *M. lucifugus.*

Table 14.2. Records for *M. volans* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
SQNP	Marble Kaweah	Giant Forest, Hazelwood Trail	36.56488	-118.76477	1962	27-Jun-95	53108	Pierson, E
SQNP	MFK Kaweah	Redwood Meadow	36.53164	-118.63657	1836	28-Jul-95	59635	Koshear, J.
SQNP	MFK Kaweah	Redwood Meadow	36.53164	-118.63657	1836	28-Jul-95	59638	Koshear, J.
SQNP	SFK Kaweah	Clough Cave	36.35023	-118.76151	1141	9-Jun-87	44296	Jeffrey, T

Table 14.3. Capture records for *M. volans* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
DEPO	MFK San Joaquin	San Joaquin, nr. Ranger Station	37.63028	-119.08516	2304	23-Aug-01								1		1
DEPO	MFK San Joaquin	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	24-Aug-01						2	1	1		4
DEPO	MFK San Joaquin	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	28-Jul-04				3						3
KCNP	SFK San Joaquin	Franklin Meadow	37.18255	-118.79134	2657	31-Jul-05		1		1		2		1		5
KCNP	SFK San Joaquin	1 Km blw. Goddard Junction	37.19930	-118.79703	2566	3-Aug-05		1	1							2
KCNP	MFK Kings	Tehipite, Side Channel #2	36.91243	-118.77670	1270	22-Jul-06				2						2
KCNP	MFK Kings	Tehipite, nr. Crown Creek	36.91012	-118.78315	1260	23-Jul-06						1				1
KCNP	MFK Kings	Tehipite, nr. Camp	36.9-1193	-118.78076	1266	24-Jul-06					1					1
KCNP	SFK Kings	Cedar Grove, River Side Channel	36.78673	-118.62043	1483	11-Jul-02						2				2
KCNP	SFK Kings	Fallen Monarch, Grant Grove	36.74858	-118.97085	1945	30-Jun-05	1	13	2	8		3				27
KCNP	NFK Kaweah	Redwood Creek, Low Trail Xing	36.68922	-118.90831	1706	1-Jul-05	1	8	1	1		2				13
KCNP	NFK Kaweah	Log Cabin, Redwood Creek	36.71150	-118.91361	1837	3-Jul-05		1								1
SQNP	MFK Kaweah	River blw Bearpaw, Pool #6	36.55938	-118.61206	1940	31-Aug-06		1		1		1	1	1		5
SQNP	Kern	Rock Ck, blw Kern Hot Springs	36.47710	-118.40388	2099	29-Aug-04		1	1	1			3	1		7
SQNP	Kern	Upper Funston Mdw, Side Channel	36.45295	-118.41235	2045	31-Aug-04				1						1
SQNP	Kern	Lower Funston, Laurel Ck	36.38678	-118.41097	1994	2-Sep-04						1				1

Table 14.3. Capture records for *M. volans* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument (continued).

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
SQNP	Kern	Rock Ck, blw Kern Hot Springs	36.47710	-118.40388	2099	22-Aug-05						1		1		2
SQNP	Kern	Tarn, E Upper Trail Jct, Chagoopa	36.49267	-118.46293	3156	24-Aug-05								1		1
SQNP	Kern	Coyote Creek, Kern RS	36.34200	-118.40837	1970	27-Aug-05						2				2
						TOTALS	**2**	**26**	**5**	**18**	**1**	**17**	**5**	**7**	**0**	**81**
EARLIER STUDIES																
SQNP	Marble Kaweah	Giant Forest, Hazelwood Trail[a]	36.56488	-118.76477	1962	27-Jun-95						1				1
SQNP	NFK Kaweah	Pool #7, abv Yucca Ck	36.54697	-118.89764	538	19-Sep-96			1							1
SQNP	SFK Kaweah	Clough Cave[b]	36.35023	-118.76151	1141	9-Jun-87						2				2
						TOTALS	**0**	**0**	**1**	**0**	**0**	**3**	**0**	**0**	**0**	**4**

[a] SEKI WODB 53108

[b] SEKI WODB 44296

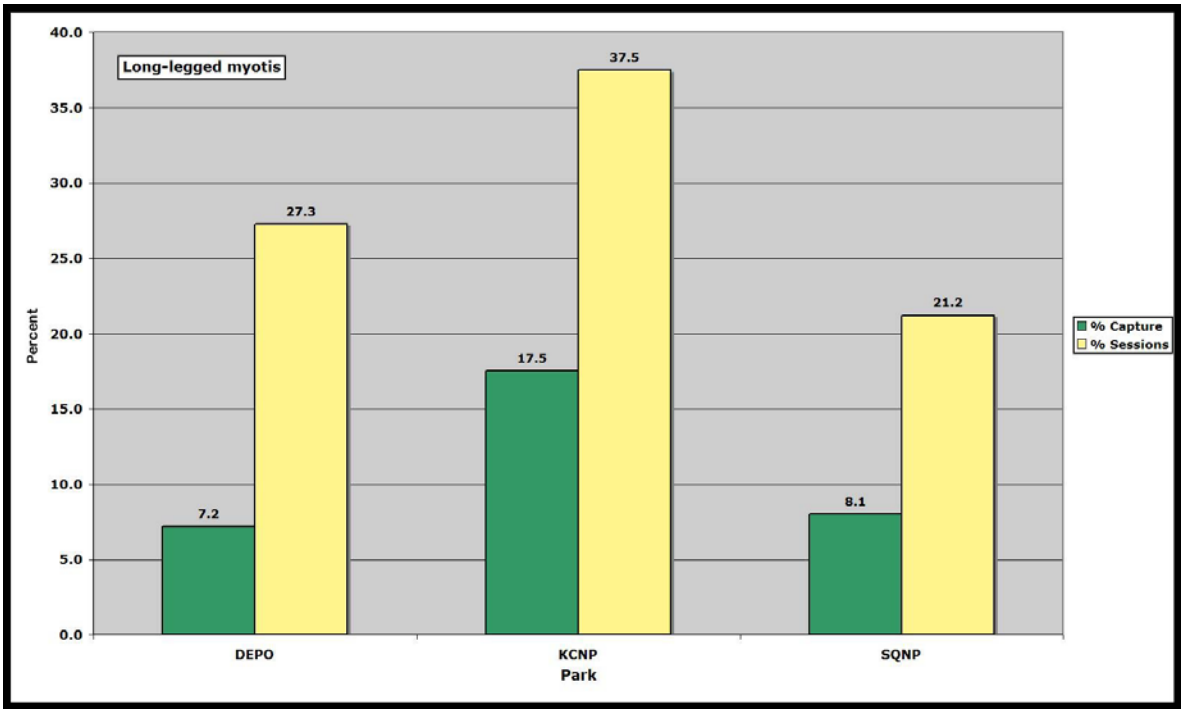


Figure 14.3. A bar graph comparing capture records by park as measured by the percentage of total captures and the percentage of sampling sessions in which long-legged myotis were detected.

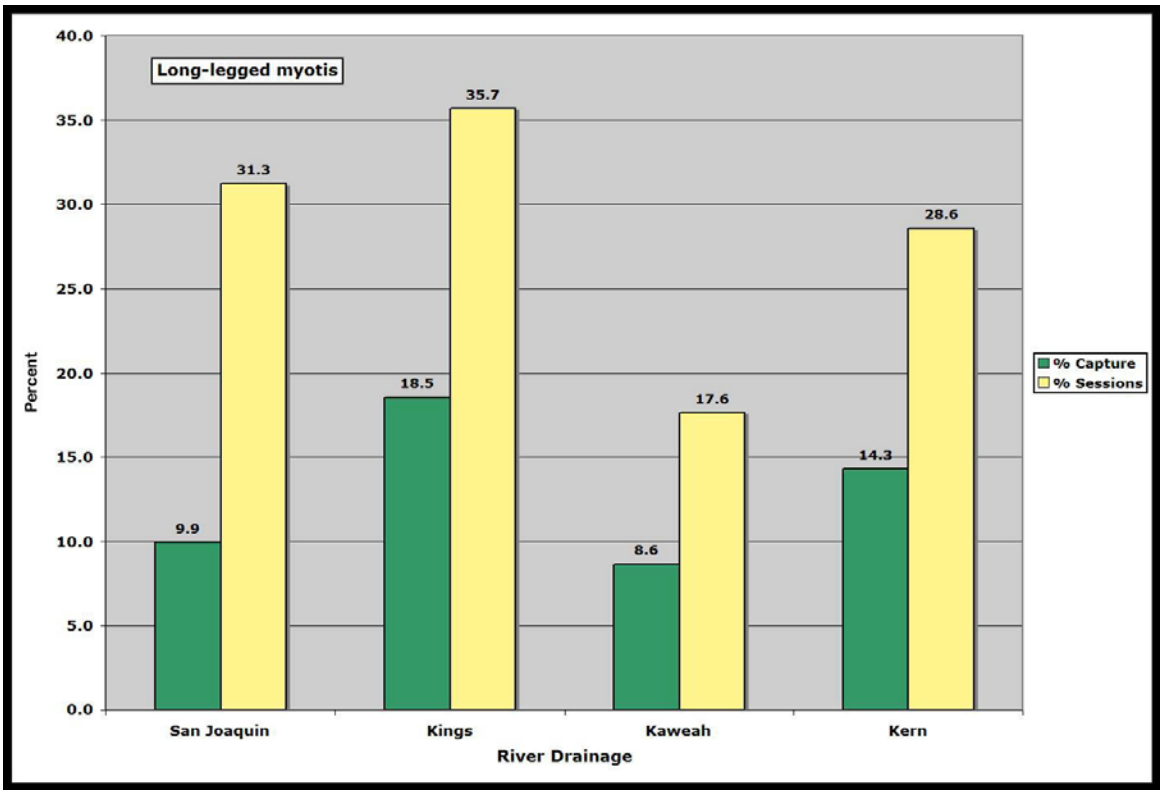


Figure 14.4 A bar graph comparing capture records by river drainage as measured by the percentage of total captures and the percentage of sampling sessions in which long-legged myotis were detected.

An analysis of our netting data using a univariate model indicates that water is the strongest indicator associated with the capture of *M. volans* (Table 14.4).

Table 14.4. Univariate Model Selection.

	df	AIC
Meadow_Scrub	4	269.3449
Forest	2	271.4345
Elev_m	2	277.2852
Water	7	224.0210
Rock	4	266.9178

An analysis of captures at water sites shows that we captured significantly more *M. volans* at creeks than at non-water sites, and we were more likely to capture them at rivers than at creeks (Table 14.5, Figure 14.5).

Table 14.5. Terms of the model for water categories.

Coefficients:	Estimate	Std. Error	Z Value	Pr(>|z|)
Creek(Intercept)	0.02985	0.1715	0.174	0.861810
Flooded Meadow	0.19329	0.47897	0.404	0.686540
Lake	-16.33244	1214.37693	-0.013	0.989269
Marsh	-16.33244	1487.30192	-0.011	0.991238
Not Water	-3.74343	1.0146	-3.690	0.000225 ***
Pond	0.66329	0.39295	1.688	0.091416
River	-1.01068	0.44281	-2.282	0.022463 *

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Null deviance: 227.41 on 102 degrees of freedom

Residual deviance: 161.51 on 96 degrees of freedom

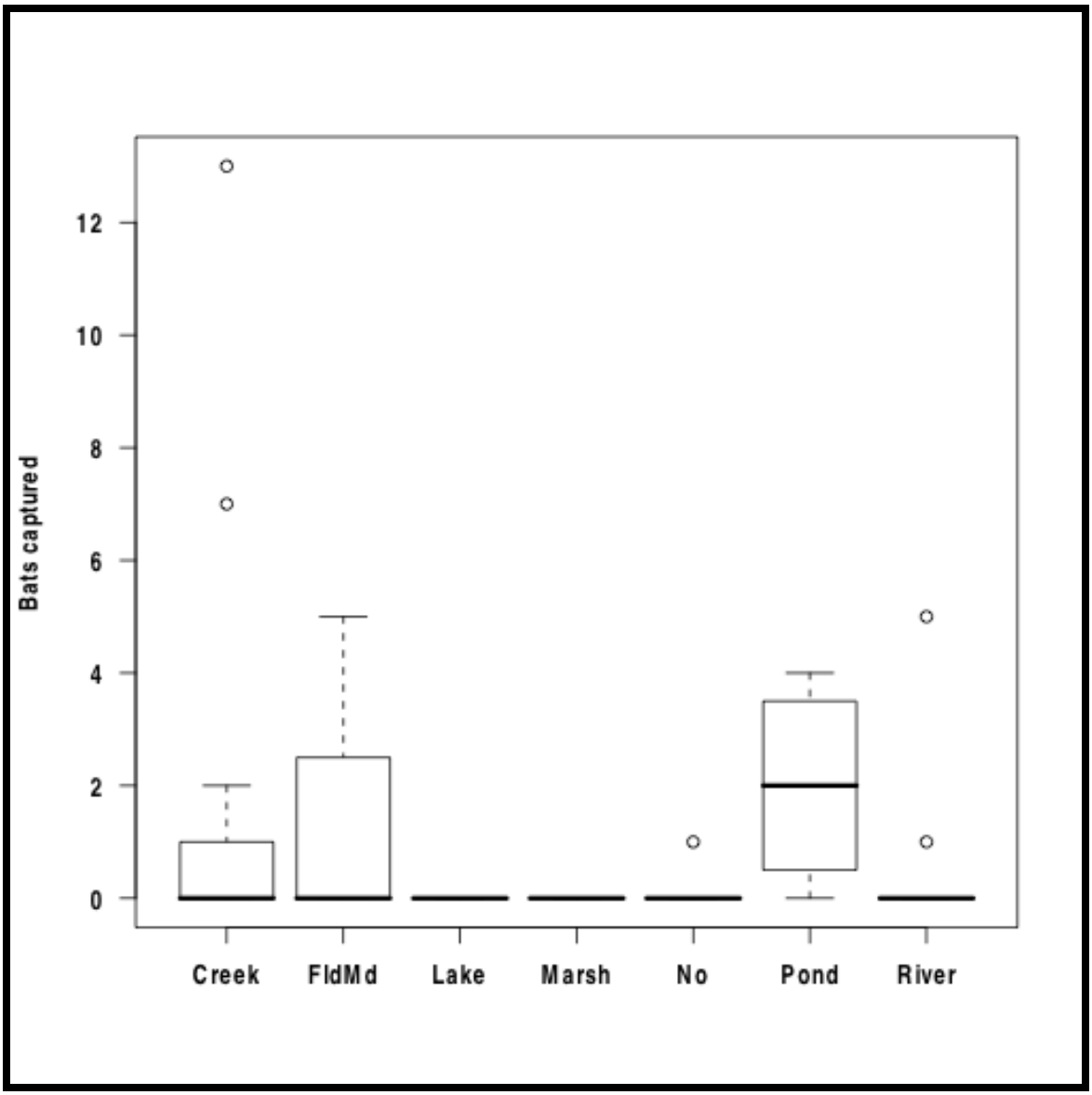


Figure 14.5. Graph showing the quartiles (with median values in bold) for number of *M. volans* captured at six types of water sites, and sites that were not at water.

14.3. Habitat Associations

Vegetative Communities

Distribution for this species covers a very large elevation range, from Yucca Creek on the North Fork Kaweah to Kearsarge Pass, and appears to be found in all the major forest communities throughout that range. These surveys would suggest a particular association with giant sequoia groves.

Roosting

Although this species has been found roosting in abandoned buildings, mines, and rock crevices (Barbour and Davis 1969, Warner and Czaplewski 1984), recent research suggests it roosts primarily in trees, particularly large diameter conifer snags, or live trees with lightning scars. Colonies of up to

200 have been found in live and dead ponderosa pine in New Mexico (Chung-MacCoubrey 1996). Radio-tagged females have also been found in *Ponderosa* snags in South Dakota (Cryan 1996) and in large snags and hollow cedar trees in the Central Oregon Cascades (Ormsbee 1996). Ormsbee (1996) found that females used multiple day roosts within a single area. Along the upper Sacramento River in California, a post-lactating female *M. volans* was radio-tracked to a large diameter conifer snag (Rainey and Pierson 1996), and in Yosemite National Park two adult males were radio-tracked to large sugar pine snags in the Mariposa Grove (Pierson et al. 2006). Individuals of this species were also captured roosting in fire-scarred basal hollows of giant sequoias in both the Mariposa and Merced Groves (Pierson et al. 2006). A nursery colony was discovered recently in an abandoned mine building in the Sierra foothills (Pierson and Rainey 2002).

Foraging

M. volans is an aerial pursuit forager that feeds primarily on moths (Lepidoptera), but it also eats a variety of other soft-bodied invertebrates and small beetles (Warner and Czaplewski 1984). It is known to feed on spruce budworm moths in southern Oregon (M. Perkins, personal communication). In a study on the upper Sacramento River its diet consisted primarily of moths (Rainey and Pierson 1996). From a sample of 14 individuals in Yosemite National Park, their diet consisted primarily of Hemiptera and Lepidoptera (Pierson et al. unpublished data).

