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Site 300 Bat Survey Report

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Site 300 Bat Survey

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EXECUTIVE SUMMARY

A review of prior bat records in literature and museum collections for the five counties around Site 300 (Alameda, Contra Costa, San Joaquin, Santa Clara, and Stanislaus) identified 1038 specimens of 15 species. No roosting bats or bat sign indicating roosting were observed in examining samples of structures on Site 300 both day and night. Acoustic monitoring and visual observation detected seven to nine species, including three special status species -- the pallid bat, *Antrozous pallidus*, the western red bat, *Lasiurus blossevillii* and the Yuma myotis, *Myotis yumanensis*. An additional special status species, the long-legged myotis, *Myotis volans* was possibly present. As a consequence of the windy conditions typically encountered, no bats were caught in mist net sampling, though simultaneous acoustic monitoring demonstrated bats were present at those locations.

The highest bat activity and species richness on the Ranges was observed at locations along incised drainages that had surface water, riparian vegetation and some protection from wind. Grassland slopes, hilltops and other sites exposed to the wind had typically low bat activity and species richness. In the General Services area, the sewage evaporation pond and outdoor lighting associated with parking and gates had especially high bat activity, presumably as a consequence of perennial open water and insect prey concentrations.

This report also provides species accounts for those positively or tentatively identified, with information from the literature and the authors' experience regarding distribution and habitat associations for each. Managing the Site 300 landscape to retain dispersed perennial surface water and favoring survival and recruitment of larger trees along drainages will help to maintain bat populations.

1.0 INTRODUCTION

1.1 Project goals

Project activities were designed, as requested, to survey Site 300 for presence/absence and distribution of special status bat species and provide information on their habitat and other aspects of ecology. The following introductory sections provide ecological background information for California bats.

1.2 Bat roosting ecology

Bats use a wide variety of roost sites, which, for North American species, fall into three general categories: crevices, cavities, and foliage (Barbour and Davis 1969, Kunz 1982a, Pierson 1998). In natural settings, cavity-roosting species aggregate on open surfaces inside dark chambers, such as caves or large tree hollows; crevice-roosting species occupy a variety of narrow "slots," such as rock crevices, exfoliating tree bark, and damaged wood in snags. While some species appear to be obligate cavity- or crevice-dwellers, there is a continuum between crevices and cavities, and many species use a range of roosts. Most of these species will also roost in cave-like spaces or crevices in man-made features, such as old mine workings, tunnels, buildings, and bridges. Foliage-roosting species, which are usually solitary, often hang from petioles beneath large leaves, frequently at canopy level.

During the late spring through the early fall, the most demographically significant roosts are those used diurnally by breeding females to raise young (*i.e*., maternity roosts). Colony size varies widely among and within species. Some, like the foliage-roosting western red bat, do not appear to form maternity colonies, and single females are generally found only in association with their young. However, some species in the Central Valley and perimeter hills form colonies of 100 to greater than several thousand individuals (*e.g.*, the Mexican free-tailed bat, *Tadarida brasiliensis*, and Yuma myotis, *Myotis yumanensis*). Natural features and built structures may also serve as diurnal roosts for solitary or aggregated males or non-reproductive females during the summer, as temporary aggregation sites for migrating animals in the spring and fall, and as refuges for both hibernating and non-hibernating species in the winter.

After leaving their diurnal roost to forage, bats may night roost, often in less concealed settings than their day roost. Individuals may briefly roost while consuming prey or join larger aggregations including both sexes and sometimes several species in sites that offer protection from predators and thermal buffering against air temperature declines through the night.

Winter distribution and activity is poorly understood for most bat species in California. Some species or populations have extended hibernation (Barbour and Davis 1969, Marcot 1984, Pearson *et al.* 1952, Pierson and Rainey 1996a), and may move to higher elevation to find stable, low temperature refuges that lessen stored energy drain (Sherwin *et al*. 2000, Szewczak *et al*. 1998). Others overwinter in climatically more moderate sites, where they employ torpor during cold periods, and arouse to feed on warm nights. A few species do not hibernate, and rely on overwintering in areas with primarily non-freezing temperatures. Recent long-term acoustic monitoring at fixed stations at Pt. Reyes National Seashore (Fellers and Corben 2001) and at 4,000 feet elevation in Yosemite National Park (W.E. Rainey and E.D. Pierson, unpubl. obs.), are consistent with prior reports (e.g., O'Farrell *et al*. 1967) of extensive winter activity by a number of western North American species.

1. 3 Bat foraging ecology

All the bat species expected in the study area are predominantly insectivorous (with a few also consuming other arthropods such as scorpions and spiders). While bat species show some specialization for particular foraging styles and habitats, they also opportunistically exploit locally abundant prey (Fenton 1982, Whitaker 1994). A diet study conducted along the upper Sacramento River and a nearby control drainage showed that, while there were marked differences among species in average diet composition, when there was high regional availability of a particular prey type (*e.g.*, alate termites or caddisflies), many species took advantage of that resource (Rainey and Pierson 1996). Studies have generally found that in seasonally dry and even mesic, forested landscapes (e.g., Grindal *et al*. 1999, Pierson *et al*. 2001, Thomas and West 1991) bat foraging activity is concentrated over or near water. Also, especially in hot, dry summer roosts, daily water loss may be as much as 15-20% of body weight (Studier *et al.* 1970) This is regained after emergence by drinking, while flying over water.

Nightly foraging movement scales vary with landscape resource distribution, species flight morphology, season and energetic demands of reproduction, but are much larger than for insectivorous birds of similar body size. Movements of several kilometers one way are frequently encountered in radiotracking foraging bats.

2.0 METHODS

2.1 Museum and Literature Records

To review information on the distribution of bat species in the vicinity of Site 300, records were compiled from literature, agency reports (*e.g.*, Grinnell 1918, Pierson and Rainey 1998a, b) and accessible museum specimen records for a five county area -- the two counties bridged by Site 300 (Alameda and San Joaquin), plus three adjacent counties (Contra Costa, Santa Clara, and Stanislaus)

2.2. Study Area

Field studies were largely within the Site 300 boundaries (Alameda and San Joaquin counties). Daylight reconnaissance and limited visual and acoustic monitoring at night were conducted on the adjacent Dept. of Fish and Game Ecological Reserve in the Corral Hollow Creek riparian. In addition, a passive acoustic monitor ran for one evening at an excavated pond in the Middle Canyon drainage on the Carnegie SVRA residence area adjacent to the Site 300 south boundary.

Appendix I lists sampling localities with geographical coordinates in decimal degrees (Datum: NAD27 CONUS) as obtained with hand held consumer GPS (Garmin 12XL). Coordinates were not taken for numbered structures on Site 300 property maps.