14.4. Management Issues

Status. Long-legged myotis have no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we characterized this species as being locally abundant and having a large range, but because it appears to use caves, which are extremely sensitive habitat, and because it appears to be associated with giant sequoias in both Sequoia and Kings Canyon, we categorized its habitat as restricted.

Roosts. Any management activities that involve caves, hazard trees, or giant sequoia groves should trigger concern for this species. Cave roosting has been documented in Clough Cave in Sequoia National Park. An important roost was identified in the Fallen Monarch in Grant Grove (Table 14.3).

Foraging. Because this species forages primarily on moths, any management actions to control forest pests would potentially affect this species.

Fire. Prescribed burns could result in loss of roosting and foraging habitat in the short-term but would be expected to increase the availability of both in the longer-term.

Climate Change. Given the very wide elevational range over which this species is found, it is unknown and unclear what impacts climate change are likely to have.

15. *Myotis yumanensis*, Yuma Myotis

15.1. Identification

Myotis yumanensis is a small myotis species with a forearm of 32-38 mm (Figure 15.1). It has large feet (10 mm), and an unkeeled calcar (Barbour and Davis 1969). Although its color can vary, in the Sierra Nevada it tends to be a grey brown. It is most readily confused with *M. lucifugus*, and can be most confidently distinguished from this species by its echolocation call. *M. yumanensis* is a 50 kHz species, and *M. lucifugus* is a 40 kHz species. It is, however, difficult to distinguish acoustically from *M. californicus*, but can be readily distinguished morphologically. *M. californicus* is smaller and has a keeled calcar.



Figure 15.1. Photograph of Yuma myotis. (Credit: William E. Rainey)

15.2. Distribution

Geographic Range

M. yumanensis, is widely distributed throughout western North America, from Mexico to southern Canada. It is found throughout much of California. While it occurs from sea level to >2,500 m in the Sierra Nevada, its maternity colonies (which typically comprise 300-1,000 females) are generally confined to elevations below 1,000 m.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for *M. yumanensis* are mapped in Figure 15.2, and detailed in Table 15.1-15.3. All prior records for this species are from Sequoia National Park. Of the four museum records in the park collection, three are from Ash Mountain, and one is from Cascade Creek (Table 15.1). There are a number of records in the WODB, 12 from the Kaweah drainage and one from the Kern (an important record from Big Arroyo, supplied by J. Koshear) (Table 15.2). We had obtained a few

records from earlier studies, one from the North Fork Kaweah and two from the South Fork, including a record from Clough Cave (Table 15.3).

M. yumanensis was overall the second most commonly encountered species in this inventory, accounting for 16.62 % of all captures (Figure 7 in main report narrative). It occurred in all the parks and in all the river drainages. If we examine their distribution by park, they were by far more commonly encountered in Sequoia than the other two jurisdictions (Figure 15.3). They were the most commonly encountered species in Sequoia, accounting for 33.5 precent of all captures. Yet, interestingly, they occurred in a greater percentage of the sampling sessions in both Devils Postpile and Kings Canyon. There was a concentration of juveniles and reproductive females at lower elevation sites in Sequoia, where multiple animals were captured at most sites where the species was detected. In Devils Postpile and Kings Canyon the most animals ever captured per site was four, whereas in Sequoia it was 25. Consistent with these results the river drainage with the greatest number of records was the Kaweah, where this species was captured at 100 % of the sites sampled. The lowest percentages for number captured and percentage of sites at which they were detected was the Kern (Figure 15.4).

Although we obtained capture records up to 3051 m at Eagle Lake above Mineral King (possibly a high elevation record for this species), and we captured lactating females at two sites that were over 2,000 m (the San Joaquin River in Devils Postpile and near the Big Arroyo Junction in the Kern), more typically this species raises their young at lower elevations. It was near Ash Mountain at 502 m that we captured the most reproductive females and newly volant juveniles. It is interesting to note that there were several sites where multiple males were captured (two sites on the Middle Fork Kaweah below Bearpaw Meadow and over the South Fork Kaweah above the campground) (Table 15.3).

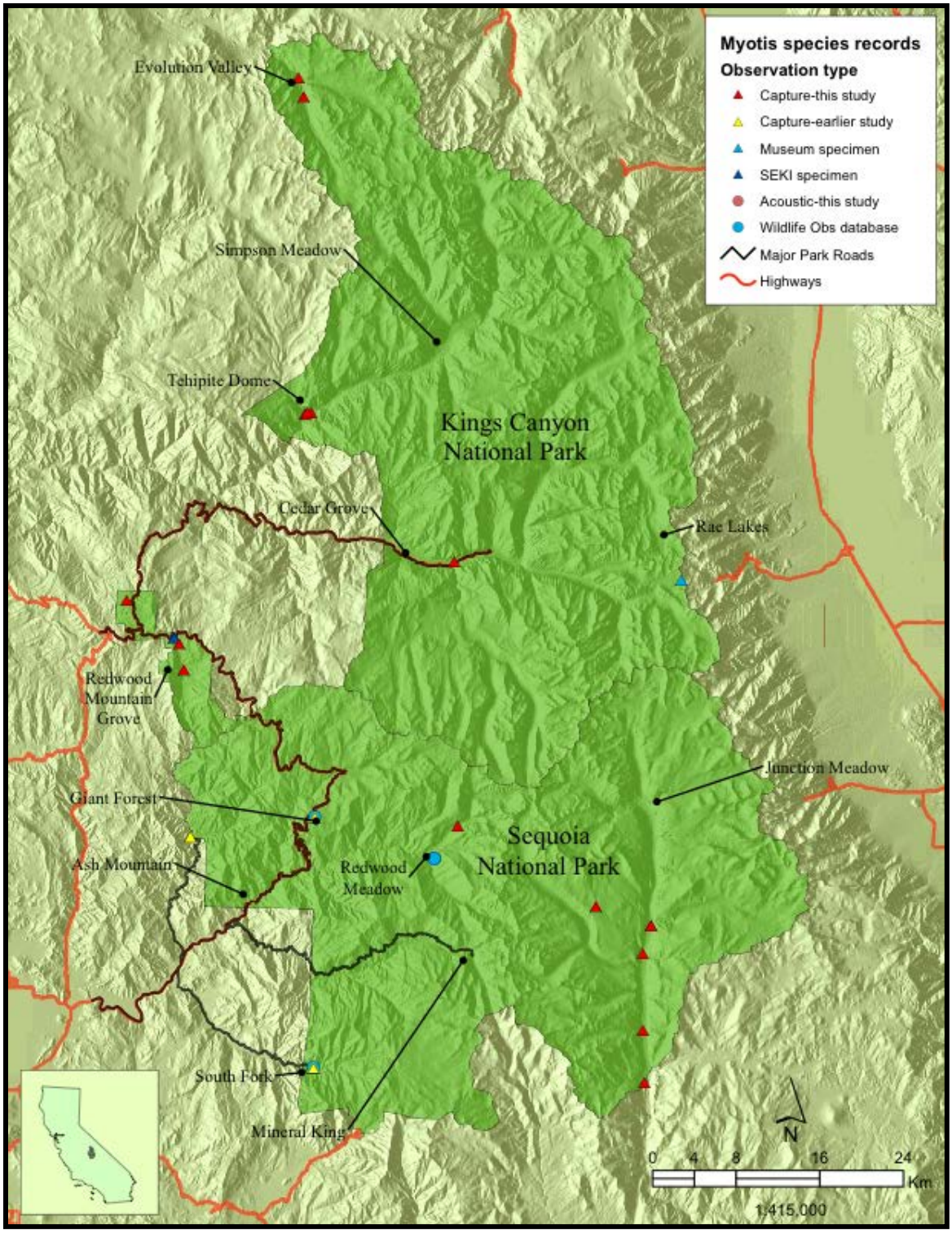


Figure 15.2. Map showing records *Myotis yumanensis (*Yuma myotis*)* in Sequoia and Kings Canyon National Parks. **Note map error:** The Ash Mountain records indicated in Tables 15.1 and 15.2 are missing from this map. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 15.1. Museum records for *M. yumanensis* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/ Age	MUS ID	REC NUM	Collector
SQNP	MFK Kaweah	near Ash Mt Hdqrtrs	36.48985	-118.82811	509	17-Aug-88	F/A	SEKI-8356*	45302	Petterson, J.
SQNP	MFK Kaweah	near Ash Mt Hdqrtrs	36.48985	-118.82811	509	6-Jul-88	M/A	SEKI-8357*	45303	Petterson, J.
SQNP	MFK Kaweah	near Ash Mt Hdqrtrs	36.48985	-118.82811	509	17-Aug-88	M/A	SEKI-8354	45301	Petterson, J.
SQNP	Marble Kaweah	Cascade Ck, blw Crystal Cave	36.59912	-118.82575	1386	18-Aug-88	M/A	SEKI-8313	45289	Petterson, J.

* Misidentified as *M. lucifugus* in museum records.

Table 15.2. Records for *M. yumanensis* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
SQNP	MFK Kaweah	near Ash Mt Hdqrtrs	36.48985	-118.82811	509	17-Aug-88	45302*	Petterson, J
SQNP	MFK Kaweah	near Ash Mt Hdqrtrs	36.48985	-118.82811	509	6-Jul-88	45303*	Petterson, J
SQNP	MFK Kaweah	near Ash Mt Hdqrtrs	36.48985	-118.82811	509	17-Aug-88	45301	Petterson, J
SQNP	Marble Kaweah	Cascade Ck, blw Crystal Cave	36.59912	-118.82575	1386	18-Aug-88	45289	Petterson, J
SQNP	NFK Kaweah	No. Fork. Burnt Pt	36.57860	-118.89467	665	21-Aug-88	45294	Petterson, J
SQNP	SFK Kaweah	SFK Campground[a]	36.34992	-118.76331	1114	28-Aug-86	43181	Pierson, E
SQNP	SFK Kaweah	SFK Campground	36.34992	-118.76331	1114	28-Aug-86	43182	Jeffrey, T
SQNP	SFK Kaweah	SFK Campground[b]	36.34992	-118.76331	1114	27-Jul-88	46469	Jeffrey, T
SQNP	SFK Kaweah	Ladybug Trail	36.34992	-118.76331	1114	16-Jul-87	44298	Jeffrey, T
SQNP	SFK Kaweah	Ladybug Trail	36.34992	-118.76331	1114	22-May-88	46413	Jeffrey, T
SQNP	SFK Kaweah	Ladybug Trail	36.34992	-118.76331	1114	29-Jun-88	46444	Jeffrey, T
SQNP	SFK Kaweah	Clough Cave[b]	36.35023	-118.76151	1141	9-Jun-87	44297	Jeffrey, T
SQNP	Kern	Big Arroyo/Kern River	36.44137	-118.41301	2034	20-Aug-93	60030	KoshearJ

* Misidentified as *M. lucifugus* in museum records

[a] Likely the same record as REC NUM 43182

[b] Reported also in Pierson and Rainey capture records (Table 15.3)

Table 15.3. Capture records for *M. yumanensis* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
DEPO	MFK San Joaquin	San Joaquin, nr. Ranger Station	37.63028	-119.08516	2304	23-Aug-01								2		2
DEPO	MFK San Joaquin	San Joaquin, nr. Ranger Station	37.63028	-119.08516	2304	30-Jul-04		1								1
DEPO	MFK San Joaquin	San Joaquin @ Meadow	37.62911	-119.08447	2304	23-Aug-01						1				1
DEPO	MFK San Joaquin	San Joaquin @Meadow	37.62911	-119.08447	2304	30-Jul-04						1		1		2
DEPO	MFK San Joaquin	San Joaquin, blw Muir Trail	37.61297	-119.08223	2288	29-Jul-04						1				1
KCNP	SFK San Joaquin	Blayney Meadows (outside park)	37.24126	-118.88847	2331	29-Jul-05			1		1	1				3
KCNP	MFK Kings	Tehipite, Side Channel #1	36.91227	-118.77769	1265	21-Jul-06						3				3
KCNP	MFK Kings	Tehipite, Side Channel #2	36.91243	-118.77670	1270	22-Jul-06						4				4
KCNP	MFK Kings	Tehipite, nr. Camp	36.9-1193	-118.78076	1266	24-Jul-06						1				1
KCNP	MFK Kings	Simpson Mdw, Side Pool	36.97580	-118.62123	1830	27-Jul-06						3				3
KCNP	SFK Kings	Cedar Grove, River @ Zumwalt	36.79312	-118.59533	1527	10-Jul-02						1				1
KCNP	SFK Kings	Cedar Grove, River Side Channel	36.78673	-118.62043	1483	11-Jul-02		1								1
KCNP	SFK Kings	Lower Paradise Valley	36.83484	-118.54026	2011	19-Jul-04						2				2
KCNP	SFK Kings	Fallen Monarch, Grant Grove	36.74858	-118.97085	1945	30-Jun-05		2								2
KCNP	NFK Kaweah	Redwood Creek, Low Trail Xing	36.68922	-118.90831	1706	1-Jul-05						2				2
KCNP	NFK Kaweah	Log Cabin, Redwood Creek	36.71150	-118.91361	1837	3-Jul-05						1				1
SQNP	NFK Kaweah	Pool #7, abv Yucca Ck	36.54697	-118.89764	538	31-Jul-06		1			1	1	1	1		5

Table 15.3. Capture records for *M. yumanensis* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
SQNP	EFK Kaweah	Eagle Lake abv Mineral King	36.41723	-118.60369	3051	4-Aug-02						1				1
SQNP	MFK Kaweah	River abv Ash Mountain	36.49378	-118.82102	502	14-Jul-02		5					9	11		25
SQNP	MFK Kaweah	River blw Bearpaw, Pool #3	36.55901	-118.61414	1938	30-Aug-06						11				11
SQNP	MFK Kaweah	River blw Bearpaw, Pool #6	36.55938	-118.61206	1940	31-Aug-06						8	3			11
SQNP	MFK Kaweah	River blw Bearpaw, Pool #5	36.55899	-118.61271	1940	1-Sep-06			1			1		3		5
SQNP	SFK Kaweah	River abv Campground	36.49378	-118.82102	502	13-Jul-02						11				11
SQNP	Kern	Rock Ck, blw Kern Hot Springs	36.47710	-118.40388	2099	29-Aug-04						2				2
SQNP	Kern	Upper Funston Mdw, Side Channel	36.45295	-118.41235	2045	31-Aug-04						1				1
SQNP	Kern	Kern, 1 Km blw Big Arroyo Br	36.43590	-118.41373	2037	26-Aug-05		1	1			1	2		1	6
SQNP	Kern	Coyote Creek, Kern RS	36.34200	-118.40837	1973	28-Aug-05				1						1
						TOTALS	**0**	**11**	**3**	**1**	**2**	**58**	**15**	**18**	**1**	**109**
EARLIER STUDIES																
SQNP	NFK Kaweah	Pool #7, abv Yucca Ck	36.54697	-118.89764	538	19-Sep-96						1				1
SQNP	SFK Kaweah	Clough Cave[a]	36.35023	-118.76151	1141	9-Jun-87						1				1
SQNP	SFK Kaweah	Across River, Campground[b]	36.35061	-118.76373	1115	27-Jul-88						1				1
						TOTALS	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**3**

[a] Also SEKI WODB 44297

[b] Also SEKI WODB 46469

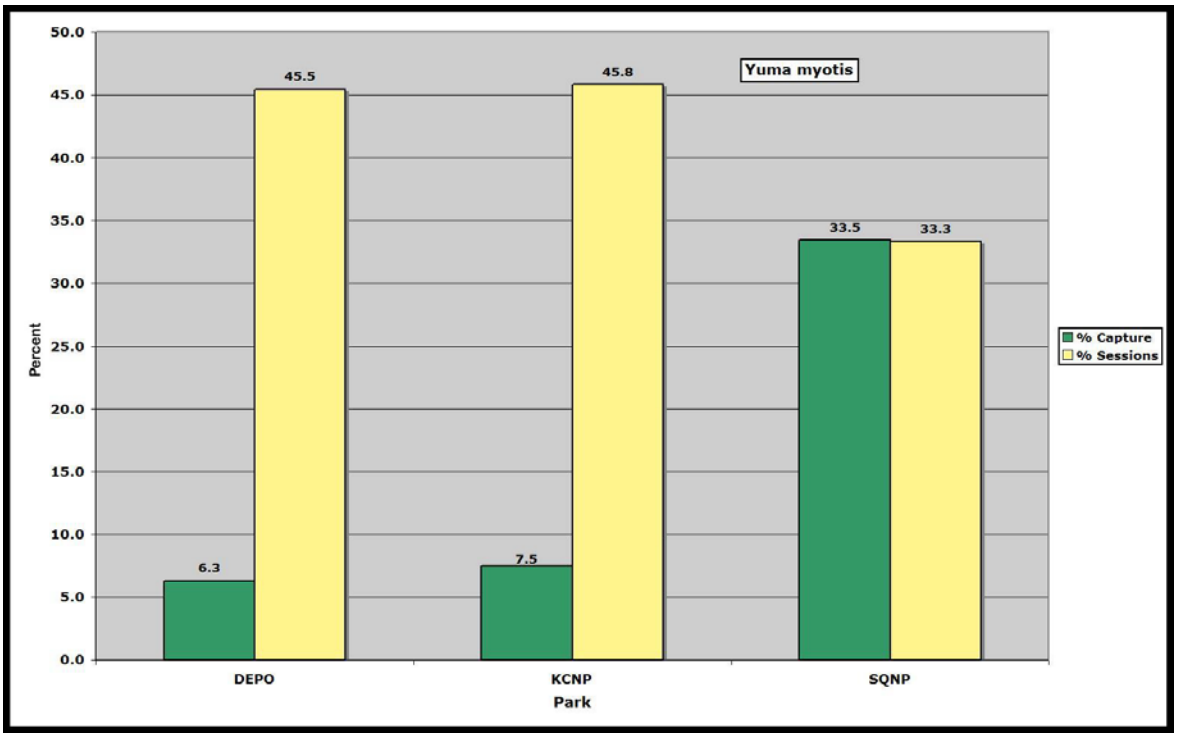


Figure 15.3. A bar graph comparing capture records by park as measured by the percentage of total captures and the percentage of sampling sessions in which Yuma myotis were detected.

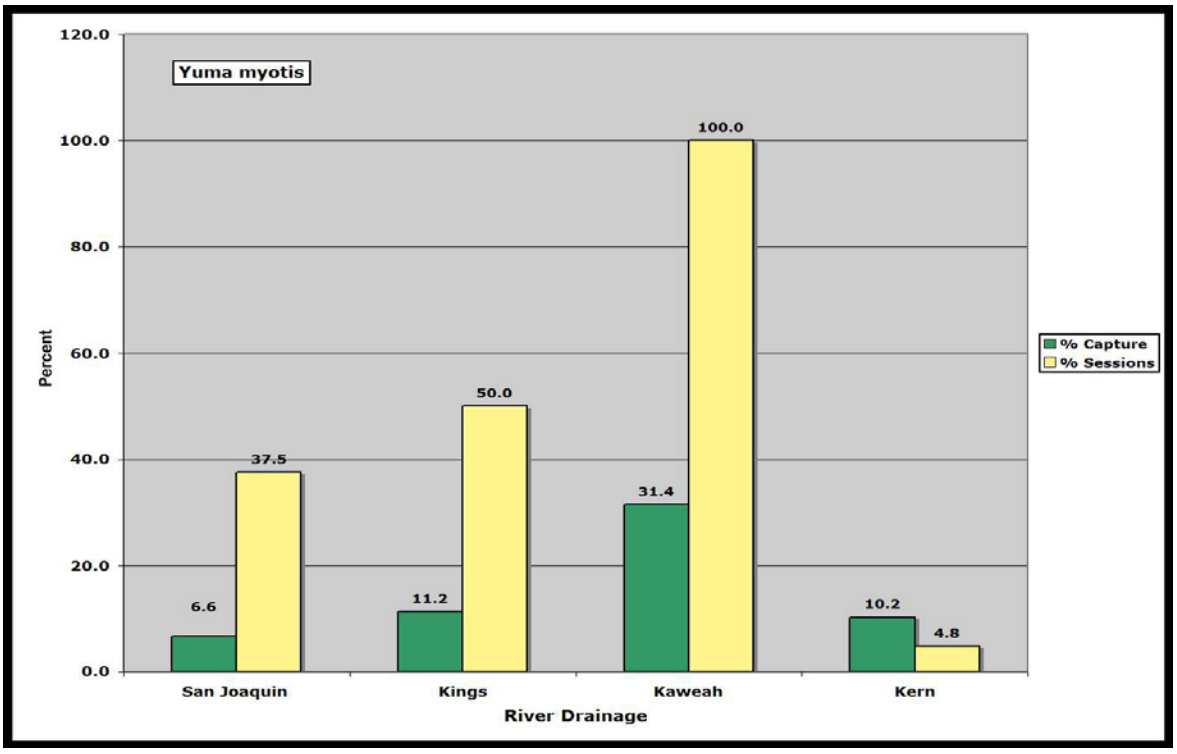


Figure 15.4. A bar graph comparing capture records by river drainage as measured by the percentage of sampling sites at which Yuma myotis were detected.

An analysis of our netting data using a univariate model indicates that water is by far the strongest indicator for the capture of *M. yumanensis* (Table 15.4).

Table 15.4. Univariate Model Selection

	df	**AIC**
Meadow_Scrub	4	447.1969
Forest	2	443.1969
Elev_m	2	352.7656
Water	7	284.8746
Rock	4	456.0552

An analysis of captures at water sites shows that we captured significantly more *M. yumanensis* at creeks than at non-water sites, and were much more likely to capture them at rivers than at creeks (Table 15.5, Figure 15.5).

Table 15.5. Terms of the model for water categories.

Coefficients:	**Estimate**	**Std. Error**	**Z Value**	**Pr(>|z|)**
Creek(Intercept)	-0.2007	0.1925	-1.043	0.297
Flooded Meadow	-17.1019	1733.9293	-0.010	0.992
Lake	-0.8979	1.0184	-0.882	0.378
Marsh	-17.1019	2452.1463	-0.007	0.994
Not Water	-2.4143	0.6086	-3.967	7.28e-05 ***
Pond	-17.1019	1733.9293	-0.010	0.992
River	1.7456	0.2244	7.778	7.39e-15 ***

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Null deviance: 393.19 on 102 degrees of freedom

Residual deviance: 196.27 on 96 degrees of freedom

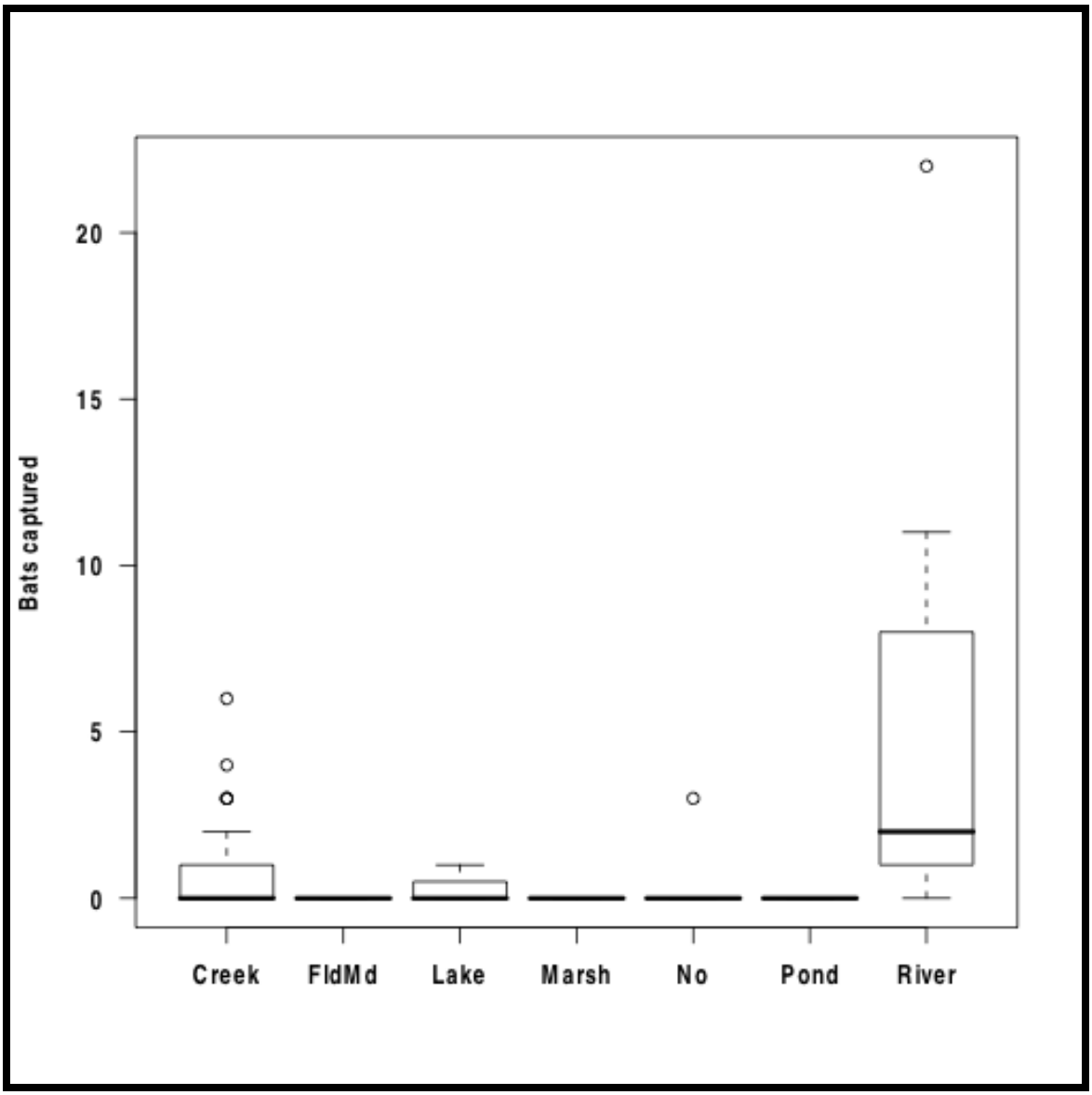


Figure 15.5. Graph showing the quartiles (with median values in bold) for number of bats captured at six types of water sites, and sites that were not at water.

Elevation is also a strong indicator regarding the distribution of *M. yumanensis*, with the numbers decreasing with increasing elevation (Table 15.6, Figure 15.6).

Table 15.6. Terms of the model for elevation.

Coefficients:	**Estimate**	**Std. Error**	**Z Value**	**Pr(>|z|)**
(Intercept)	2.6773038	0.2101717	12.74	<2e-16 ***
Elev_m	-0.0012936	0.0001293	-10.00	<2e-16 ***

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

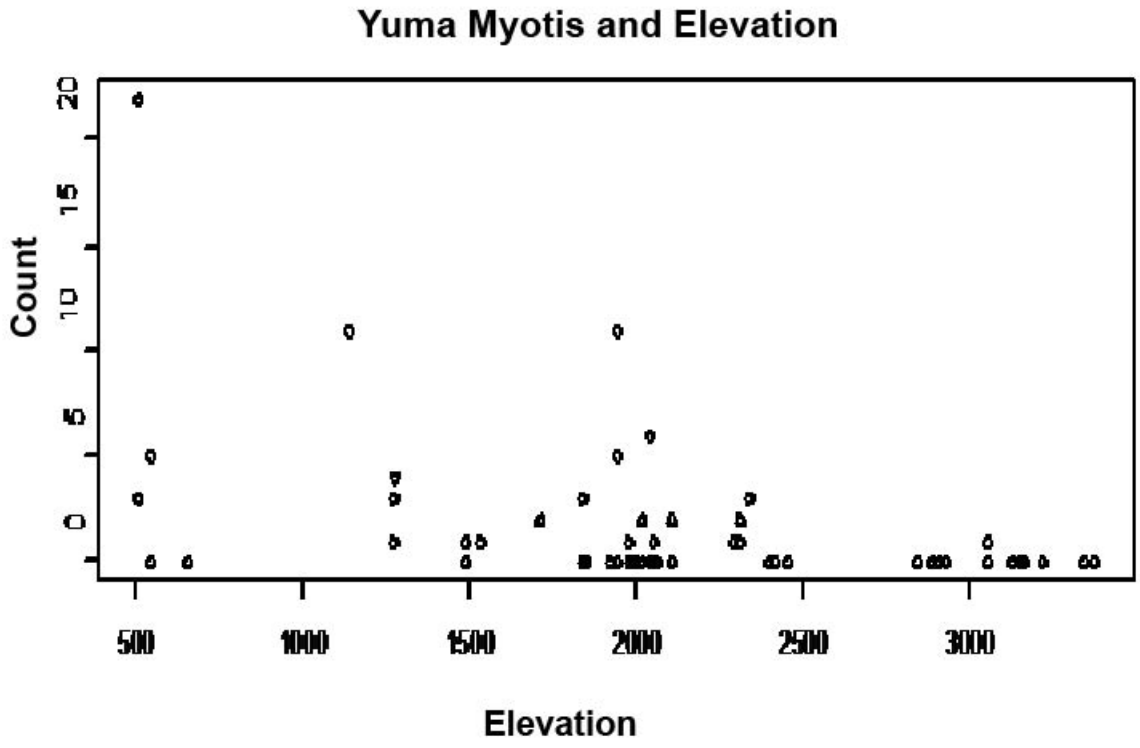


Figure 15.6. Graph showing the number of Yuma myotis captured per site by elevation.

15.3. Habitat Associations

Vegetative Communities

M. yumanensis appears to occur in all plant communities from low elevation blue oak savannah to lodgepole pine forest.

Roosting

M. yumanensis is predominantly a crevice dwelling species, although it is also frequently found roosting on open surfaces. It forms large, conspicuous maternity colonies, in a wide variety of roost sites. It is one of the species most commonly associated with anthropogenic structures, including barns and bridges, although it will also roost in caves, mines, abandoned swallow nests, and under flaking bark of large snags (Barbour and Davis 1969, Dalquest 1947, Evelyn et al. 2004, Rainey and Pierson 1996). Some of the largest known colonies of *M. yumanensis* are found in buildings and on bridges. In northern California, maternity colonies are known from fire-scarred coast redwoods and sugar pine snags (Pierson and Rainey 1997, Rainey and Pierson 1996, Rainey et al. 1992).

Foraging

M. yumanensis is more highly associated with water than any other species. It flies low over relatively calm water (reservoirs, ponds, or slowly flowing reaches, and pools of rivers and streams), feeding primarily on small, emergent aquatic insects, such as midges, mayflies and caddis flies

(Barbour and Davis 1969, Dalquest 1947, Rainey and Pierson 1996, van Zyll de Jong 1985). *M. yumanensis* is often found in association with reservoirs in California (*e.g.*, Pierson et al. 2001). Studies in Oregon found this species feeding on a wide variety of taxa, including Lepidoptera, Coleoptera, Trichoptera, Homoptera, Isoptera and Diptera (Whitaker et al. 1977 & 1981). In a study in the upper Sacramento River drainage the diet of this species was dominated by Trichoptera (Rainey and Pierson 1996). It is also known to forage over fields, and some diet samples from orchard roosts are composed largely of moth remains (Brigham *et al.* 1992, Rainey and Pierson 1996).

15.4. Management Issues

Status. *M. yumanensis* has no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we characterized this species as being locally abundant and having a large range, but because its reproductive females are concentrated at lower elevation, we categorized its habitat as restricted.

Roosts. Any management activities that involve human structures (including bridges), caves, or hazard trees should trigger concern for this species. Cave roosting has been documented in Clough Cave.

Foraging. Because this species forages primarily on aquatic emergent insects, any management actions that potentially impact the productivity of aquatic insects should trigger a concern for this species.

Fire. Prescribed burns may result in loss of roosting habitat in the short-term but would be expected to increase its availability in the longer-term.

Climate Change. Given that this species is concentrated at lower elevations, its range would be expected to expand up in elevation with a warming climate. An important consideration would be how a warming climate and drier habitats would alter their prey base.

16. *Parastrellus hesperus*, Canyon Bat

16.1. Identification

Parastrellus hesperus is the smallest bat in California, with a forearm of 27-33 mm (Figure 16.1). While it has a keeled calcar, and could be confused with *M. californicus* or *M. ciliolabrum*, it has a blunt tragus (Barbour and Davis 1969). Also it has a very distinct dark mask and dark ears, which contrast with a light brown, sometimes blondish pelage. It was known as *Pipistrellus hesperus*, the western pipistrelle, until recent genetic studies confirmed what taxonomists had long claimed, that both the eastern and western North American forms of the genus *Pipistrellus* were sufficiently distinct from the Old World forms in this genus, and sufficiently distinct from each other, that each should be granted generic status (Hooper et al. 2006). The common name now being used preferentially is “canyon bat.” *P. hesperus* is readily identifiable acoustically (Figure 16.2).