2.3. Structure Surveys

While it is not uncommon for bats to occupy crevices or cavities in man made structures (which may either be defects or design elements) as day or night roosts, structure surveys for BioSystems in the prior EIS had shown the design and materials of most accessible structures at Site 300 minimized external roost sites and access portals to interior spaces. In this study, a subset of accessible structures were examined externally during the day for bats or bat sign (guano, culled insect parts, or urine stains) and an overlapping sample were examined at night for bats night roosting.

2.4 Mist net surveys

As noted earlier, near ground bat activity, especially in dry landscapes, is typically greatest in association with slowly moving or still surface water. In this study, mist nets were set over or adjacent to natural water sources, or in potential flyways nearby. Even light winds affect both the distribution of aerial insect prey and directly reduce mist net bat capture rates, so that, when possible, net sites sheltered by vegetation and topography were selected. Mist net deployment 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 ft height; 30 and 42 ft in length) were set on sectional or telescoping aluminum poles. Nets were generally opened 0.5 hrs after local sunset and remained open and closely tended for several hours.

On-site processing of netted bats involves species identification (see van Zyll de Jong 1985 for keys); measurement of the forearm with digital calipers; visual assessment of age class (adult, juvenile) from ossification of the metacarpal phalangeal joints (Anthony 1988); and determination of sex and reproductive condition.

2.5 Acoustic surveys

California bats rely heavily on echolocation for prey detection and orientation near habitat features. In a sampling method similar to auditory point counts for birds, recording bat echolocation calls offers a non-disruptive index of bat activity and information the species present. Both technologies for recording bat ultrasound and analytic methods are rapidly diversifying and evolving, accompanied by increasing data on species' vocal repertoires from release recordings of net captures.

We conducted acoustic sampling predominantly using broadband frequency-dividing Anabat II ultrasound detectors (Titley Electronics, Ballina, NSW, Australia). Echolocation sequences down-converted by the detector were transferred and displayed on a laptop computer through a zero-crossing analyzer (=zcaim) attached to the parallel port. The laptops were powered by external gel cell batteries. Detector stations were generally deployed prior to sunset, and run for 4 to 6 hours after sunset (in association with mist netting), or overnight.

During the study, a low power recording device, the storage zcaim, became commercially available from Titley Electronics. It stores compressed bat call data on compact flash memory cards and can operate nightly (on a stored schedule) for more than a week on a 7 Ahr battery. Several of these were deployed simultaneously at multiple sites in later monitoring sessions for intervals up to nine nights.

The detector microphone is interchangeable with several models available. The standard microphone incorporates a high pass filter that lessens response to sounds in the audible range (0-20 kHz). Most bat detectors include such a filter to suppress 'extraneous' noise from stridulating insects, wind moving vegetation, footfalls or speech of detector operators, etc. However, the frequency range of echolocation calls of several bat species expected on Site 300 extend into the upper audible (e.g., hoary bat, *Lasiurus cinereus*). Also, nearly the entire vocal range of one special status species (Western mastiff, *Eumops perotis*) that might be present is audible. Consequently, most detectors were equipped with low frequency sensitive microphones to increase the likelihood of detecting this species. This also increases the likelihood that wind or insect noise will rapidly fill data storage on longer deployments.

The detectors were either angled upward at approximately 45° from the ground in a location without nearby obstructions or were mounted at the same angle on a frame attached to an aluminum mist net pole section(height ca 1m). The height lessened the probability of recording litter insect sounds (e.g., crickets) or mechanical disturbance by animals.

2.5.1 Analysis of Acoustic Data

The detection system typically records bat activity in 15-second sequence files, with the restriction that only the loudest signal at any instant is retained (so that nearly simultaneous calls may be fragmented and parts of each retained). Sequence files may be shorter than 15 seconds if nothing is detected for five seconds or if (infrequently) bat calling intensity is so high that a maximum file size criterion is reached. For the purposes of this study, subsequent analyses were based on counts of these files. Thus, a species (or a species group with very similar calls) was counted whenever it appeared at least once in a file, regardless of the number of calls identified. For discussion of overall activity, all identified sequences are counted. In effect, we have employed an approximately 15-second presence/absence unit for the various acoustic categories considered (species, species groups, all bats).

Methods for partly or largely automated bat call identification is an area of active research worldwide and varied approaches (different suites of call parameters, different classification techniques, etc.) are being explored. Both visual and parameter-based analytical identification of call sequences is based on accumulation of libraries of known sequences from relevant species either by capture and recording on release, or by active observational monitoring for species that can be recognized in flight. A limitation of most fully automated approaches is that they analyse individual calls (or pulses) only, so that features of call sequences (e.g., rapid shifts in pulse to pulse minimum frequency) which readily identify some species are ignored. This study employed both generalized filters detecting all bat calls and more specific ones for distinctive

calls of particular species or species groups, but all files were also evaluated qualitatively before tabulation.
Calls from open-air flight distant from obstacles are typically the most differentiated. As bats approach habitat obstacles or prey items in the air, interpulse intervals decline and call shapes converge on simple, short, declining frequency sweeps. Thus, in cluttered settings, while activity can monitored, the proportion of calls identified to species may decline. Somewhat similarly, when large numbers of bats are simultaneously calling as they forage on a cloud of midges, calls may overlap temporally and be fragmented in the acoustic record This reduces the fraction that can be identified, but it is still possible to examine levels of activity.

3.0 RESULTS AND DISCUSSION

3. 1 Review of existing information

We reviewed museum collection records obtained from 40 institutions for a five county area -- the two counties bridged by Site 300 (Alameda and San Joaquin), plus three adjacent counties (Contra Costa, Santa Clara, and Stanislaus). There were a total of 1038 bat specimen records (Table 1), held at 22 institutions (Appendix II). Eighty-nine percent of these are in three collections: the Museum of Vertebrate Zoology at the University of California, Berkeley (62 %), the California Academy of Sciences (22 %), and the Los Angeles County Museum (5 %).

This survey yielded museum records for 15 species in the five county area (Table 1, Fig. 1). We did not travel to examine these specimens, so this tabulation may include some identification or clerical errors. We did screen the data for internal inconsistencies (*e.g.*, named location actually in another county). While these records provide geographic, seasonal, and some demographic data, they should not be used to infer relative abundance. The number of records per county reflects collecting effort (both episodic research and chance encounters in areas of high human density), not necessarily the density of bat populations. Colonial species that sometimes roost in man-made structures, such as *Antrozous pallidus*, *Tadarida brasiliensis*, and *Myotis yumanensis*, may be over-represented relative to other species (Fig. 1A). Colonial roosts are more easily detected, and offer the opportunity to collect multiple specimens from single localities. Other species that are usually solitary (*e.g.*, *Myotis californicus* , both *Lasiurus* species) or infrequently roost in human structures (*e.g.*, *Lasionycteris noctivagans*, *Pipistrellus hesperus*, or *Nyctinomops macrotis*) may be under-represented in museum collections. Thus a lack of museum records for these species is not an adequate basis for inferring current or historical status.