Figure 16.1. Photograph of *P. hesperus* (Credit: Keith Paul, USFWS)

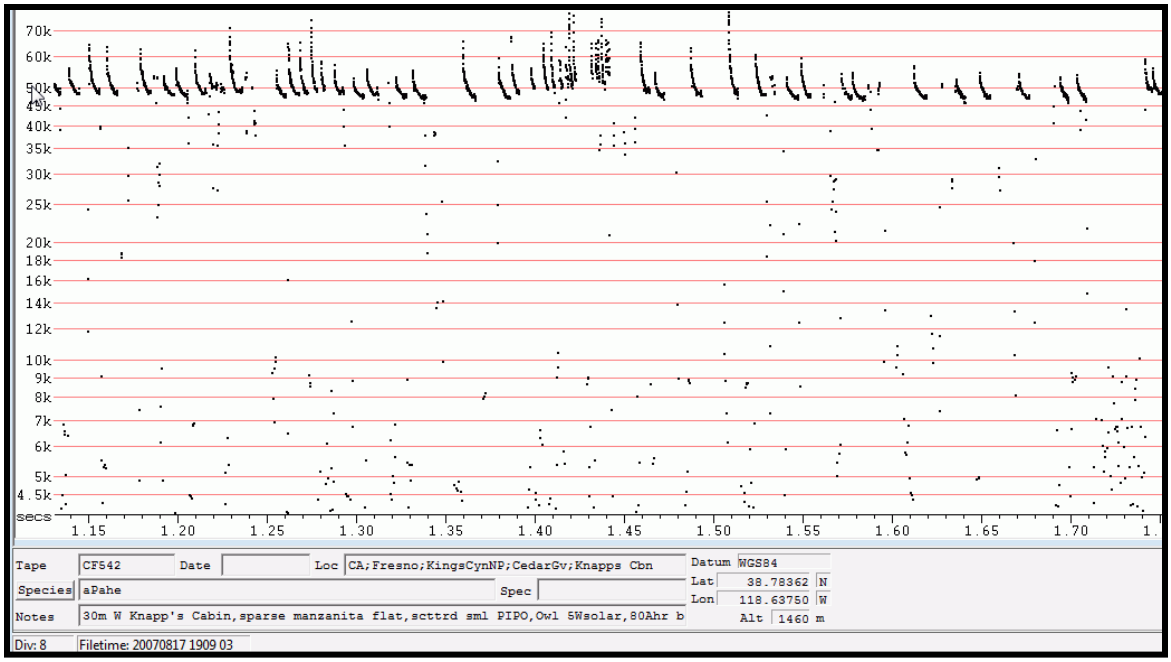


Figure 16.2. Echolocation call of canyon bat, Knapp's Cabin, Cedar Grove, Kings Canyon National Park, August 17, 2007.

16.2. Distribution

Geographic Range

Parastrellus hesperus occurs from the desert lowlands of the southwestern United States to southern Washington. While most commonly associated with arid, desert landscapes, it also occurs in mixed conifer forest in mountain ranges in California and up to fir-spruce forest in Arizona. Recent surveys in the Sierra Nevada suggest it is more widespread in this mountain range than was previously realized (Pierson et al. 2001 and 2006), occurring as far north as Shasta and Siskiyou counties (Constantine 1982, Pierson and Rainey 1998b, Pierson et al. 2001, Rainey and Pierson 1996).

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for *P. hesperus* are mapped in Figure 16.3, and detailed in Tables 16.1-16.3. There is one museum record from Big Baldy Ridge in Kings Canyon, near the high elevation limit for this species (Table 16.1). There are no records in the WODB, although we had captured them in an earlier study at Sycamore Creek, near Ash Mountain (Table 16.2). This species is generally associated with hot, dry, rocky habitats, and 15 of the 21 individuals captured by us in this inventory were from three sites in Tehipite Valley (Table 16.2). Although *P. hesperus* was relatively rare in net captures, representing only 3.2% of animals captured, acoustic surveys documented a much wider distribution (Table 16.3, Figures 16.4 and 16.5), with records from lowest elevations in Tehipite Valley to 2,323 m at Redwood Creek on the Mineral King Road. Relatively large numbers of records at dusk at both Moro Rock and the cliffs east of Lookout Point (just inside the entrance station on the Mineral King Road) (Table 16.3) indicate roost sites at these rock features. Although records were concentrated at lower elevations, much of the Kern Trench falls within its known

elevational distribution. Its absence from our records in the Kern drainage is puzzling and unexpected.

Of the 23 individuals we captured in this and a prior study, 19 (83%) were reproductive females.

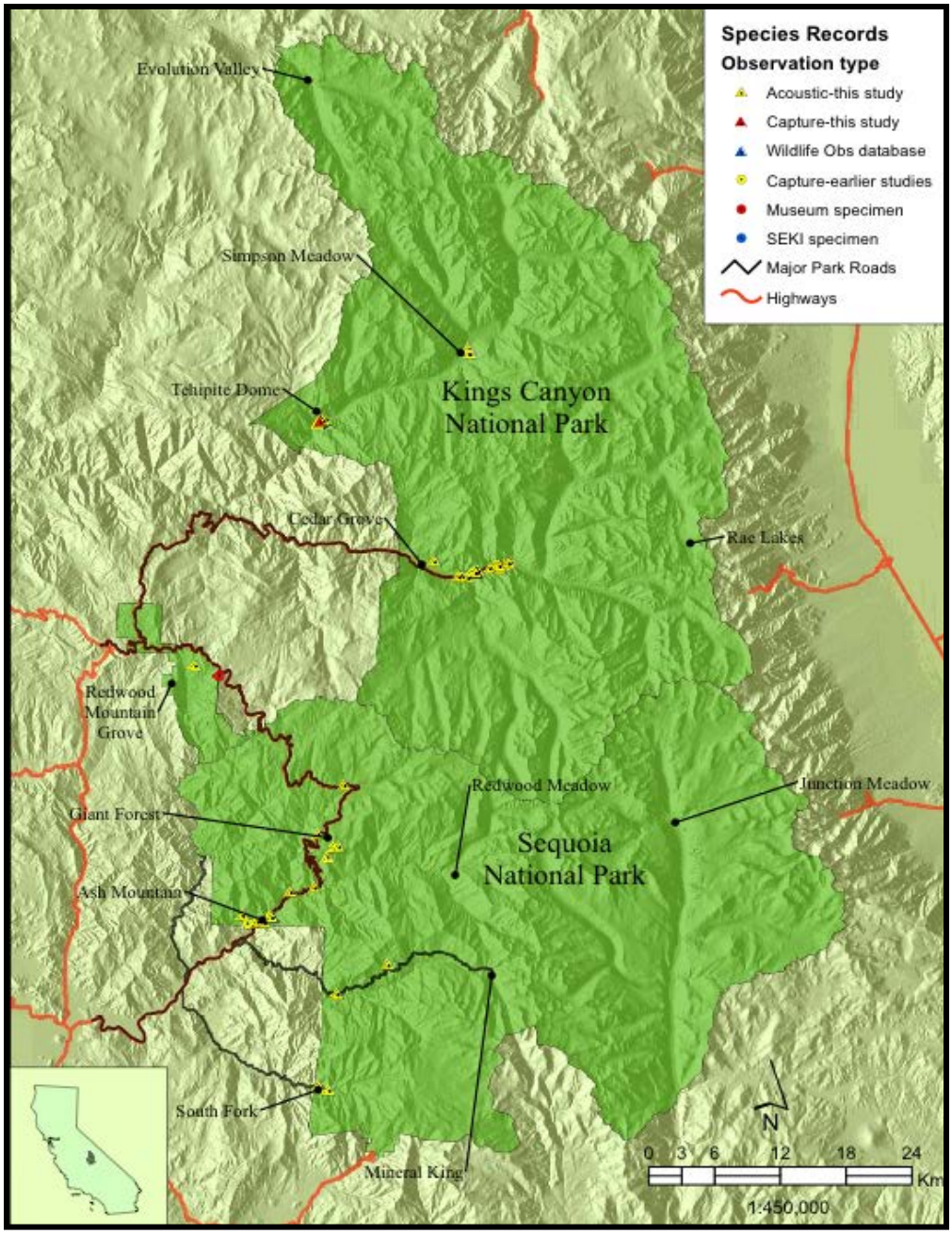


Figure 16.3. Map showing records for *Parastrellus hesperus* (canyon bat) in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 16.1. Museum records for *P. hesperus* for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Sex/Age	MUS ID	REC NUM	Collector	NOTES
KCNP	Marble Kaweah	Big Baldy Ridge	36.69586	-118.87857	2302	16-Aug-51	U/U	MVZ-114835		Brown, J.L.	

Table 16.2. Capture records for *P. hesperus* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
KCNP	MFK Kings	Cedar Grove, River @ Zumwalt	36.79312	-118.59533	1527	10-Jul-02		2								2
KCNP	MFK Kings	Cedar Grove, River Side Channel	36.78673	-118.62043	1483	11-Jul-02		2				1				3
KCNP	SFK Kings	Tehipite, Side Channel #1	36.91227	-118.77769	1265	21-Jul-06		5				1				6
KCNP	SFK Kings	Tehipite, Side Channel #2	36.91243	-118.77670	1270	22-Jul-06	1	6				1				8
KCNP	SFK Kings	Tehipite, nr. Camp	36.9-1193	-118.78076	1266	24-Jul-06		1								1
SQNP	MFK Kaweah	River abv Ash Mountain	36.49378	-118.82102	502	14-Jul-02								1		1
						TOTALS	**1**	**16**	**0**	**0**	**0**	**3**	**0**	**1**	**0**	**21**
EARLIER STUDIES																
SQNP	MFK Kaweah	Sycamore Creek, Ash Mountain	36.48770	-118.84446	510	13-Jul-95	1	1								2
						TOTALS	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**

Table 17.3. Acoustic records for *P. hesperus* obtained in this study. X = present, files not counted.

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	28-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	29-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	30-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	29-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	30-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	28-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	29-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	30-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Postpile, talus, Ctr S edge	37.62493	-119.08424	2339	23-Aug-01	X
DEPO	MFK San Joaquin	Postpile	Postpile, talus, dowstream	37.62454	-119.08406	2337	23-Aug-01	X
DEPO	MFK San Joaquin	Postpile	Postpile, top	37.62442	-119.08328	2329	23-Aug-01	X
DEPO	MFK San Joaquin	Rainbow Falls	King Ck	37.59844	-119.09064	2194	29-Jul-04	X
DEPO	MFK San Joaquin	Rainbow Falls	King Ck	37.59844	-119.09064	2194	30-Jul-04	X
DEPO	MFK San Joaquin	Rainbow Falls	Rock outcrop above King Ck	37.59939	-119.08945	2210	30-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	28-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	29-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	30-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Cottonwood, nr. Pkg,	37.63028	-119.08516	2280	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Cottonwood, upstrm Pkg	37.63069	-119.08532	2280	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Gravel bar, nr. Mdw nets	37.62901	-119.08441	2325	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Mdw edge, nr. Mdw nets	37.62870	-119.08438	2314	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Meadow near footbridge	37.62799	-119.08480	2302	28-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Meadow near footbridge	37.62799	-119.08480	2302	29-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Meadow near footbridge	37.62799	-119.08480	2302	30-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, 70m N Soda Spg	37.62810	-119.08487	2158	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, Forest Edge	37.62832	-119.08570	2349	23-Aug-01	X

Table 16.3. Acoustic records for *P. hesperus* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, Willow Riparian	37.62911	-119.08447	2316	23-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Buttress Notch	37.61836	-119.08661	2381	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	East side Buttress, N end	37.62017	-119.08662	2379	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Lower end seep, SE Buttresses	37.61366	-119.08543	2292	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Rock face nr. Seep net site	37.61524	-119.08516	2314	24-Aug-01	X
KCNP	SFK San Joaquin	Blw. Goddard-Evolution Jct	Bench abv. Cyn floor	37.20017	-118.79784	2851	03-Aug-05	8
KCNP	SFK San Joaquin	Blw. Goddard-Evolution Jct	Campsite	37.20023	-118.79728	2560	03-Aug-05	1
KCNP	SFK San Joaquin	Blw. Goddard-Evolution Jct	Talus base Cyn wall	37.19987	-118.79759	2555	03-Aug-05	1
KCNP	SFK San Joaquin	Colby Mdw	Mdw/River edge	37.18321	-118.72972	2967	01-Aug-05	3
KCNP	SFK San Joaquin	Colby Mdw	Meadow	37.18333	-118.72922	2959	01-Aug-05	5
KCNP	SFK San Joaquin	Colby Mdw	Net Site	37.18339	-118.73023	2963	01-Aug-05	4
KCNP	SFK San Joaquin	Colby Mdw	Rock abv camp	37.18398	-118.73019	2979	01-Aug-05	1
KCNP	SFK San Joaquin	Goddard Canyon	Bench abv river	37.17298	-118.79077	2652	31-Jul-05	5
KCNP	SFK San Joaquin	Goddard Canyon	Meadow blw camp	37.18069	-118.79114	2655	31-Jul-05	13
KCNP	SFK San Joaquin	Goddard Canyon	Swamp, net site	37.18255	-118.79134	2657	31-Jul-05	2
KCNP	SFK San Joaquin	Goddard-Evolution Jct	Bench abv. Bridge	37.19247	-118.79441	2583	30-Jul-05	1
KCNP	SFK San Joaquin	McClure Mdw	Granite bench with grass	37.18730	-118.74550	2943	02-Aug-05	10
KCNP	SFK San Joaquin	McClure Mdw	Mdw nr camp	37.18832	-118.74419	2942	02-Aug-05	16
KCNP	SFK San Joaquin	McClure Mdw	River edge	37.18790	-118.74409	2939	02-Aug-05	58
KCNP	SFK San Joaquin	McClure Mdw	Shallow pool flooded mdw	37.18724	-118.74464	2933	02-Aug-05	31
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	23-Jul-04	X
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	1-Jul-05	4
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	2-Jul-05	1
SQNP	EFK Kaweah	Mineral King	Cliffs east of Lookout Point, Entrance Sta	36.43034	-118.75281	1264	1-Aug-02	68
SQNP	EFK Kaweah	Mineral King	Cliffs east of Lookout Point, Entrance Sta	36.43034	-118.75281	1264	1-Aug-02	28
SQNP	EFK Kaweah	Mineral King	Redwood Ck, blw Xng Mineral King Rd	36.45586	-118.70159	2323	1-Aug-02	3
SQNP	Marble FK Kaweah	Giant Forest	Beetle Rock, 50 m to forest edge	36.56462	-118.77499	1963	30-Jul-02	4

Table 16.3. Acoustic records for *P. hesperus* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-02	4
SQNP	Marble FK Kaweah	Giant Forest	Moro Rock, first rest area, 1/2 to top	36.54554	-118.76456	2003	30-Jul-02	127
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, bare rock below Rd	36.55355	-118.75900	2059	31-Jul-02	2
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	31-Jul-02	2
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	29-Jul-02	2
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	30-Jul-02	2
SQNP	MFK Kaweah	Ash Mt	Alder Creek, below road	36.49268	-118.82482	542	12-Jul-02	24
SQNP	MFK Kaweah	Ash Mt	Marble Fork Confluence	36.51569	-118.80184	635	12-Jul-02	22
SQNP	MFK Kaweah	Ash Mt	Mile 60 Creek	36.51991	-118.77791	781	12-Jul-02	2
SQNP	MFK Kaweah	Ash Mt	Above Parking at net site	36.49555	-118.82218	543	14-Jul-02	47
SQNP	MFK Kaweah	Ash Mt	Gravel bar 30 m abv abve net site	36.49390	-118.82068	501	14-Jul-02	149
SQNP	MFK Kaweah	Ash Mt	Gravel bar dwn fr net site	36.49429	-118.82032	499	14-Jul-02	148
SQNP	MFK Kaweah	Ash Mt	Gravel terrace, 100 m abv net site	36.49370	-118.82206	493	14-Jul-02	122
SQNP	MFK Kaweah	Ash Mt	Net site	36.49371	-118.82092	494	14-Jul-02	159
SQNP	MFK Kaweah	Ash Mt	Rocks behind Research office	36.48948	-118.82825	523	14-Jul-02	43
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr, E on dirt rd., just abv. Hwy	36.48935	-118.83494	500	14-Jul-02	24
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr. - Farther East on dirt rd	36.49004	-118.83413	512	14-Jul-02	33
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr. -dry ck at 1st turn out	36.48870	-118.83641	482	14-Jul-02	13
SQNP	MFK Kaweah	Sycamore Creek	Abv Waterfall abv road, Net site	36.49552	-118.85029	646	28-Jun-05	1
SQNP	Marble FK Kaweah	Giant Forest	Beetle Rock, 50 m to forest edge	36.56462	-118.77499	1963	30-Jul-02	4
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-02	4
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	River edge, above footbridge, nr. net site	36.34955	-118.75966	1134	13-Jul-02	17
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Rock face, above entrance road	36.35282	-118.76980	1080	13-Jul-02	76
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Rocks below road, entrance road	36.35095	-118.76814	1078	13-Jul-02	42
				TOTAL SAMPLING SESSIONS				**87**

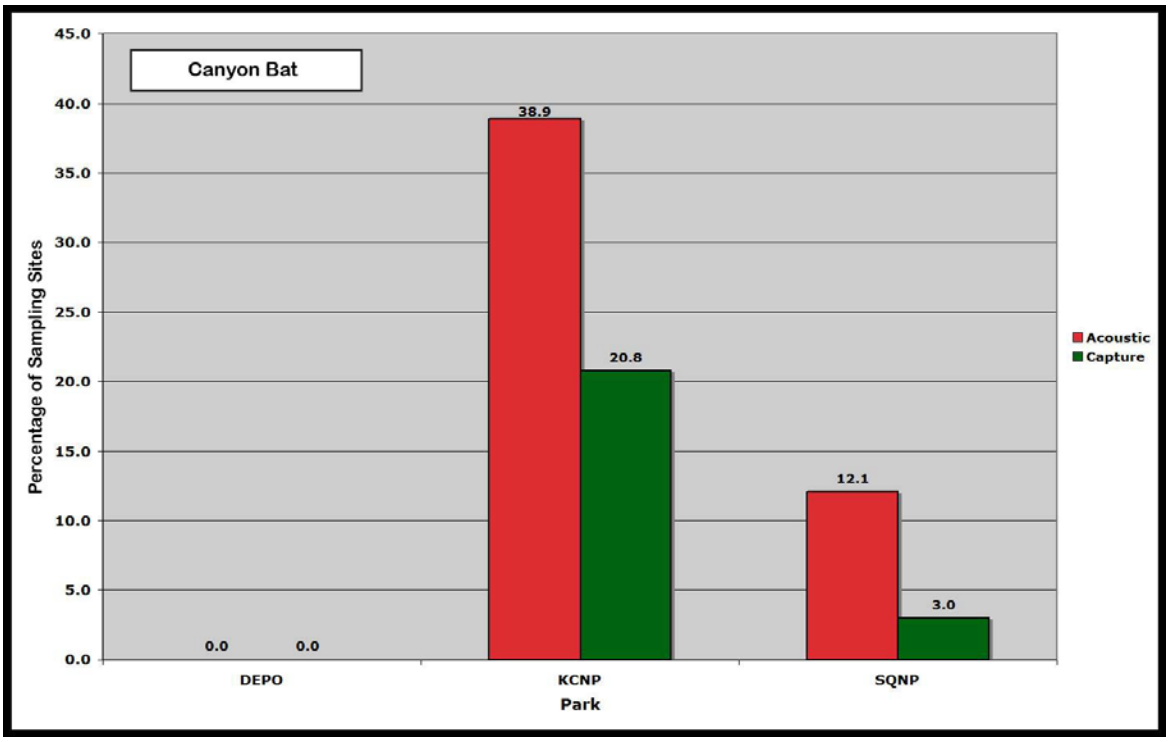


Figure 16.4. A bar graph comparing capture and acoustic records by park as measured by the percentage of sampling sites at which canyon bats were detected.

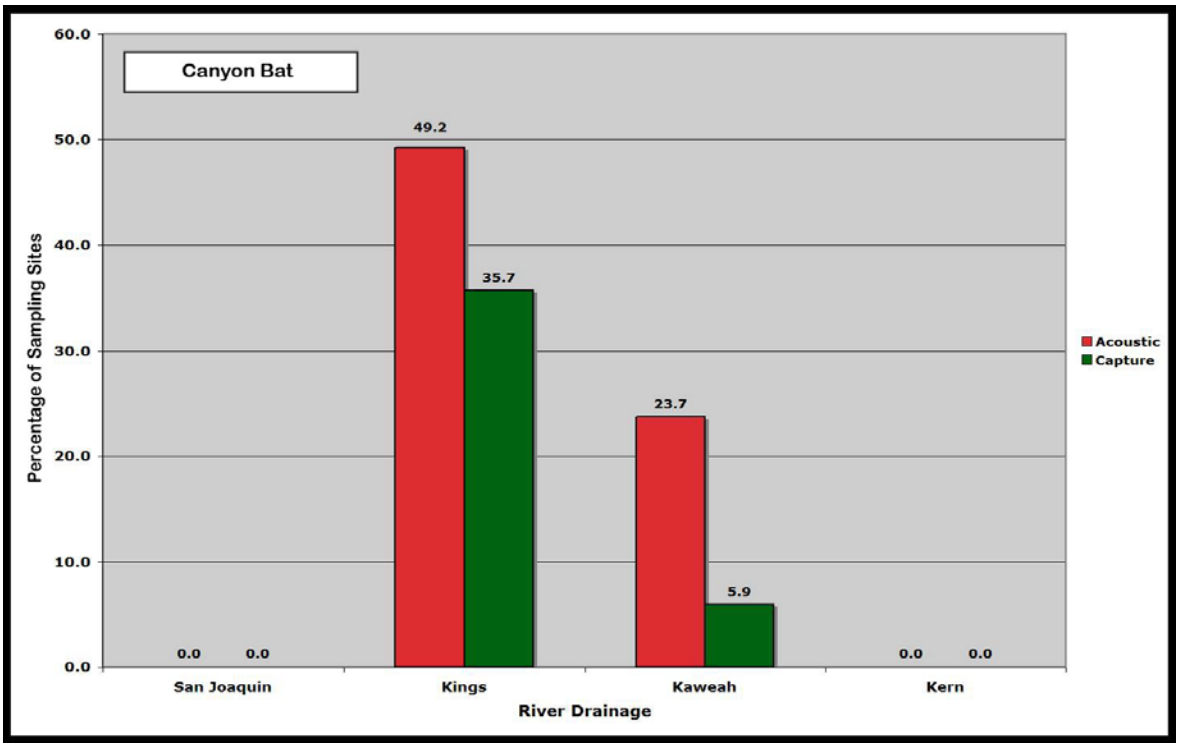


Figure 16.5. A bar graph comparing capture and acoustic records by river drainage as measured by the percentage of sampling sites at which canyon bats were detected.

An analysis of our netting data using a univariate model indicates that elevation is the strongest indicator for the capture of *P. hesperus* (Table 16.4).

Table 16.4. Univariate Model Selection

	df	**AIC**
Meadow_Scrub	4	150.4596
Forest	2	146.4596
Elev_m	2	-118.0609
Water	7	127.2023
Rock	4	149.5157

An analysis of the elevational distribution of captures showed that this species was quite limited in its elevational distributuion, and that numbers decreased with increasing elevation (Table 16.5, Figure 16.6).

Table 16.5. Terms of the model for elevation.

Coefficients:	**Estimate**	**Std. Error**	**Z Value**	**Pr(>|z|)**
(Intercept)	1.4949531	0.4506406	3.317	0.000909 ***
Elev_m	-0.0017674	0.0003064	-5.767	8.05e-09 ***

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Null deviance: 130.93 on 102 degrees of freedom

Residual deviance: 96.86 on 101 degrees of freedom

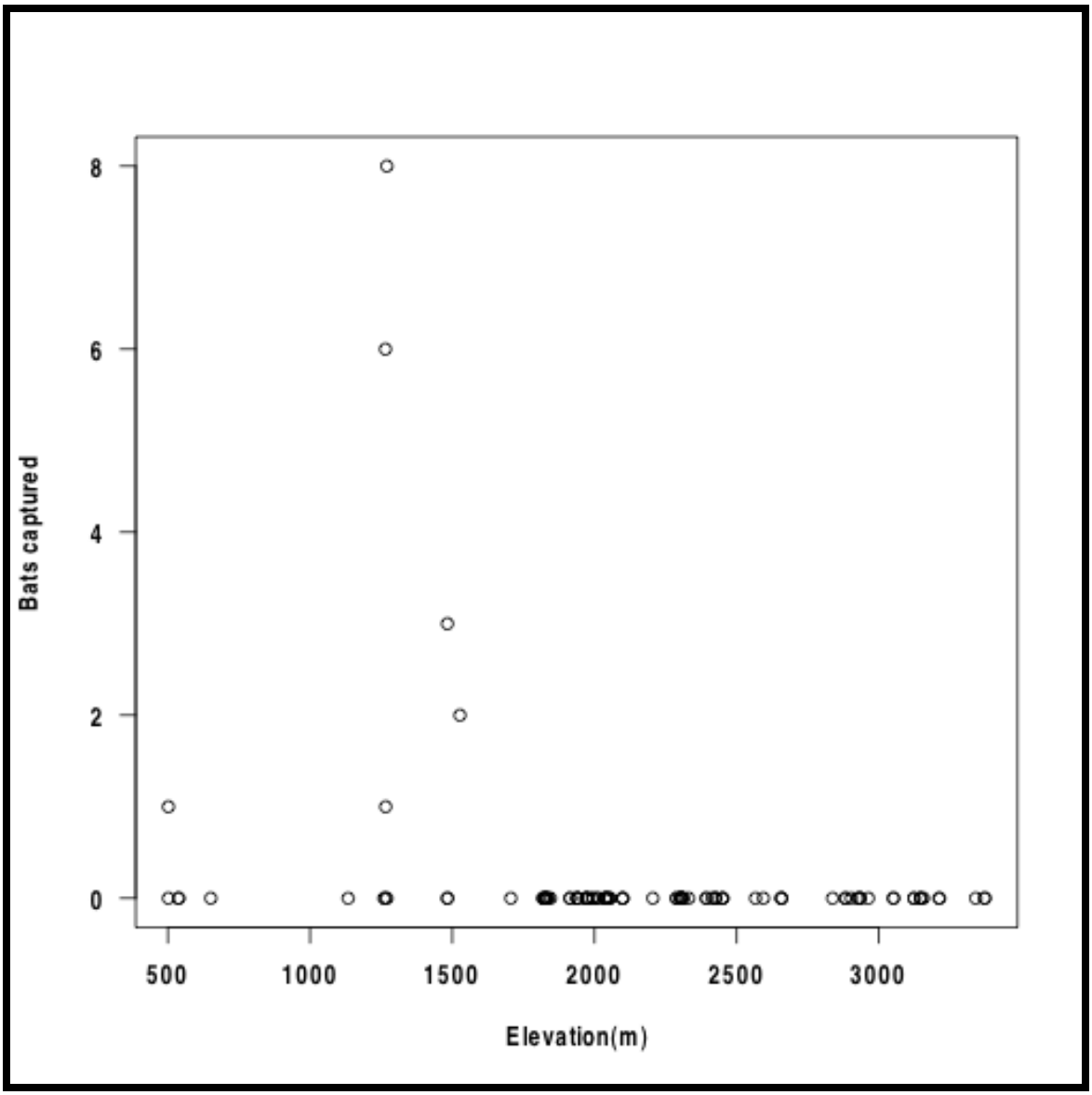


Figure 16.6. Graph showing the elevational distribution of captures of *P. hesperus*.

Seasonal Distribution

A long-term acoustic detector at Shepherd's Saddle near Ash Mountain provided four years of seasonal data for this species, showing peak activity in the summer. The occasional records from late fall through early spring, including some winter records, suggests that this species hibernates in the area (Figure 16.7).

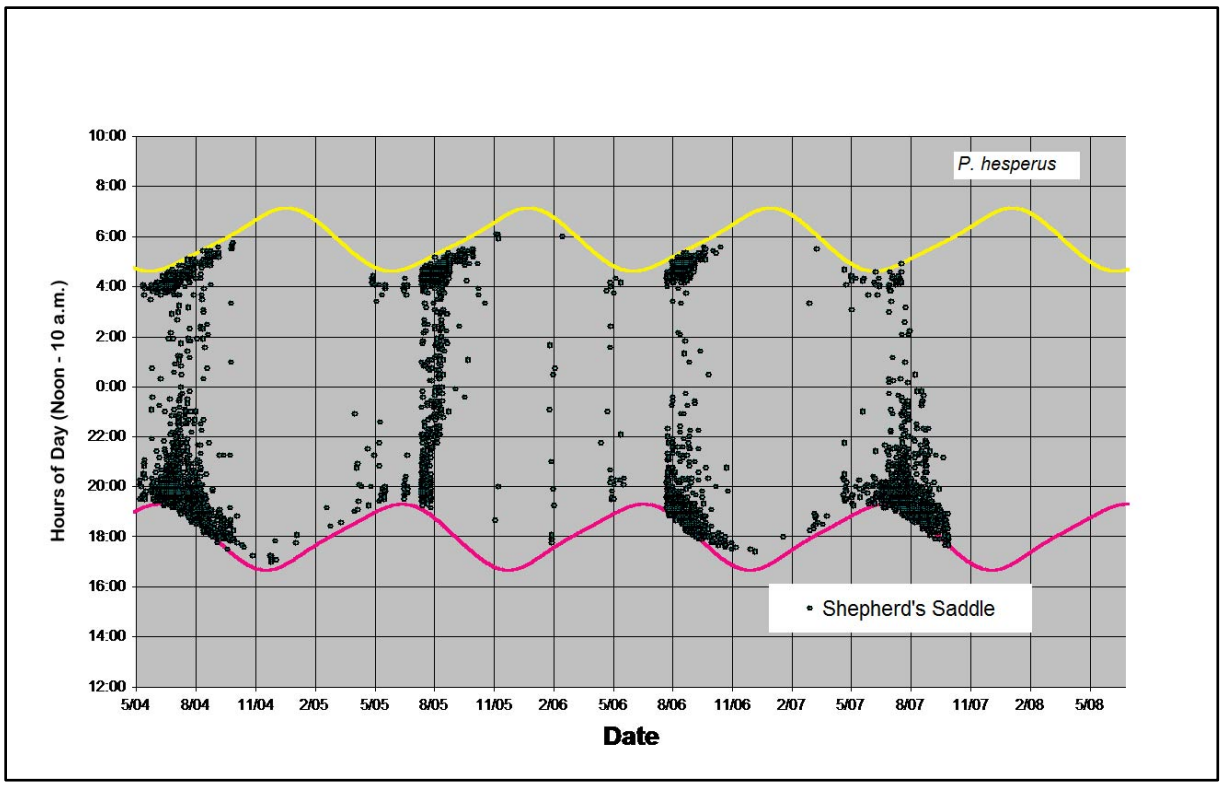


Figure 16.7. Seasonal pattern of canyon bat acoustic activity at Shepherd's Saddle. Symbols indicate 5 minute intervals with at leas one identified call. Curved lines show calculated local sunrise and sunset.

16.3. Habitat Associations

Vegetative Communities

This species is found all the forest communities from low elevation blue oak to mixed deciduous forest and giant sequoia habitat.

Roosting

P. hesperus, which roosts primarily in cliffs or rock outcrops, is often regarded as a bat of desert waterholes and canyons (Barbour and Davis 1969, Hayward and Cross 1979). Yet it is locally common in river canyons along the western slope of the Sierra Nevada, and occurs in Shasta and Siskiyou Counties at isolated river canyon rock features in mixed conifer forest (Constantine 1982, Pierson and Rainey 1998b, Rainey and Pierson 1996). It has also been reported roosting in crevices in buildings and mine tunnels (Cross 1965, Stager 1943), and very occasionally in expansion joints in bridges (G. Erickson, California Department of Transportation, personal observation).

P. hesperus is usually described as non-colonial, though aggregations up to twelve have been reported (Koford and Koford 1948). This is the smallest North American bat, but, in contrast to the single offspring produced annually by many local species, females typically give birth to twins.

Foraging

P. hesperus often emerges to hunt before dark, flying seemingly erratically, while pursuing small insects in open air. Diet analyses indicate an opportunistic generalist aerial hunter. Moths dominate

in the diet (Black 1974), but other groups include homopterans, hymenopterans, and some coleopterans (Ross 1967, Whitaker 1981).

16.4. Management Issues

Status. *P. hesperus* has no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we ranked them as locally abundant, but having a restricted range and specific habitat requirements.

Roosts. This species is likely an obligate cliff-dwelling species, and we located two roosting areas in Sequoia (Moro Rock and cliffs near Mineral King Entrance station). This species should be considered for any management activities that potentially impact cliff roosts.

Foraging. This species forages in a number of habitats, mostly in open areas. Thus it should be considered in any management activities that potentially impact meadows, scrub or chaparral.

Fire. Prescribed burns are not likely to pose problems for this species.

Climate Change. This species would be likely to expand its range up in elevation with a warming climate.

17. *Tadarida brasiliensis*, Mexican free-tailed bat

17.1. Identification

Tadarida brasiliensis is a medium-sized bat (forearm of 36-46 mm), with long narrow wings, a tail that extends about half its length beyond the back of the inter-femoral membrane (Figure 17.1). The ears are rounded and almost meet at the mid-line (Barbour and Davis 1969), and it has hairy toes. Its pelage is generally grey. The only other molossids (free-tailed bats) known to occur in California are considerably larger. A subset of its echolocation calls is diagnostic for this species (Figure 17.2).



Figure 17.1. Photograph of Mexican free-tailed bat. (Credit: Keith Paul, USFWS).

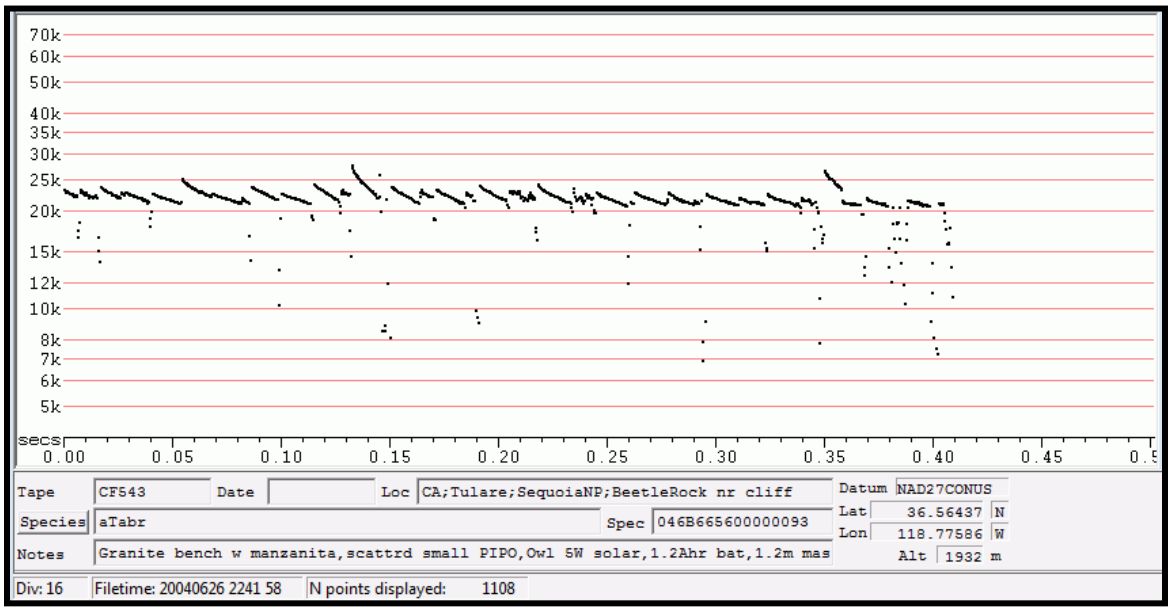


Figure 17.2. Echolocation call of *T. brasiliensis*. Beetle Rock, June 26, 2004.