While not necessarily an indicator of relative abundance, the number of collection localities for a species does offer an indication of geographic distribution. At least five species (*A. pallidus*, *T. brasiliensis*, *Myotis californicus*, *Lasiurus cinereus*, and *Lasiurus blossevillii*) appear to be widespread in the five county area (Fig. 1B).

3.2. Capture Surveys

Appendix III lists the sites netted in May 2002. These were clustered in the drainages near Spring 12and Draney Canyon, Spring 16 and 17 and the nearby axis of Elk Ravine. Nets were placed in potentially productive protected localities near surface water which might be visited for feeding or drinking and/or close to rock exposures or trees which were potential roost habitat. Nets were placed to lessen wind disturbance, but this was largely unavoidable. No bats were captured, despite recording reasonable rates of bat acoustic activity on detectors co-located with the nets. With no data yielded by these substantial net deployments and the likelihood that capture rates would remain low or nil, we subsequently relied on acoustic monitoring alone.

3.3. Structure surveys

Building surveys were a focus of bat surveys for BioSystems in the prior EIS and showed little or no use. In this survey, a subset of buildings were surveyed externally during the day for bat sign. Many (*e.g.*, the Bldg 865 complex) are smooth painted metal or tooled concrete with gasketed or flanged metal joints and do not provide convenient external roost sites. Ventilators typically have adequately fine screens and doors are seated in metal frames with no gaps, so that bat entry is improbable. A few more open structures (*e.g.*, East and West O.P.) that had sheltered potential day or night roost sites had no bat sign, perhaps as a consequence of their exposed, frequently windy locations. The roughened masonry exterior of newer structures in the General Services Area offers possible sites for night roosting by bats foraging around adjacent outdoor lighting in parking areas, but examination of likely sites on building perimeters yielded no evidence of night roosting

A subset of structures were examined briefly again at night for bats night roosting on the structure. No evidence of roosting, guano or other sign was observed, including on structures (*e.g*, wooden blast cribs) near lighted potential foraging areas which had surface that would permit clinging.

3.4. Acoustic Surveys

Analysis of recordings yielded 13, 698 bat call sequence file identifications. Appendix III tabulates sequence identifications to species and acoustic species groups by date and site. Some files may contain calls sequences from more than one species or species group. The total number of files examined is considerably larger than the number of identifications due to noise from wind on the detector hardware or vegetation, insect, and bird calls.

Figure 2 provides an overview of the relative activity observed for all sites and dates pooled. Both the totals observed and the relative activity across species and species groups reflects the distribution of sampling effort across the site. For example, the more than 10,000 sequence files containing 50 kHz *Myotis* (probably largely *M. yumanensis*, a special status species) are almost entirely at the General Services Area sewage pond sites or the nearby fence line. 50 kHz Myotis calls on the ranges (likely *M. californicus*) were uncommon.

Figure 3A shows total sequence file identifications for nine days with ten monitors operating simultaneously at sites in the General Services Area and East sites on the range (the western range was closed at the time of deployment). Storage on the two monitors at the East O.P. filled with insect or wind noise files early in the sampling period and so do not have wholly comparable data. The highest total activity is in areas of infrastructure associated resource concentration (sewage pond, fence line, and lighted parking area). Sites on the Ranges at this season have tens of identifiable sequence files/night, but, notably, relatively more detections of the pallid bat, *A. pallidus*, one of the other two special status species. Activity by the red bat, *L. blossevilli*, occurs both in the General Services area and mesic survey sites on the Ranges

3.5. Species Accounts

Table 2 identifies the species detected as occurring or likely to occur at Site 300. Species accounts are provided below for the nine species for which we obtained confirmed or likely detections, and two that were not detected in this survey, but likely occur there (*Corynorhinus townsendii* and *Eptesicus fuscus*). These accounts provide general and local distributional information, observations from this survey, and a summary discussion of autecology as relevant to species management. The accounts draw on descriptive material prepared by E. D. Pierson and W.E. Rainey for earlier regional survey documents (*e.g.*, Brylski *et al*. 2001, Pierson and Rainey 2002a & b, Pierson *et al*. 2002).

Four additional species, not included in the accounts, are represented by museum records from the five county region. Two *Myotis* species, *M. evotis* (FWS-SC) and *M. thysanodes* (DFG-MSSC proposed, FWS-SC), are generally associated with more densely wooded habitats in the central Coast Range, including redwood forest, but extend into oak savannah (*e.g.*, there are records for both from Calaveras Dam [MVZ]). Both are known to roost in rock and tree crevices or cavities. The habitats on Site 300 most consistent with areas where they occur elsewhere are the larger rock outcrops and the Draney and Oasis Canyon riparian corridors. These species have similar echolocation calls and no acoustic records attributable to either were obtained during our surveys.

There are also two large molossid species, *Eumops perotis* and *Nyctinomops macrotis* (both DFG-MSSC, FWS-SC), with rare records in the region (Constantine 1998). Both species echolocate at audible frequencies. The western mastiff bat, *E. perotis*, was regarded until recently as occurring primarily in southern California (Best *et al.* 1996, Krutzsch 1955). Its range is now known to extend well into northern California (Rainey and Pierson 1996), with multiple records for the Sierra Nevada (Pierson and Rainey 1998a, Pierson *et al.* 2001), acoustic detection along the central Sacramento River in Butte and Tehama Co. (Stillwater Sciences *et al*. 2003) and a roost in the Sutter Buttes (Johnson 2000).

In contrast, the northernmost Coast Range mastiff specimen is from Hayward (December 1898, USNM). Accessible records at USNM do not indicate the circumstances of collection, leaving some uncertainty regarding provenance. More recent specimens from near Oakdale (MVZ), Escalon, and Empire (Constantine 1998; LACM), may be associated with roosts to the east in the dissected basalt table lands along the Stanislaus River corridor (Pierson and Rainey 1998a). Recently active localities for *E. perotis* in the Coast Range closest to Site 300 are well to the south: Los Banos Creek (Pierson and Rainey 1998a), near Hollister (EDP, unpubl. obs.), Pinnacles National Monument, and Silver Creek near Panoche (Dalquest 1946). Aerial observations of large resistant rock exposures in other incised creek canyons south of Site 300 suggest potential roosting habitat. However, mastiff bats range tens of kilometers from their roosts and no acoustic detections were obtained in the Site 300 survey, even though most of the bat detectors used in this study were equipped with low frequency microphones designed to enhance detection of species which echolocate at audible frequencies.

There are few records for *N. macrotis* in California (Constantine 1998) and currently no known maternity roosts. Most are concentrated in southern California, but there are scattered winter records for individuals farther north, particularly along the coast (Martinez in November 1979 [MVZ; Constantine 1998], and Berkeley in December 1916 [MVZ]). This species, which also emits loud, distinctive calls was not detected in this study.

3.5.1 *Antrozous pallidus*, **Pallid bat**

The pallid bat is a state and federal special-status species (DFG-MSSC; FSS). There are 295 museum records for pallid bats from 42 localities in the five county area (Table 1, Fig. 1). There are several large series, presumably from collections at roost sites: *e.g.*, 70 specimens from Stanford University, 37 from one locality in Berkeley, 46 from Arroyo Mocho southeast of Livermore (possibly 2-3 localities). The Berkeley records date from 1919 and the Stanford records from 1895 to 1951. This species is likely extirpated from the now urbanized areas of Berkeley and Palo Alto.

The museum specimens closest to Site 300 are a single male from Castle Rock on Corral Hollow Road (12 October 1941 [MVZ]), 14 animals taken in Del Puerto Canyon (1977 and 1978 [MSU]), and animals taken in a series of collections from Arroyo Mocho (CAS, CM, KU, and MVZ) between 1941 and 1943. One of us (WER) observed a pallid bat maternity roost in an abandoned mine adit on the Connolly ranch south of Site 300 during 1991 surveys for Biosystems for a prior Site300 EIS; another (EDP) located a small maternity roost in a natural cavity on Castle Rock, also on the ranch, during a University of California field trip in the early 1980’s.

This species is widely distributed in California, and found in diverse habitats from sea level to well over 2, 000 m in the southern Sierra Nevada. It will occupy a variety of roosting sites. Although encountered in buildings and bridges, it also roosts in caves, mines, rock crevices, and tree hollows. At low elevations on the margins of the Central Valley, it is associated with oak grassland habitat. Colony size is typically 50-300 (Barbour and Davis 1969, Hermanson and O’Shea 1983, Lewis 1994, Orr 1954, Pierson *et al*. 1996, Vaughan and O’Shea 1976). Diet analyses indicate it often feeds on large, often ground dwelling, arthropods (*e.g.*, scorpions, Jerusalem crickets), but also takes large flying insects (*e.g.*, long-horned beetles, such as *Prionus californicus*, and katydids). It has been observed in the Napa Valley feeding on tomato hornworm (*Manduca quinquemaculata*) caterpillars in gardens, suggesting it may also take other large insect larvae (Patricia Winters, personal communication).

Radiotracking in the upper Sacramento River drainage (Rainey and Pierson 1996) found this species foraging along river channels, but within a broad zone primarily upslope from the river. Another radiotracking study in coastal oak savannah in Santa Barbara County documented this species roosting predominantly in ranch buildings, plus solution cavities, crevices, and caves in sandstone outcrops. They foraged along dry stream beds and in oak savannah (Pierson *et al.* 2002).

Hall (1947) reported this species hunting low over ground among cottonwoods under windy conditions. At a frequently windy site, such as Site 300, searching the ground for large terrestrial prey may allow pallid bats to forage over wider areas when wind speeds restrict the smaller flying insects typically consumed by aerial hunting bats to sheltered localities. O'Farrell *et al*. (1967) found that this species was one of several observed foraging (at air temperatures down to freezing) with repeated winter sampling near a Nevada desert spring. The literature includes scattered winter records from low elevation sites in California of individual hibernating pallid bats.

At Site 300 near vertical rock exposures with fractures and erosional cavities, as well as bark and bole defects on larger trees, are potential roost habitat. This species produces distinctive foraging and social echolocation calls that allow acoustic identification (see Appendix IV, Fig. A1 and A2). Pallid bat acoustic records were obtained at multiple sites across 3 seasons (May: Spring #12, Ecological Reserve; July: Spring #12, Bldg. 865 Wetland, Spring #17, Elk Ravine; October: 865 Wetland, Spring #17, East O.P.). Pallid bat acoustic detection rates at sites monitored for nine days in October 2002 are shown in Figure 2B. At one of two nearby sites at the 865 roadside wetland , this species was detected on eight of nine nights.

3.5.2 *Corynorhinus townsendii,* Townsend’s big-eared bat

Townsend’s big-eared bat is a state and federal special-status species (DFG-MSSC, FSS, FWS-SC). There are 78 specimens from 18 localities in the five county area (Table 1, Fig. 1). Almost half (36) of these records come from collections made in 1942 and 1943 at one locality -- a nursery roost located in the attic of the Old Mission San Jose in Fremont (MVZ, UW; Dalquest 1947a).

Records closest to Site 300 are two males collected in 1956 (one on June 15, the other on July 29) from a locality given as “Corral Hollow, 2 miles east of the county line, San Joaquin County” (MVZ). Individually roosting *C. townsendii* were observed (by W.E.Rainey) in two adjacent inactive mine adits on the Connolly ranch in May 1991 surveys for a previous Site 300 EIS. Also, several singly roosting animals, most likely males, were observed in abandoned mines on the Carnegie State Vehicle Recreation area in the winter of 2000 (E.D. Pierson, unpubl. obs.). Other sites in the region from which multiple animals were collected are Mt. Diablo in 1938 (LACM) and Calaveras Dam in 1944 and 1946 (MVZ). More recently, a single animal was observed in an abandoned mine prospect near Calaveras Dam in August, 1987 (Pierson and Rainey 1996a).

Townsend’s big-eared bat is widely distributed in California, with records from the margins of the Central Valley to all elevations in the Coast ranges, and moderately high elevations in the

Sierra Nevada. Maternity roosts appear to be confined to elevations below ca. 1, 800 m (Pierson and Fellers 1998). Townsend's big-eared bat is an obligate cavity-dwelling species that is largely reliant on caves and abandoned mines for maternity roosts. While many other species are concealed by retreating into crevices even within caves, this species typically hangs on open surfaces, with females and young frequently in obvious clusters. Maternity colonies are typically 25-300 adult females.

If undisturbed, maternity colonies of this species will preferentially roost late in the development of the young within the twilight zone, close to cave or mine openings. Thus they can be found in relatively shallow caves, if ceiling height is sufficient (generally greater than 2 m) to provide protection from terrestrial predators (Pierson *et al*. 1991).

Roosts are also encountered in manmade structures with cave-like spaces (*e.g.*, dark, unused attics or, rarely, bridges with large dark cavities), but this species is notably sensitive to roost disturbance. Individual males, while also roosting in caves and mines, can be found roosting in more open rock shelters and small cavities in bridges (Barbour and Davis 1969, Graham 1966, Kunz and Martin 1982, Pierson and Fellers 1998, Pierson *et al.* 2001).

Several diet studies indicate that this species typically feeds largely on moths. Radiotracking studies conducted in coastal California suggest that this species forages along vegetated creek drainages, and in nearby forested areas (Fellers and Pierson 2002). Radiotracking in open, often windy settings at Lava Beds National Monument showed that bats hunted around shrubs sheltered in trenches created by lava tube collapse (Fellers and Pierson 2002).