17.2. Distribution

Geographic Range

T. brasiliensis is one of the most widely distributed and commonly encountered species in California. While breeding populations occur primarily at low to mid-elevations, this species is found all the way to the crest of the Sierra Nevada (Pierson et al. 2001). *T. brasiliensis* is found in a range of habitats, and is the species most tolerant of urbanization.

Distribution in Sequoia and Kings Canyon National Parks, Devils Postpile National Monument, and Vicinity

All known park localities for *T. brasiliensis* are mapped in Figure 17.3, and detailed in Tables 17.1-17.3, and Appendices III and V (also see Pierson and Rainey 2017 – acoustic and capture data). There are no museum records for *T. brasiliensis*, and only a few records in the WODB, all from relatively low elevation in Sequoia, most from the Ash Mountain area (Table 17.1). *T. brasiliensis* was overall the fifth most commonly encountered species in net captures, accounting for 6.86% of all captures (Figure 7 in main report narrative). Acoustic records, however, suggest it was present at > 80% of all sampling stations (Table 17.3, Pierson and Rainey 2017 – acoustic data).

Table 17.1. Records for *T. brasiliensis* in Park Wildlife Observation Database (WODB), not supported by specimens.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	REC NUM	Observer
SQNP	MFK Kaweah	River, Ash Mountain	36.48985	-118.82811	509	1-Jun-80	43813	Dixon, J.
SQNP	MFK Kaweah	Ash Mountain	36.48985	-118.82811	509	29-Jun-84	43814	Grater, R.
SQNP	MFK Kaweah	Ash Mountain Research	36.49005	-118.82157	484	6-Sep-33	50121	Strkee
SQNP	MFK Kaweah	Ash Mountain Research	36.48985	-118.82811	509	9-Sep-66	50122	Stephenson, N.
SQNP	MFK Kaweah	Potwisha Bridge	36.48985	-118.82811	509	2-Oct-90	43815	San Miguel, G.
SQNP	MFK Kaweah	Potwisha Bridge	36.48985	-118.82811	509	2-Oct-90	43816	Norris, L.
SQNP	SFK Kaweah	SFK Campground [a]	36.34992	-118.76331	1114	27-Jul-88	46301	Jeffrey, T

[a] Pierson and Rainey Capture Record (Table 17.2)

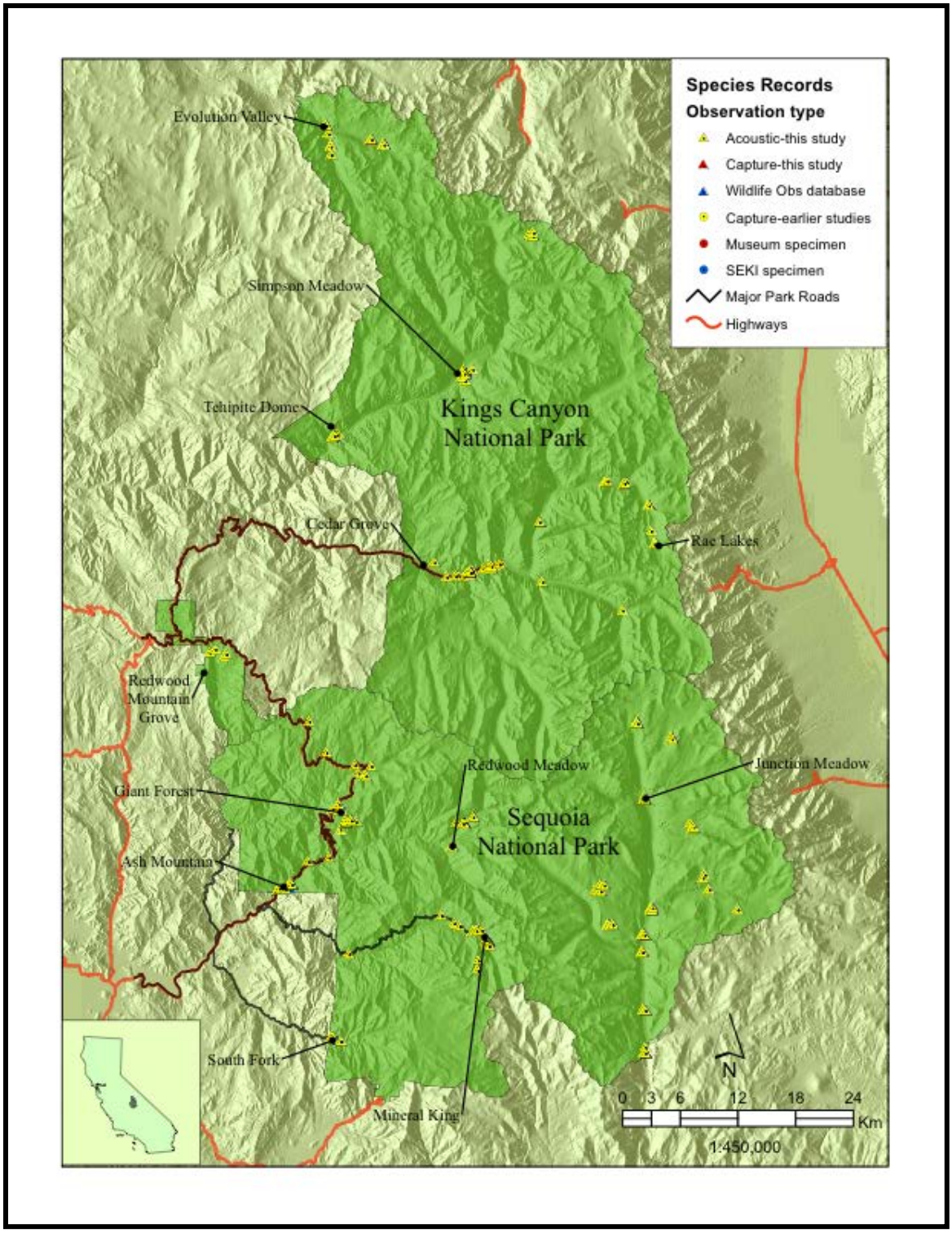


Figure 17.3. Map showing records for Mexican free-tailed bat in Sequoia and Kings Canyon National Parks. Due to the scale of the map, sampling points overlap, making many points impossible to see. A geodatabase is available that combines the data from all the data sources, and can be used to spatially display the sampling points in a GIS platform (Pierson and Rainey 2017).

Table 17.2. Capture records for *T. brasiliensis* from netting efforts in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

Park	Drainage	General Locality	Lat	Long	Elev (m)	Date	Number of Bats									
							Adult Females					Adult	Juv	Juv	Unk	Totals
THIS STUDY							Preg	Lact	Plac	Null	Par	Male	Female	Male		
DEPO	MFK San Joaquin	River, blw Muir Trail Xing	37.61297	-119.08223	2288	29-Jul-04			1			1				2
KCNP	SFK San Joaquin	McClure Meadow	37.18724	-118.74464	2933	2-Aug-05						1				1
KCNP	MFK Kings	Tehipite, Side Channel #1	36.91227	-118.77769	1265	21-Jul-06						6				6
KCNP	MFK Kings	Simpson Mdw, Deep Pool	36.97109	-118.62931	1831	28-Jul-06						5				5
KCNP	SFK Kings	Cedar Grove, River @ Zumwalt	36.79312	-118.59533	1527	10-Jul-02				2		12				14
KCNP	SFK Kings	Cedar Grove, River Side Channel	36.78673	-118.62043	1483	11-Jul-02						1				1
KCNP	SFK Kings	Lower Paradise Valley	36.83484	-118.54026	2011	19-Jul-04		1				5				6
SQNP	MFK Kaweah	River abv Ash Mountain	36.49378	-118.82102	502	14-Jul-02		5								5
SQNP	Kern	Junction Meadow, River	36.57804	-118.41533	2450	28-Aug-04						2		1		3
SQNP	Kern	Upper Funston Mdw @ River	36.45207	-118.40990	2040	30-Aug-04						2				2
						TOTALS	**0**	**6**	**1**	**2**	**0**	**35**	**0**	**1**	**0**	**45**
EARLIER STUDIES																
SQNP	SFK Kaweah	Across River, Campground[a]	36.34992	-118.76331	1114	27-Jul-88		16						1		17
						TOTALS	**0**	**16**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**17**

[a] RECNUMB 46301 in SEKI-WODB (Table 17.1)

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted.

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	28-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	29-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	King Ck Trail Jct	37.62388	-119.08794	2360	30-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	24-Aug-01	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	29-Jul-04	X
DEPO	MFK San Joaquin	King Creek Trail	Sag Pond, King Ck Trail	37.62153	-119.09019	2425	30-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	28-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	29-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Base of postpile	37.62502	-119.08418	2314	30-Jul-04	X
DEPO	MFK San Joaquin	Postpile	Postpile, talus, Ctr S edge	37.62493	-119.08424	2339	23-Aug-01	X
DEPO	MFK San Joaquin	Postpile	Postpile, talus, dowstream	37.62454	-119.08406	2337	23-Aug-01	X
DEPO	MFK San Joaquin	Postpile	Postpile, top	37.62442	-119.08328	2329	23-Aug-01	X
DEPO	MFK San Joaquin	Rainbow Falls	King Ck	37.59844	-119.09064	2194	29-Jul-04	X
DEPO	MFK San Joaquin	Rainbow Falls	King Ck	37.59844	-119.09064	2194	30-Jul-04	X
DEPO	MFK San Joaquin	Rainbow Falls	Rock outcrop above King Ck	37.59939	-119.08945	2210	30-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	28-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	29-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Backwater on river, meadow edge	37.62757	-119.08412	2340	30-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Cottonwood, nr. Pkg,	37.63028	-119.08516	2280	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Cottonwood, upstrm Pkg	37.63069	-119.08532	2280	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Gravel bar, nr. Mdw nets	37.62901	-119.08441	2325	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Mdw edge, nr. Mdw nets	37.62870	-119.08438	2314	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Meadow near footbridge	37.62799	-119.08480	2302	28-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Meadow near footbridge	37.62799	-119.08480	2302	29-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Meadow near footbridge	37.62799	-119.08480	2302	30-Jul-04	X
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, 70m N Soda Spg	37.62810	-119.08487	2158	23-Aug-01	X
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, Forest Edge	37.62832	-119.08570	2349	23-Aug-01	X

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
DEPO	MFK San Joaquin	Ranger Station	Visitor Mdw, Willow Riparian	37.62911	-119.08447	2316	23-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Buttress Notch	37.61836	-119.08661	2381	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	East side Buttress, N end	37.62017	-119.08662	2379	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Lower end seep, SE Buttresses	37.61366	-119.08543	2292	24-Aug-01	X
DEPO	MFK San Joaquin	Trail below buttresses	Rock face nr. Seep net site	37.61524	-119.08516	2314	24-Aug-01	X
KCNP	SFK San Joaquin	Blw. Goddard-Evolution Jct	Bench abv. Cyn floor	37.20017	-118.79784	2851	03-Aug-05	8
KCNP	SFK San Joaquin	Blw. Goddard-Evolution Jct	Campsite	37.20023	-118.79728	2560	03-Aug-05	1
KCNP	SFK San Joaquin	Blw. Goddard-Evolution Jct	Talus base Cyn wall	37.19987	-118.79759	2555	03-Aug-05	1
KCNP	SFK San Joaquin	Colby Mdw	Mdw/River edge	37.18321	-118.72972	2967	01-Aug-05	3
KCNP	SFK San Joaquin	Colby Mdw	Meadow	37.18333	-118.72922	2959	01-Aug-05	5
KCNP	SFK San Joaquin	Colby Mdw	Net Site	37.18339	-118.73023	2963	01-Aug-05	4
KCNP	SFK San Joaquin	Colby Mdw	Rock abv camp	37.18398	-118.73019	2979	01-Aug-05	1
KCNP	SFK San Joaquin	Goddard Canyon	Bench abv river	37.17298	-118.79077	2652	31-Jul-05	5
KCNP	SFK San Joaquin	Goddard Canyon	Meadow blw camp	37.18069	-118.79114	2655	31-Jul-05	13
KCNP	SFK San Joaquin	Goddard Canyon	Swamp, net site	37.18255	-118.79134	2657	31-Jul-05	2
KCNP	SFK San Joaquin	Goddard-Evolution Jct	Bench abv. Bridge	37.19247	-118.79441	2583	30-Jul-05	1
KCNP	SFK San Joaquin	McClure Mdw	Granite bench with grass	37.18730	-118.74550	2943	02-Aug-05	10
KCNP	SFK San Joaquin	McClure Mdw	Mdw nr camp	37.18832	-118.74419	2942	02-Aug-05	16
KCNP	SFK San Joaquin	McClure Mdw	River edge	37.18790	-118.74409	2939	02-Aug-05	58
KCNP	SFK San Joaquin	McClure Mdw	Shallow pool flooded mdw	37.18724	-118.74464	2933	02-Aug-05	31
KCNP	MFK Kings	Dusy Basin	Edge of NW Big Lake	37.10210	-118.55732	3455	21-Aug-02	9
KCNP	MFK Kings	Dusy Basin	Granite above lake	37.10089	-118.55355	3425	21-Aug-02	10
KCNP	MFK Kings	Dusy Basin	Outlet ck, mdw	37.10177	-118.55464	3428	21-Aug-02	159
KCNP	MFK Kings	Dusy Basin	Sm Lk, w of NW big lake, nr. Trail	37.10414	-118.55353	3453	21-Aug-02	14
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	25-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Base of talus	36.97250	-118.62934	1809	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Campsite	36.97166	-118.63129	1817	25-Jul-06	X

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	MFK Kings	Simpson Meadow	Campsite	36.97166	-118.63129	1817	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Cottonwoods, Camp trail	36.97243	-118.63158	1807	25-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Deep pool, floodplain-net site	36.97580	-118.62123	1819	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Edge of Cottonwoods	36.96515	-118.62907	1807	25-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Floodplain net site	36.97563	-118.63169	1819	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Floodplain pool	36.97569	-118.63109	1819	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Helipad log	36.97256	-118.63127	1807	25-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Helipad log	36.97256	-118.63127	1807	29-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Horsehoe Creek	36.97023	-118.63160	1815	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Horsehoe Creek	36.97023	-118.63160	1815	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Horseshoe Creek 2	36.97031	-118.63110	1817	29-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Whitethorn, PIJE, downslope trail	36.97161	-118.62993	1827	29-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Open PIJE stand, near PIJE snag	36.96851	-118.63390	1814	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail	36.97330	-118.62932	1822	26-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Sage along trail #2	36.97344	-118.62930	1830	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Top Rock outcrop	36.97104	-118.62931	1831	27-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Top Rock outcrop	36.97104	-118.62931	1831	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Very large pool, net site	36.97564	-118.63080	1819	28-Jul-06	X
KCNP	MFK Kings	Simpson Meadow	Willow thicket	36.97138	-118.63122	1815	29-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Boulder Jumble caves	36.91271	-118.77802	1285	23-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Boulder Meadow	36.91164	-118.78181	1295	20-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Boulder Meadow	36.91164	-118.78181	1295	21-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Camp floodplain	36.91173	-118.78048	1284	20-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Crown Ck Floodplain	36.90984	-118.78397	1271	20-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Crown Ck Floodplain 2	36.90961	-118.78363	1267	21-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Floodplain by campsite	36.9-1180	-118.78082	1266	24-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Floodplain by campsite	36.9-1180	-118.78082	1266	22-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Floodplain Channel Net site	36.91243	-118.77670	1265	22-Jul-06	X