This species has a relatively distinctive, but low intensity, echolocation call, so it is infrequently detected acoustically away from roost sites. It is also adept at avoiding mist nets, so that the only efficient approach to evaluating presence or absence in an area is by surveying potential roosts. On Site 300, diurnal roosting habitat for this species appears minimal, with no caves or accessible adits observed. The most suitable natural roosting sites were rock shelters (overhanging ledges or small cavities), but the low height would make hanging bats vulnerable to snakes and other predators. No evidence of this species was found on Site 300, though, given a nightly movement scale of several km and presence of roosts on adjacent properties, it would be reasonable to expect foraging activity and possible night roosting in rock shelters on the site.

3.5.3. *Eptesicus fuscus*, Big Brown Bat

The big brown bat has no state or federal special status. There are 32 records from 13 localities for th five county area (Table 1, Fig. 1). The specimen localities closest to Site 300 are Patterson (MVZ), a site 7 miles southeast of Livermore (MVZ), and Del Puerto Canyon (CM).

The big brown bat is one of the most widely distributed and commonly detected species in a variety of habitats throughout California. It 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 maternity colony containing 25-75 adult females, although colonies up to 700 have been found (Kurta and Baker 1990). Big brown bats are foraging habitat generalists, feeding aerially over both water and land, in forested and edge situations. They often emerge prior to dark and can be seen foraging high in open air or at forest edges (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 such important agricultural pests as scarab beetles (Scarabaeidae), the spotted cucumber beetle (*Diabrotica undecimpunctata*; Chrysomelidae), stinkbugs (Pentatomidae) and leafhoppers (Cicadellidae) (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, radiotracking and netting data suggest individuals follow watercourses to forage, often flying above canopy level, and not travelling 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 (E.D. Pierson and W.E. Rainey, unpubl. obs.). Observations with thermal imagers indicate they also land to take large insects from the ground (Simmons *et al*. 2001), a behavior also reported for the European species, *E. serotinus*.

Some echolocation call sequences of this 25 kHz species are distinguishable from other species calling near this frequency, and none were observed in this study. As noted, this species can be readily seen before dark and one was reported (by W.E.Rainey) during a prior Site 300 EIS survey.

3.5.4. *Lasionycteris noctivagans*, Silver-haired Bat

The silver-haired bat has no state or federal special status. There are four records for the five county area (Table 1), and only two have specific localities: Tilden Park (MVZ) and Piedmont (CAS).

The warm season distribution of silver-haired bats 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 (pers. comm.) reported, however, collecting a lactating female on Mt. Pinos in Ventura County. Although there are relatively few records for southern California (Constantine 1998), they are concentrated in the winter, suggesting that some individuals of this migratory species may overwinter in southern California. The seasonal pattern of collections for North America suggest considerable migration, with animals moving to warmer, southern sites in winter (Kunz 1982b, Cryan 2003).

Several radiotracking studies have documented that this species roosts in warm seasons almost exclusively in trees -- both in woodpecker and other 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. A few records exist for roosts in other structures (Barbour and Davis 1969, Kunz 1982b). 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

1982b). A range of seemingly less protected roost sites are reported for migrants in transit, including bole and bark crevices of small trees and even ground squirrel burrows (*e.g.*, Barclay *et al*. 1988, Brack and Carter 1985). There is a record of silver-haired bat hibernating in leaf litter (Sanborn 1953), a pattern which is likely poorly detected and, like similar behavior in red bats (see below), is probably more common than realised.

In October, a few acoustic sequences consistent with this species were recorded on detectors at the sewage pond and nearby fence, as well as the lighted parking area. The sequences are not assignable with to this species with certainty, but suggest one or more migrants. This species will hunt insects drawn to outdoor lights and can be visually identified.

3.5.5. *Lasiurus blossevillii*, Western Red Bat

The western red bat is a state and federal special-status species (DFG-MSSC proposed; FSS). There are 60 records for red bats from 28 localities in the five county region (Table 1). Most of these localities are in the Central Valley (*e.g.*, Stockton and Patterson), or from the peninsula south of San Francisco where this species appears to aggregate in the winter. There is an acoustic record from the CDFG Ecological Reserve adjacent to Site 300 (Dan Williams, *in litt.*). This species is an aerial pursuit forager that feeds extensively on moths, hunting along river or stream corridors, over stock ponds and lakes, in woodland gaps and other edge habitats.

Red bats have been recorded primarily at lower elevations in California, with breeding females and young found in cottonwood/sycamore riparian and planted windbreaks in the Central Valley, and winter records of both sexes 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)

In warm seasons, this species typically roosts non-colonially in foliage, beneath overhanging leaves, though radiotracking of eastern red bats (*L. borealis*) revealed some roosting on tree boles and other sites (Mager and Nelson 2001). In spring and summer at low elevations in California, red bats have been observed roosting or detected acoustically at dusk emerging from cottonwood/sycamore and willow riparian habitats, and fruit orchards (Constantine 1959, 1961; Pierson *et al*. 2000). A CDFG study also noted that acoustic detections were more frequent adjacent to large remnant stands of mature cottonwood/sycamore riparian that extend >50 m back from rivers than they were adjacent to younger or less extensive stands (Pierson *et al.* 1999).

On mild winter days in San Francisco, red bats can be observed roosting in foliage (Orr 1950, WER and EDP, pers. obs.) as elsewhere in summer. In the mid-continent, there are several radio telemetry based reports of eastern red bats roosting or hibernating in deciduous leaf litter in autumn and winter (*e.g.*, Moorman *et al.* 1999). Other inferences of leaf litter hibernation come from sightings of bats flying near controlled burn fire lines in the Fall.

While females are non-colonial during the maternity season, small aggregations of red bats in trees at the edges of the Central Valley in the spring and late summer (Constantine 1959, Grinnell 1918) are consistent with evidence of long distance migration (including daytime mass flights [Mearns 1898]) by eastern red bats. Long term studies of nocturnal migrant bird mortality at illuminated towers in the southeastern U.S. typically include some recoveries of dead eastern red bats (*e.g.*, Avery and Clement 1972). More recent summary data for bat mortality at wind turbine developments distributed across the U.S. is dominated by fall recoveries of presumably migrant hoary bats and red bats (Erickson *et al*. 2002). Consequently, planning for both turbine and, less frequently, static tower installations has begun to incorporate monitoring for bat mortality. In California, most aspects (*e.g.*, geographic scale, proportion of the population which migrates, movement corridors) of red bat migration are unknown (Cryan 2003). In this study, acoustic detections of red bats (*e.g.*, Appendix IV, Fig. A3 and A4) were obtained at several sites in three seasons (May: Spring #17; July: sewage pond fence line; October: Spring #17, sewage pond and fence line, Parking by Bldg W6).