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	MFK Kings	Tehipite Valley	Forest Edge by Campsite	36.91201	-118.78090	1268	24-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Live Oak Net site	36.91004	-118.78351	1262	23-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Side channel at camp	36.9-1193	-118.78077	1269	20-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Side Channel, up river from camp	36.91227	-118.77769	1293	21-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Talus, base of dome	36.91378	-118.77546	1330	21-Jul-06	X
KCNP	MFK Kings	Tehipite Valley	Talus, base of dome	36.91378	-118.77546	1330	22-Jul-06	X
KCNP	SFK Kings	Arrowhead Lake	Rocky peninsula overlooking lake	36.82844	-118.40937	3157	22-Jul-04	X
KCNP	SFK Kings	Baxter Meadow	Meadow edge	36.85279	-118.41394	2893	21-Jul-04	X
KCNP	SFK Kings	Baxter Meadow	Rocky slope	36.85191	-118.41282	2902	21-Jul-04	X
KCNP	SFK Kings	Baxter Meadow	Rocky slope	36.85191	-118.41282	2902	22-Jul-04	X
KCNP	SFK Kings	Baxter Meadow	Upper marshy pond	36.85190	-118.41382	2882	21-Jul-04	X
KCNP	SFK Kings	Bubbs Creek	Lower Junction Mdw	36.75413	-118.44200	2496	27-Sep-05	1
KCNP	SFK Kings	Bubbs Creek	Sphinx Trail Jct, campsite, on rock	36.77940	-118.53593	1901	23-Sep-05	27
KCNP	SFK Kings	Castle Dome Meadow	Floodplain	36.87299	-118.46399	2499	23-Jul-04	X
KCNP	SFK Kings	Castle Dome Meadow	Meadow	36.87335	-118.46496	2486	23-Jul-04	X
KCNP	SFK Kings	Castle Dome Meadow	Talus slope, 100 m from forest edge	36.87418	-118.46139	2506	23-Jul-04	X
KCNP	SFK Kings	Castle Dome Meadow	Willow thicket at campsite	36.87348	-118.46280	2486	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	1st pull out W Road's end	36.79371	-118.59024	1527	09-Jul-02	117
KCNP	SFK Kings	Cedar Grove	Burn area S rd, near Granite Ck	36.79098	-118.60434	1510	10-Jul-02	103
KCNP	SFK Kings	Cedar Grove	Burn by rd between bridges, E of CG	36.78456	-118.62061	1486	10-Jul-02	102
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Clearing by pack station corral	36.79615	-118.66174	1540	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	cliff base @ Zumwalt Mdw Pkg	36.79421	-118.59793	1540	09-Jul-02	27
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 1	36.78374	-118.63663	1469	09-Jul-02	181
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 1	36.78374	-118.63663	1469	10-Jul-02	733

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Flat W of Knapp's Cabin 2	36.78363	-118.63653	1466	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	island, betw River and side channel	36.78645	-118.62046	1482	11-Jul-02	281
KCNP	SFK Kings	Cedar Grove	N river @ Zumwalt Mdw	36.79301	-118.59547	1524	09-Jul-02	306
KCNP	SFK Kings	Cedar Grove	N river @ Zumwalt Mdw	36.79301	-118.59547	1524	10-Jul-02	351
KCNP	SFK Kings	Cedar Grove	Pool in side channel, near E end River Rd	36.78679	-118.62020	1481	10-Jul-02	59
KCNP	SFK Kings	Cedar Grove	Pool in side channel, near E end River Rd	36.78679	-118.62020	1481	11-Jul-02	81
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River edge E Zumwalt Mdw pullout	36.79319	-118.59542	1531	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	River just E. Knapp's cabin	36.78369	-118.63337	1467	10-Jul-02	801
KCNP	SFK Kings	Cedar Grove	River Rd, 1st turnout	36.78715	-118.61978	1477	11-Jul-02	283
KCNP	SFK Kings	Cedar Grove	Road's End	36.79672	-118.58380	1565	09-Jul-02	19
KCNP	SFK Kings	Cedar Grove	Roadside, diagonal up road	36.78692	-118.62274	1470	11-Jul-02	58
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	19-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	20-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	21-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	22-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Saddle abv.Road's End Packer parking	36.79539	-118.58597	1543	23-Jul-04	X
KCNP	SFK Kings	Cedar Grove	Service Rd, betw Knapp & Cedar Grv	36.78274	-118.64697	1461	09-Jul-02	77
KCNP	SFK Kings	Cedar Grove	Sidebar River, W Roaring R Xing	36.78251	-118.62710	1471	09-Jul-02	12
KCNP	SFK Kings	Cedar Grove	Talus at E end of River Rd	36.78809	-118.61687	1494	10-Jul-02	68
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, S edge	36.79098	-118.59503	1516	10-Jul-02	147

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw, talus slope	36.79048	-118.59558	1534	10-Jul-02	51
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,N edge	36.79237	-118.59704	1539	10-Jul-02	416
KCNP	SFK Kings	Cedar Grove	Zumwalt Mdw,NW crnr	36.79158	-118.59697	1520	10-Jul-02	202
KCNP	SFK Kings	Lower Paradise Valley	Grassy clearing at river edge	36.83501	-118.54024	2018	19-Jul-04	X
KCNP	SFK Kings	Lower Rae Lake	Lake shore	36.81647	-118.40522	3227	22-Jul-04	X
KCNP	SFK Kings	Lower Rae Lake	Outlet creek	36.81680	-118.40611	3219	22-Jul-04	X
KCNP	SFK Kings	Woods Creek Crossing	Log adj to rock outcrop	36.87236	-118.44191	2607	20-Jul-04	X
KCNP	SFK Kings	Woods Creek Crossing	Log adj to rock outcrop	36.87236	-118.44191	2607	21-Jul-04	X
KCNP	SFK Kings	Woods Creek Crossing	Log adj to rock outcrop	36.87236	-118.44191	2607	22-Jul-04	X
KCNP	SFK Kings	Woods Creek Crossing	Meadow adj to small stream	36.87115	-118.44342	2580	20-Jul-04	X
KCNP	SFK Kings	Woods Creek Crossing	Rocky slope abv wet mdw	36.87212	-118.44222	2625	20-Jul-04	X
KCNP	SFK Kings	Woods Creek Crossing	Wet meadow near creek	36.87321	-118.43965	2592	20-Jul-04	X
KCNP	NFK Kaweah	Redwood Mt. Grove	Across Creek from Log Cabin	36.71150	-118.91361	1837	03-Jul-05	12
KCNP	NFK Kaweah	Redwood Mt. Grove	Hart Meadow	36.70694	-118.90160	1966	03-Jul-05	34
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	01-Jul-05	25
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	02-Jul-05	7
KCNP	NFK Kaweah	Redwood Mt. Grove	Parking Area	36.70830	-118.92052	1933	03-Jul-05	8
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	30-Jun-05	3
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	01-Jul-05	6
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	02-Jul-05	1
KCNP	NFK Kaweah	Redwood Mt. Grove	W. of Hart Mdw	36.70498	-118.90387	1954	03-Jul-05	1
SQNP	EFK Kaweah	Mineral King	Abv Ranger Station	36.45348	-118.60994	2325	03-Aug-02	292
SQNP	EFK Kaweah	Mineral King	Aspen Flat Cottonwoods	36.44018	-118.59047	2401	03-Aug-02	117
SQNP	EFK Kaweah	Mineral King	Cliffs east of Lookout Point, Entrance Sta	36.43034	-118.75281	1264	01-Aug-02	41
SQNP	EFK Kaweah	Mineral King	Cliffs east of Lookout Point, Entrance Sta	36.43034	-118.75281	1264	01-Aug-02	27
SQNP	EFK Kaweah	Mineral King	Cottonwoods, 20 m W Tar Gap Parking	36.45364	-118.60605	2335	03-Aug-02	52
SQNP	EFK Kaweah	Mineral King	Cottonwoods, W of Tar Gap Pkg	36.45376	-118.60579	2325	01-Aug-02	283
SQNP	EFK Kaweah	Mineral King	Cottonwoods, nr. Tar Gap Pkg	36.45363	-118.60475	2330	02-Aug-02	371

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	EFK Kaweah	Mineral King	Cottonwoods, Tar Gap Pkg	36.45348	-118.60457	2327	01-Aug-02	9
SQNP	EFK Kaweah	Mineral King	Cottonwoods, E of Ranger Sta	36.45315	-118.60746	2300	02-Aug-02	99
SQNP	EFK Kaweah	Mineral King	Eagle Ck talus	36.42669	-118.60280	2825	04-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Eagle Lake Tr., 200 m trailhead	36.44571	-118.59455	2418	04-Aug-02	-118
SQNP	EFK Kaweah	Mineral King	Eagle Lake, forested shore	36.41718	-118.60467	3059	04-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Eagle Lake, outlet ck	36.41766	-118.60414	3060	04-Aug-02	1
SQNP	EFK Kaweah	Mineral King	Eagle Lake, w end dam	36.41723	-118.60369	3054	04-Aug-02	1
SQNP	EFK Kaweah	Mineral King	EFK Kaweah tow Aspen Flat, backwater	36.44135	-118.59240	2409	03-Aug-02	28
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 10 m fr river, upstrm net	36.44412	-118.59223	2414	02-Aug-02	200
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 50 m upslope fr net site	36.44463	-118.59184	2412	02-Aug-02	231
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 50 m upstream CF002	36.44347	-118.59234	2408	02-Aug-02	117
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 500 m upstrm Pack Sta, net	36.44421	-118.59245	2413	02-Aug-02	6
SQNP	EFK Kaweah	Mineral King	EFK Kaweah, 500 m upstrm Pack Sta, net	36.44421	-118.59245	2413	03-Aug-02	81
SQNP	EFK Kaweah	Mineral King	Empire Mill site, 75 m fr road	36.45450	-118.59910	2399	03-Aug-02	61
SQNP	EFK Kaweah	Mineral King	Faculty Flat Rocks	36.45794	-118.62525	2256	05-Aug-02	83
SQNP	EFK Kaweah	Mineral King	Farewell Gap trail, upslope fr net site	36.44389	-118.59134	2402	03-Aug-02	157
SQNP	EFK Kaweah	Mineral King	Highbridge Ck Rocks	36.46036	-118.63172	2234	05-Aug-02	13
SQNP	EFK Kaweah	Mineral King	Silver City Resort	36.46775	-118.64639	2168	05-Aug-02	39
SQNP	Marble FK Kaweah	Giant Forest	Beetle Rock, 50 m to forest edge	36.56462	-118.77499	1963	30-Jul-02	312
SQNP	Marble FK Kaweah	Giant Forest	Crescent Mdw	36.55364	-118.74691	2044	30-Jul-02	1243
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Pila snag	36.55230	-118.75900	2060	31-Jul-02	77
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	30-Jul-02	85
SQNP	Marble FK Kaweah	Giant Forest	GS forest, W. Huckleberry Rock, Segi burn	36.55215	-118.75900	2013	31-Jul-02	26
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood meadow	36.56343	-118.76624	2039	30-Jul-02	330
SQNP	Marble FK Kaweah	Giant Forest	Hazelwood trees	36.56419	-118.76451	2034	30-Jul-02	19
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock at edge of seep blw rd	36.55391	-118.75900	2072	31-Jul-02	39
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, bare rock below Rd	36.55355	-118.75900	2059	31-Jul-02	217
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	30-Jul-02	146

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Marble FK Kaweah	Giant Forest	Huckleberry Rock, rock abv rd	36.55455	-118.75414	2056	31-Jul-02	164
SQNP	Marble FK Kaweah	Giant Forest	Mdw at Tunnel Tree	36.55376	-118.75900	2036	31-Jul-02	1627
SQNP	Marble FK Kaweah	Giant Forest	Moro Rock, first rest area, 1/2 to top	36.54554	-118.76456	2003	30-Jul-02	319
SQNP	Marble FK Kaweah	Giant Forest	Net abv rd, Huckelberry Mdw Tr Xng	36.55459	-118.75301	2054	31-Jul-02	1
SQNP	Marble FK Kaweah	Giant Forest	Net blw rd, Huckleberry Mdw Tr Xng	36.55432	-118.75354	2054	31-Jul-02	24
SQNP	Marble FK Kaweah	Giant Forest	Round Mdw mdw	36.56901	-118.76663	2000	30-Jul-02	406
SQNP	Marble FK Kaweah	Giant Forest	Round Mdw tree	36.56973	-118.76777	2043	30-Jul-02	1
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	29-Jul-02	47
SQNP	Marble FK Kaweah	Lodgepole	Clover Ridge	36.60636	-118.74931	2110	30-Jul-02	138
SQNP	Marble FK Kaweah	Lodgepole	Dorst Ck, below rd Xng	36.64602	-118.80391	2023	29-Jul-02	95
SQNP	Marble FK Kaweah	Lodgepole	Halstead Ck, wet mdw abv rd Xng	36.61741	-118.78325	2143	29-Jul-02	222
SQNP	Marble FK Kaweah	Lodgepole	Marble Fork below PO	36.60560	-118.73111	2047	29-Jul-02	169
SQNP	Marble FK Kaweah	Lodgepole	Red fir forest along highway	36.59874	-118.74489	2110	29-Jul-02	99
SQNP	Marble FK Kaweah	Lodgepole	Wet mdw nr. Wolverton Ck	36.59604	-118.73688	2211	29-Jul-02	229
SQNP	MFK Kaweah	Ash Mt	Above Parking at net site	36.49555	-118.82218	543	14-Jul-02	9
SQNP	MFK Kaweah	Ash Mt	Alder Creek, below road	36.49268	-118.82482	542	12-Jul-02	9
SQNP	MFK Kaweah	Ash Mt	Gravel bar 30 m abv abve net site	36.49390	-118.82068	501	14-Jul-02	157
SQNP	MFK Kaweah	Ash Mt	Gravel bar dwn fr net site	36.49429	-118.82032	499	14-Jul-02	6
SQNP	MFK Kaweah	Ash Mt	Gravel terrace, 100 m abv net site	36.49370	-118.82206	493	14-Jul-02	15
SQNP	MFK Kaweah	Ash Mt	Marble Fork Confluence	36.51569	-118.80184	635	12-Jul-02	15
SQNP	MFK Kaweah	Ash Mt	Mile 60 Creek	36.51991	-118.77791	781	12-Jul-02	9
SQNP	MFK Kaweah	Ash Mt	Net site	36.49371	-118.82092	494	14-Jul-02	12
SQNP	MFK Kaweah	Ash Mt	Rocks behind Research office	36.48948	-118.82825	523	14-Jul-02	61
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr, E on dirt rd., just abv. Hwy	36.48935	-118.83494	500	14-Jul-02	17
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr. - Farther East on dirt rd	36.49004	-118.83413	512	14-Jul-02	16
SQNP	MFK Kaweah	Ash Mt	Sycamore Dr. -dry ck at 1st turn out	36.48870	-118.83641	482	14-Jul-02	3
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Campsite edge	36.55357	-118.62234	1908	29-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Campsite Edge	36.55357	-118.62234	1908	30-Aug-06	X

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Little Bearpaw Meadow	36.55457	-118.63064	2093	31-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Little Bearpaw Meadow	36.55457	-118.63064	2093	01-Sep-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Long pool, upstream	36.55975	-118.61156	1956	30-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Long pool, upstream	36.55975	-118.61156	1956	31-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Lower Terrace	36.55356	-118.62277	1910	30-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Lower Terrace	36.55356	-118.62277	1910	31-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Lower Terrace	36.55356	-118.62277	1910	01-Sep-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Lower Terrace	36.55356	-118.62277	1910	02-Sep-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Manzanita Terrace #1	36.55412	-118.62273	1951	29-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Manzanita Terrace #2	36.55369	-118.62296	1942	29-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Manzanita Terrace #3	36.55356	-118.62331	1915	30-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Redwood Meadow	36.53188	-118.63554	1839	31-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Redwood Meadow	36.53188	-118.63554	1839	01-Sep-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Redwood Meadow	36.53188	-118.63554	1839	02-Sep-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Redwood Meadow Creek	36.53133	-118.63645	1823	02-Sep-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	River crossing	36.55315	-118.62187	1891	29-Aug-06	X
SQNP	MFK Kaweah	River Crossing below Bearpaw Mdw	Rock Bar below Pool #6	36.55941	-118.61207	1951	31-Aug-06	X
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Forest above footbridge	36.34940	-118.75973	1135	13-Jul-02	1

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Park entrance, above road	36.35144	-118.77256	1065	13-Jul-02	3
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Park entrance, below road	36.35227	-118.77250	1042	13-Jul-02	3
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Rock face, above entrance road	36.35282	-118.76980	1080	13-Jul-02	1
SQNP	SFK Kaweah	SFK Kaweah Ranger Sta	Rocks below road, entrance road	36.35095	-118.76814	1078	13-Jul-02	1
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Base of talus	36.47763	-118.40243	2129	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Bench, N. side of ck	36.47676	-118.40512	2137	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Bench, S. of ck	36.47541	-118.40348	2164	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Near base of talus	36.47567	-118.40276	2140	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Net site	36.47710	-118.40379	2110	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Overflow creek channel	36.47790	-118.40386	2111	29-Aug-04	X
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 30 m blw trail xing	36.47600	-118.40382	2098	21-Aug-05	9
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 30 m blw trail xing	36.47600	-118.40382	2098	22-Aug-05	39
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 40 m up trail xing	36.47760	-118.40353	2100	21-Aug-05	6
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 40 m up trail xing	36.47760	-118.40353	2100	22-Aug-05	15
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 50 m blw trail xing	36.47652	-118.40383	2097	21-Aug-05	10
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita 50 m blw trail xing	36.47652	-118.40383	2097	22-Aug-05	32
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita campsite	36.47734	-118.30349	2096	21-Aug-05	5
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Manzanita campsite	36.47734	-118.30349	2096	22-Aug-05	20
SQNP	Kern	Branch Rock Ck, S. Kern Hot Springs	Talus slope	36.47779	-118.40270	2110	22-Aug-05	2
SQNP	Kern	Chagoopa-Treehouse Mdw	Burn pond, marsh	36.49836	-118.45844	3173	25-Aug-05	1