3.5.6. *Lasiurus cinereus*, Hoary Bat

The hoary bat has no state or federal special status. There are 40 records from 30 localities in the five county area (Table 1**)**. Most are fall, winter, or spring records from coastal areas (Berkeley and the peninsula south of San Francisco). The closest records to Site 300 are from Del Puerto Canyon in April 1972 (CM). One of us netted hoary bats in Del Puerto Canyon in the fall of 1978 (E.D. Pierson, unpubl. obs.). Like the red bat, the hoary bat is a non-colonial, foliage roosting species and available diet data indicates individuals feed primarily on moths (Shump and Shump 1982). They forage along river and stream corridors, over open bodies of water, and in open forest habitats, over meadows and above forest canopies (Kalcounis *et al*.1999).

Although this species is found throughout California in a wide variety of habitats, both museum records and more recent netting data suggest that nearly all summer residents are males or non-reproductive females. This species, which raises young north and east of California (southern Canada and the U.S. Great Plains) is known to make long distance seasonal migrations (Findley and Jones 1964, Cryan 2003), with increased numbers of both sexes 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, Pierson *et al.* 2001, E.D. Pierson and W.E. Rainey, unpubl. obs.) is consistent with the idea that this species migrates in aggregations through the Central Valley and adjacent foothills in the spring and the fall. Hall (1947) reported an observation of mass daytime flights of presumed migrant hoary bats in Nevada in August. Similar to red bats, hoary bats form a significant proportion of the fall migrant bat mortalities observed at communication towers (Crawford and Baker 1981) and are usually the most common species of bat recovered in wind turbine mortality monitoring (Erickson *et al*. 2002). Also, as with red bats, the geographical pattern and size of the migratory hoary bat population in California are unknown.

The wide frequency range of hoary bat echolocation calls overlaps with those of several other species, but their vocal repertoire includes several characteristic patterns (Appendix IV, Fig. A5 and A6). Hoary bats were recorded in all three seasonal samples at Site 300, but October was notable in that they were present at most sites sampled (May: Spring #12, Sewage pond, DFG Ecological Reserve, Carnegie SVRA pond near Site 300 S boundary; July: Sewage pond fence line, Elk Ravine; October: 865 Wetland, Sewage pond and adjacent fence line, Spring #17, Elk Ravine main channel, East O.P., East C.P., Lighted parking area near W6). Wider distribution and consistent activity (*e.g.*, detected on all of nine nights of monitoring at the Sewage pond and the lighted parking area near W6) may represent the pattern of hoary bat concentration in moderate coastal climates in winter.

3.5.7. *Myotis californicus*, California Myotis

The California myotis has no state or federal special status. There are 72 museum records from 34 localities (Table 1). The museum localities closest to Site 300 are seven miles southeast of Livermore (MVZ), Calaveras Dam (MVZ), and Del Puerto Canyon (MSB).

This species, which may be either solitary or form small colonies (generally fewer than 30 animals), is widely distributed throughout most of California at low to moderate elevation. It roosts in crevices (rocks, trees, and a variety of man-made structures including buildings, bridges, and abandoned mines) (Barbour and Davis 1969, Brigham *et al*. 1997, Krutzsch 1954, Simpson 1993). While it is found in a wide variety of habitats, it is often detected foraging around the canopy of oak trees or along riparian corridors in association with cottonwood, sycamore and willow. Diet data indicate this species is a generalist aerial forager consuming a wide variety of small insects. O'Farrell *et al*. (1967) observed that this was one of several species which were at least periodically active all winter at a Nevada desert spring, even at temperatures close to freezing. There are no data to suggest aggregated migration or long distance movements. In the moderate climate of the California coast range, California myotis are likely foraging actively in winter as well as summer, with episodes of torpor of varied duration during cold or wet weather.

In this study we have not distinguished the two 50 kHz *Myotis, M. californicus* and *M. yumanensis* on echolocation call characteristics, but 50 kHz detections (*e.g.*, Appendix IV, Fig. A7) distant from ponds or other substantial areas of open water in this region are likely to be *M. californicus* (May: Spring #12, Ecological Reserve; July: Spring #12, Spring #17; October: Bldg 865 Wetland, Spring #17, East O.P., East C.P.). These two species commonly co-occur at the edge of ponds and streams and it is also likely that some of the large number of 50 kHz sequences recorded at the sewage pond are *M. californicus*. Visual observations of the flight style of some 50 kHz *Myotis* there (repeated erratic excursions toward the pond from near adjacent tree canopies) are typical for *M. californicus.*

3.5.8. *Myotis volans*, Long-legged Myotis

The long-legged myotis is considered a Species of Concern by the U.S. Fish and Wildlife Service, and is proposed for State Special Concern status (CDFG-MSSC proposed, FWS-SC). There are three records from three localities for the five county area (Table 1) -- two from Santa Clara County (CAS in 1910, MVZ in 1945), and one from Stanislaus County -- a cave 3 miles east of Oakdale (WFBZ in 1957). All three individuals were males.

M. volans occurs in a variety of habitats throughout most of the state, including coastal forests, inland desert valley mines and high elevations in the Sierra Nevada and White Mountains. A notable percentage of the records (from California and elsewhere in the range) are from relatively high elevations, although reproductive females have been captured at lower elevations in the Sierra Nevada (Pierson *et al.* 2001), and a maternity colony was recently identified in Amador County (Pierson and Rainey 2002b).

While this species has been found roosting in abandoned buildings, mines, and rock crevices (Barbour and Davis 1969, Warner and Czaplewski 1984, Quay 1948), recent research suggests it roosts primarily in trees, particularly large diameter conifer snags, or live trees with defects (Chung-MacCoubrey 1996, Cryan 1996, Ormsbee 1996, Rainey and Pierson 1996).

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).

M. volans may occur at Site 300. It is one of three *Myotis* species that echolocates at 40 kHz, and is the only one represented by museum specimens for the five county region treated here. We recorded 40 kHz *Myotis* at Site 300 at the sewage pond (May, October), and on a riparian edge vehicle track in the adjacent DFG Ecological Reserve (July). Though the echolocation sequences obtained are not diagnostic, this species is more likely than the other two that echolocate at 40 kHz (little brown bat, *M. lucifugus* and small-footed myotis, *M. ciliolabrum*), given our current understanding of the distribution and habitat preferences of those species.

3.5.9. *Myotis yumanensis*, Yuma Myotis

The Yuma myotis is a federal special-status species (FWS-SC). There are 96 records from 17 localities for the five county area (Table 1, Fig.1). These include several series -- 10 animals collected from a site near Pleasanton in 1954 (MVZ), 18 from a site near La Grange in 1965 (MSB, TCWC), 28 from Calaveras Dam between 1943 and 1948 (CM, MVZ). Surveys conducted at Calaveras Dam in 1987 revealed a colony of about 300 in one of the buildings associated with the dam (W.E. Rainey, unpubl. obs.). We located no records for the immediate vicinity of Site 300.

The Yuma myotis is widely distributed throughout much of California, being most abundant below 1, 500 m elevation (Barbour and Davis 1969). Although it is listed as a USFWS Species of Concern (because of issues elsewhere in its range), it is locally abundant at lower elevations in California (e.g, Barbour and Davis 1969, Pierson *et al.* 2000 & 2001). This is one of the species most commonly associated with human structures, including barns and bridges, although it will also roost in caves, abandoned swallow nests, defects in living trees and under flaking bark of large snags (Barbour and Davis 1969, Dalquest 1947b, Evelyn *et al*. 2004, Rainey and Pierson 1996, unpubl. obs.). It forms maternity colonies of a few tens to several thousand animals. This species has large feet and commonly forages on emerging aquatic insects by trawling over relatively calm water (reservoirs, ponds, or slower reaches and pools of rivers and streams).

However, 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).

In this study, the sewage evaporation pond had the highest bat activity of all sites sampled, and over 90 % of the call sequences are 50 kHz (Figure 2). It is likely that most are from *M. yumanensis*, though another 50 kHz echolocator, *M. californicus* is also present. Netting is not feasible at this site, but the foraging flight styles of the two species have distinctive elements. Bats were observed skimming above the water surface of the pond, consistent with typical *M. yumanensis* aquatic foraging.

3.5.10. *Pipistrellus hesperus,* Western pipistrelle

The western pipistrelle has no state or federal status. There are 31 museum records from 7 localities in the five county area (Table1, Fig.1). Eighteen of these records come from two sites near Clayton (MVZ). The remainder are all from sites in the vicinity of Site 300 -- Corral Hollow (MVZ), seven miles southwest of Tracy (MVZ), Ingram Canyon (MVZ), and Del Puerto Canyon (CM, MSB). The distribution records in the five counties suggest this species may occur there only on the eastern slope of the central Coast Range, so that Site 300 is of interest as the most western record now known for this area.

This species, which roosts almost exclusively in cliffs or rock outcrops, is often regarded as a bat of desert waterholes and canyons (Barbour and Davis 1969). 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).

Western pipistrelles are usually described as non-colonial, though aggregations up to twelve have been reported. This is smallest North American bat, but, in contrast to the single offspring produced annually by many local species, females typically give birth to twins. Pipistrelles often emerge to hunt before dark, flying seemingly erratically, while pursuing small insects in open air. Diet analyses indicate an opportunistic generalist aerial hunter. Hall (1947) observed geographical segregation by sex in summer collections in Nevada. Though radiotracked individuals were observed to fly several km. in one night (D. Constantine, pers. comm.), there is no indication of seasonal migration. As with several other species, O'Farrell *et al.* (1967) observed that pipistrelles flew on winter nights at temperatures down to near freezing at a Nevada desert spring. In moderate California coast range climate, foraging though the winter in warmer intervals is more likely than prolonged hibernation.

Pipistrelles could be seen before dark on Site 300 and were commonly detected acoustically (Appendix IV, Fig. A8 and A9) at most sites in all seasonal samples (Appendix III). The exceptions were windy ridge sites with low total activity.

3.5.11. *Tadarida brasiliensis*, Mexican Free-tailed Bat

The Mexican free-tailed bat has no state or federal special status. Consistent with its status as the most common bat in much of lowland California, there are 298 records from 39 localities in the five county area (Table1, Fig.1). Most of these are series from colonies in cities (*e.g.*, 29 animals from Oakland in September 1942 [CM, MVZ], 25 from Concord in 1912 and 1913 [MVZ], 26 from Stockton in October 1918 [MVZ], 95 from San Jose in 1893 [CAS]). The records closest to Site 300 are a single mummy from beneath an active colony in a hillside mine adit on the Connolly Ranch in May 1991 (collected by W.E.Rainey [MVZ]) and single animals from Arroyo Mocho in 1943 (KU) and 1945 (MVZ).

Mexican free-tailed bats roost in aggregations in crevices or cavities. While this species roosts in a range of natural features (rock crevices, caves, less commonly trees and inactive swallow nests), it is also a species often found in human structures (*e.g.*, rural or urban buildings and bridges) in California (Barbour and Davis 1969, Wilkins 1989). Colonies appear to be more mobile than in many other bats, seemingly displaying less loyalty to particular roost sites, with the exception of major maternity sites which are occupied year to year. Mexican free-tailed bats form colonies estimated at several million in caves in Texas, but in California, with the exception of one colony of several hundred thousand in a lava cave near the Oregon border, most colonies in California range in size from a few hundred to a few thousand. Free-tailed bats can tolerate torpor during cold weather, but are not thought to hibernate. They occupy roosts in the Central Valley at least as far north as Redding year round (Johnston 1998, WER and EDP, unpubl. obs.).

Although some populations of Mexican free-tailed bats migrate large distances (*e.g.*, Texas populations overwinter in Mexico), seasonal movement patterns and population structure within California are poorly understood. While numbers decrease in the Central Valley and increase in the Bay area and elsewhere along the coast in the winter, it is not known whether the animals that overwinter in the Valley are a subset of the summer population or belong to populations that summer elsewhere. It is possible that the Central Valley serves as a migratory corridor for populations that raise their young farther north (*e.g.*, in the volcanic landscapes of Lassen, Modoc and Shasta counties).

Mexican free-tailed bats are aerial foragers, and feed on a wide variety of flying insects (Whitaker et. al. 1996). Because of their abundance, they may have a economically significant effect on agricultural pests. McCracken (1996) has shown this species is a significant predator on corn earworm moths (*Heliothis zea*), with the bats intercepting mass migrations of moths as they move north from Mexico into Texas. A study conducted in Yolo County showed a correlation between activity patterns of codling moths (*Cydia pomonella* L.) and bats, with increasing number of moth scales occurring in the guano of Mexican free-tailed bats at the same time that increasing numbers of codling moths were captured in orchard traps (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). Although this species is generally best known for foraging at considerable height above the ground, both visual observations and diet studies in the Central Valley suggest that they also take insects close to water surfaces and near outdoor lighting. D. Johnston (pers. comm.) has identified aquatic taxa in the diet of Mexican free-tailed bats: midges and/or mosquitoes (Chaoboridae and/or Culicidae) in the spring, and water boatmen (Corixidae) in the fall.