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Kern	Chagoopa, Treehouse Mdw	Burn pond, open water	36.49799	-118.45844	3196	25-Aug-05	2
SQNP	Kern	Chagoopa, Treehouse Mdw	Meadow edge	36.49849	-118.46284	3162	25-Aug-05	2
SQNP	Kern	Chagoopa, Treehouse Mdw	Rock slope	36.49832	-118.46322	3168	25-Aug-05	2
SQNP	Kern	Chagoopa, Upper Trail Jct	Larger moraine pond	36.49282	-118.46271	3156	24-Aug-05	4
SQNP	Kern	Chagoopa, Upper Trail Jct	Meadow, wet area	36.49291	-118.46903	3110	24-Aug-05	3
SQNP	Kern	Chagoopa, Upper Trail Jct	Sandy Flat	36.49297	-118.46653	3124	24-Aug-05	3
SQNP	Kern	Chagoopa, Upper Trail Jct	Smaller moraine pond	36.49294	-118.46384	3134	24-Aug-05	3
SQNP	Kern	Guyot Creek	Foxtail 2	36.50944	-118.34233	3197	16-Aug-05	1
SQNP	Kern	Guyot Creek	Mdw, W. trail 2	36.50670	-118.34447	3147	17-Aug-05	2
SQNP	Kern	Junction Meadow, Kern River	Adj to ck in boggy mdw, cowlilies	36.57883	-118.41451	2478	28-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	On another log in PIJE grove	36.57910	-118.41303	2457	28-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	On log in PIJE grove	36.57897	-118.41311	2461	27-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Quiet pool on river	36.57804	-118.41533	2450	27-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Quiet pool on river	36.57804	-118.41533	2450	28-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Rock outcrop at campsite	36.57792	-118.41325	2469	27-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Rock outcrop at campsite	36.57792	-118.41325	2469	28-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Shallow side channel near campsite	36.57841	-118.41402	2450	27-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Shallow side channel near campsite	36.57841	-118.41402	2450	28-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Up trail from Junction Mdw	36.58146	-118.41344	2490	27-Aug-04	X
SQNP	Kern	Junction Meadow, Kern River	Up trail from Junction Mdw	36.58146	-118.41344	2490	28-Aug-04	X

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Kern	Kern Cut-Off, Abv Mitochondria Lk	Base cliff	36.64977	-118.42400	3341	20-Aug-05	4
SQNP	Kern	Kern Cut-Off, Abv Mitochondria Lk	Lower Mdw	36.64906	-118.42371	3340	20-Aug-05	4
SQNP	Kern	Kern Cut-Off, Abv Mitochondria Lk	Middle Mdw	36.64920	-118.42295	3340	20-Aug-05	1
SQNP	Kern	Kern Cut-Off, Abv Mitochondria Lk	Rock slope abv mdw	36.64944	-118.42338	3353	20-Aug-05	5
SQNP	Kern	Kern Ranger Station	Log, upslope Ranger Station	36.34254	-118.40972	1970	27-Aug-05	4
SQNP	Kern	Kern Ranger Station	Log, upslope Ranger Station	36.34254	-118.40972	1970	03-Sep-04	X
SQNP	Kern	Kern Ranger Station	Coyote CK, nr. Trail Xing	36.34210	-118.40840	1966	03-Sep-04	X
SQNP	Kern	Kern Ranger Station	Open manzanita/Jeffrey by camp	36.34258	-118.41015	1981	03-Sep-04	X
SQNP	Kern	Kern Ranger Station	Pasture at RS	36.34251	-118.40843	1964	03-Sep-04	X
SQNP	Kern	Kern Ranger Station	Pasture at RS	36.34251	-118.40843	1964	27-Aug-05	4
SQNP	Kern	Kern Ranger Station	Pasture RS 1	36.34266	-118.40793	1964	28-Aug-05	15
SQNP	Kern	Kern Ranger Station	Pasture Center	36.34251	-118.40810	1964	28-Aug-05	20
SQNP	Kern	Kern Ranger Station	Ponderosa snag	36.34833	-118.40833	1979	27-Aug-05	2
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Fir stand talus base	36.43590	-118.41373	2037	26-Aug-05	6
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Flood plain	36.43745	-118.41348	2030	26-Aug-05	2
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Side Channel	36.43670	-118.41299	2045	26-Aug-05	3
SQNP	Kern	Kern Trench, 1 km blw Big Arroyo Br	Talus above camp	36.43659	-118.41445	2044	26-Aug-05	22
SQNP	Kern	Lower Crabtree Meadow	Campsite on rock bench	36.55133	-118.35789	3156	26-Aug-04	X
SQNP	Kern	Lower Crabtree Meadow	Dry part of mdw, marmot mounds	36.55282	-118.35542	3146	26-Aug-04	X
SQNP	Kern	Lower Crabtree Meadow	E. trail to Wallace Ck	36.55685	-118.35892	3211	26-Aug-04	X

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Kern	Lower Crabtree Meadow	Shore Whitney Ck, Deep pool net site	36.55230	-118.35684	3146	26-Aug-04	X
SQNP	Kern	Lower Crabtree Meadow	W. trail to Wallace Ck	36.55701	-118.36049	3230	26-Aug-04	X
SQNP	Kern	Lower Funston Meadow	Base of talus	36.38268	-118.41175	1973	02-Sep-04	X
SQNP	Kern	Lower Funston Meadow	Campsite under cottonwoods	36.38260	-118.40927	1962	02-Sep-04	X
SQNP	Kern	Lower Funston Meadow	Cobble bar, river floodplain	36.38240	-118.40876	1972	02-Sep-04	X
SQNP	Kern	Lower Funston Meadow	Grove of Jeffrey at base of talus	36.38388	-118.41124	1978	02-Sep-04	X
SQNP	Kern	Lower Funston Meadow	Open meadow, edge by willows	36.38206	-118.41017	1974	02-Sep-04	X
SQNP	Kern	Lower Rock Creek Crossing	Edge of boggy meadow	36.49583	-118.33678	2908	24-Aug-04	X
SQNP	Kern	Lower Rock Creek Crossing	Willow patch mid-meadow	36.49515	-118.33744	2901	24-Aug-04	X
SQNP	Kern	Moraine Lake	Lakeshore by camp	36.46186	-118.45367	2844	23-Aug-05	67
SQNP	Kern	Moraine Lake	Lodgepole nr camp	36.46166	-118.45319	2834	23-Aug-05	400
SQNP	Kern	Moraine Lake	Rocky lakeshore	36.46093	-118.45296	2837	23-Aug-05	278
SQNP	Kern	Moraine Lake	Sky Parlor Mdw 1	36.46125	-118.44861	2796	23-Aug-05	26
SQNP	Kern	Moraine Lake	Sky Parlor Mdw 2	36.46180	-118.44830	2807	23-Aug-05	25
SQNP	Kern	Tyndall Frog Ponds	Effluent Creek	36.63495	-118.38392	3372	19-Aug-05	14
SQNP	Kern	Tyndall Frog Ponds	Foot of talus	36.63506	-118.38209	3371	19-Aug-05	3
SQNP	Kern	Tyndall Frog Ponds	Frog Pond 1	36.63548	-118.38353	3369	19-Aug-05	17
SQNP	Kern	Tyndall Frog Ponds	Frog Pond 2	36.63715	-118.38290	3372	19-Aug-05	15
SQNP	Kern	Tyndall Frog Ponds	Jct btw ponds	36.63628	-118.38290	3364	19-Aug-05	12

Table 17.3. Acoustic records for *T. brasiliensis* obtained in this study. X = present, files not counted (continued).

Park	Drainage	General Locality	Specific Locality	Lat	Long	Elev (m)	Date	# Files
SQNP	Kern	Upper Funston Meadow	Campsite, Upper Funston Mdw	36.45305	-118.41267	2054	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Campsite, Upper Funston Mdw	36.45305	-118.41267	2054	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Center of meadow, on log	36.45274	-118.41297	2049	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Center of meadow, on log	36.45274	-118.41297	2049	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Near net site on river	36.45253	-118.41104	2064	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Near net site on river	36.45253	-118.41104	2064	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Nr. Base of talus, meadow edge	36.45196	-118.41351	2053	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Willow edge below talus	36.45278	-118.41342	2068	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Open area near stock rail	36.45317	-118.41299	2041	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Side channel near campsite	36.45295	-118.41235	2076	30-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Side channel near campsite	36.45295	-118.41235	2076	31-Aug-04	X
SQNP	Kern	Upper Funston Meadow	Talus above trail	36.45273	-118.41406	2046	31-Aug-04	X

An analysis of our netting data using a univariate model indicates that water is by far the strongest indicator for the capture of Mexican free-tailed bats (Table 17.3).

Table 17.4. Univariate Model Selection.

	df	AIC
Meadow_Scrub	4	262.5888
Forest	2	258.5888
Elev_m	2	241.7411
Water	7	188.8951
Rock	4	260.5662

An analysis of captures at water sites shows that we captured significantly more Mexican free-tailed bats at rivers than at creeks, and that the median number captured at creeks was sifgnificantly greater than zero. Given that none of the other water sites differed from creeks, our data suggest that rivers are the preferred type of water site for capturing this species (Table 17.4, Figure 17.4).

Table 17.4. Terms of the model for water categories.

Coefficients:	Estimate	Std. Error	Z Value	Pr(>|z|)
Creek(Intercept)	-1.0116	0.28868	-3.504	0.000458 ***
Flooded Meadow	-0.3747	1.04083	-0.360	0.718852
Lake	-18.2910	5442.45978	-0.003	0.997318
Marsh	-18.2910	6665.62470	-0.003	0.997811
Not Water	-18.2910	1472.1902	-0.012	0.990087
Pond	-18.2910	4713.3084	-0.004	0.996904
River	1.7047	0.33850	5.036	4.75e-07 ***

Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Null deviance: 235.75 on 102 degrees of freedom

Residual deviance: 143.91 on 96 degrees of freedom

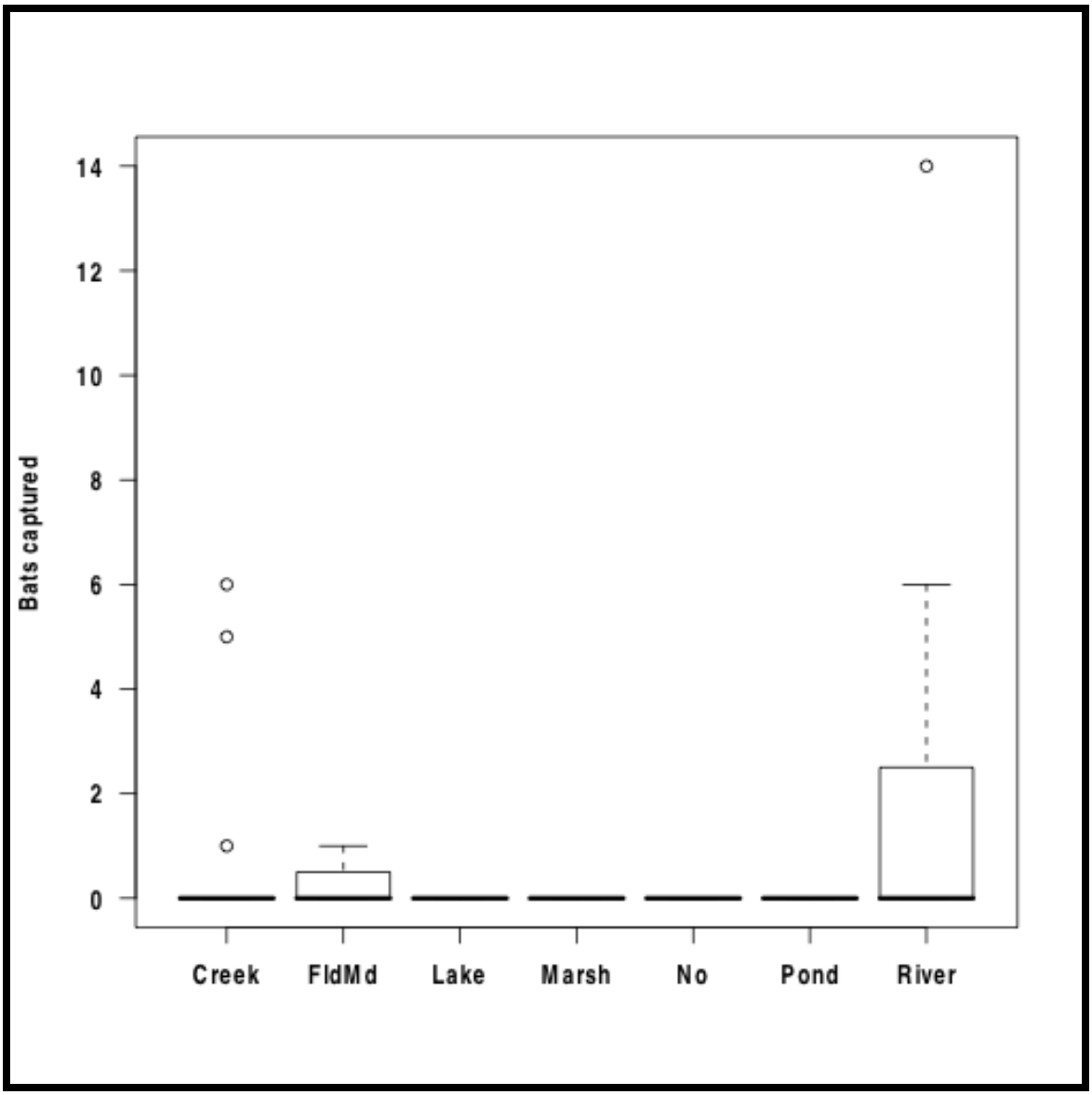


Figure 17.4. Graph showing the quartiles (with median values in bold) for number of Mexican free-tailed bats captured at six types of water sites, and sites (= No) that were not at water.

17.3. Habitat Associations

Vegetative Communities

This species is found in all vegetative communities in the parks.

Roosting

T. brasiliensis forms maternity colonies of up to several million in some caves in Texas, but in California, with the exception of one population of about 250,000 (in a lava cave in northern California), most colonies in California range in size from a few hundred to a few thousand. Although some populations migrate large distances (*e.g.*, Texas populations over-winter in Mexico), seasonal movement patterns and population structure within California are poorly understood. Free-tailed bats can tolerate torpor during cold weather, but do not hibernate.

T. brasiliensis are crevice or cavity dwellers, and can fit in cracks smaller than one inch wide. While this species roosts in a number of natural features (rock crevices, caves, and abandoned swallow nests), it is also the species most often found in man-made structures, including buildings, bridges, and mines (Barbour and Davis 1969, Wilkins 1989). Colonies also appear to be more mobile than many bat species, apparently displaying less loyalty to particular roost sites, with the exception of major maternity sites which are occupied year to year.

Foraging

T. brasiliensis are aerial foragers, and feed on a wide variety of flying insects (Whitaker et. al. 1996). This is the species most likely to include a variety of agricultural pests in its diet, including the corn earworm moth (*Heliothis zea*) (McCracken 1996), and most likely the codling moth (*Cydia pomonella* L.) (Hogan 2000). Year-round diet studies conducted at Lemoore Naval Air Station showed that this species foraged primarily over cotton fields and other agricultural areas, and included flies, moths, true bugs (mostly plant hoppers) and beetles in their diet (Johnston 1998).

17.4. Management Issues

Status. *T. brasiliensis* has no special status. Using the Rabinowitz model for Seven Forms of Rarity (Figure 50 in main report narrative), we ranked them as “Common” based on their relative abundance and ubiquitous presence in our surveys.

Roosts. Although we have relatively little information on roosting behavior for this species within Sequoia and Kings Canyon, data from elsewhere document a species that uses a variety of roost sites. While it is likely that use of natural roosts predominates in the parks, this species should be considered whenever alterations are proposed to any potential roost sites. This would include, but not be limited to, closures of abandoned mines, alteration of rock/cliff areas (*e.g.*, blasting for road construction or repair), hazard tree removal, bridge construction or repair, and removal of or major modifications of buildings. Based on information from Yosemite, where large colonies are known to occupy crevices in cliff overhangs, it is likely that cliff-roosting predominates in Sequoia, Kings Canyon and Devils Postpile.

Foraging. This species forages primarily on moths, and should be considered for any management activities that would potentially alter its prey base.

Fire. *T. brasiliensis* is capable of traveling long distances to forage. Prescribed burns are not likely to pose problems for this species.

Climate Change. The potential impacts on this species from climate change are unknown. Although this species is detected at most elevations, its maternity colonies are concentrated at lower elevations. Maternity colonies could be expected at higher elevations with warming climate conditions. A warming climate might also alter migration patterns for this non-hibernating species.

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