This species is readily detected acoustically (Appendix IV, Fig. A10), but in May it was only detected foraging above lighted areas near the Main Gate. Relatively few detections were obtained in July (Elk Ravine; sewage pond fence line; West O.P), but the lighted parking area was not sampled at that time. In October, infrequent detections were more widespread on the site (Bldg 865 wetland, Elk Ravine, Spring #17, East C.P., East O.P.) and freetails were present every night of the nine day sample at the sewage pond and the lighted parking area near building W6. This appears consistent with the pattern, also seen in hoary bats, of increased abundance near the coast in Fall and Winter.

4.0 DISCUSSION AND CONCLUSIONS

In the open, frequently windy, soil mantled grass and shrub habitats that dominate Site 300, both roosting and foraging resources for bats are largely concentrated in the limited areas of incised drainages. These areas have localized seasonal to perennial surface water which likely yields emerging aquatic insects -- an important bat prey resource, especially in dry landscapes. Elevated soil moisture in these riparian corridors or patches also enhances seasonally prolonged terrestrial plant growth, supporting populations of terrestrial insects and other arthropods on which bats also feed. The topography of the drainages and vegetation structure in them alter wind speeds and create some relatively calm areas where smaller flying insects may accumulate actively and passively.

Except for the foliage roosting red and hoary bats, bat species in this region roost diurnally in cavities or crevices. Since roosting bats may be in torpor to conserve energy, they cannot escape rapidly from a terrestrial predator such as a snake, raccoon or squirrel. Though there are scattered literature records of bats roosting in ‘vulnerable’ sites such as soil desiccation cracks or ground squirrel burrows, typical solitary or colonial longer term refuge sites limit access for climbing predators (*e.g.*, the ‘roof’ of caves or rock shelters; rock flakes on steep or overhanging cliff faces; bark, branch or bole defects in larger trees). Low relief rock ledges are scattered throughout much of Site 300, but substantial vertical rock exposures (and the larger trees) are largely concentrated in small areas of the drainages (e.g., Oasis and Draney Cyns, vicinity of Spring 17). For rock faces in particular, orientation, changing solar exposure, and the diurnal pattern of substrate temperature affect the energy costs of roosting for bats. Thus for rock sites, their suitability for roosting varies seasonally, and bats may shift roost sites during an annual cycle.

As a consequence of design and construction materials, the structures surveyed at Site 300 were generally unsuitable as bat roosts. The exteriors of the buildings did not offer appropriate shelter or surfaces of clinging, and due to tight construction, access to interior spaces was minimal. Even where potentially suitable structures were available, we encountered no evidence of bats.

The acoustic data demonstrate high bat activity at both the sewage evaporation pond and the illuminated parking lot in the General Services Area. High activity at the pond through the night strongly suggest it yields emerging flying insect prey as well as sheltered open water for drinking. Concentrations of bats around isolated water in seasonally dry landscapes are common, and sewage ponds elsewhere are recognized as favorable sites for bats (*e.g.,* Anderson and Choate 1989, Tigner and Stukel 2003[South Dakota]). Even where water is less limited, abundant anoxia tolerant chironomid larvae in highly eutrophic sites such as sewage ponds, or near sewage discharges into surface waters, often yield swarms of small midges. This resource is favored by surface skimming *Myotis*, but also consumed by larger bats (*e.g.*, Rydell and Baagøe 1996 [Sweden], Vaughan *et al*. 1996[United Kingdom]).

Depending on the emission spectra of the lamps chosen, individual street lighting and the massed lighting of parking areas can draw substantial concentrations of insects (often moths) from adjacent areas. Typically this increased local prey density attracts larger aerial pursuit foraging species (*e.g.*, *T. brasiliensis*, *L. blossevillii*, and *L..cinereus*), but other bats, including *Myotis volans*, may also be present (Lee and McCracken 2002; Hickey *et al.* 1996; Chris Corben, pers. comm.). This pattern of opportunistic resource exploitation around lights is also found worldwide and may extend the range of bat species into otherwise marginal environments, where prey densities are otherwise too low (Rydell 1992; Blake *et al.* 1994).

Management recommendations for the bat species on Site 300 should be similar to those for co-occurring native vertebrates, such as riparian birds. The Western red bat, *L. blossevillii* and the pallid bat, *A. pallidus*, are the special status species confirmed as present at several sampling locations. Pallid bat roosts include cavities in both trees and exposed rock faces; the species likely forages in both riparian corridors and over the extensive grasslands when not restricted by wind. As currently understood, favored roosting sites for the Western red bat are in broadleaf tree foliage and natural foraging sites are often riparian corridors. Management for both would focus on maintenance and natural replacement of larger trees in the limited riparian areas and seeps.

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Figures and Tables

Figure 1. **A**. Total number of reported museum specimens by bat species for Alameda, Contra Costa, San Joaquin, Santa Clara, and Stanislaus counties. (Acronyms for species are listed in

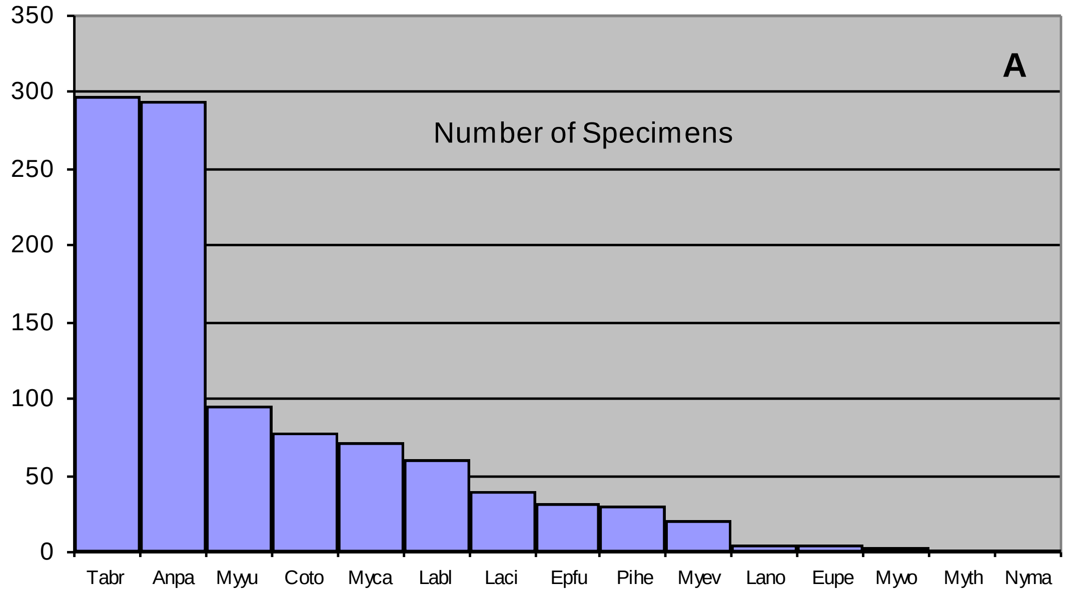

Table 2.)
B. Number of localities by species for the same museum records.

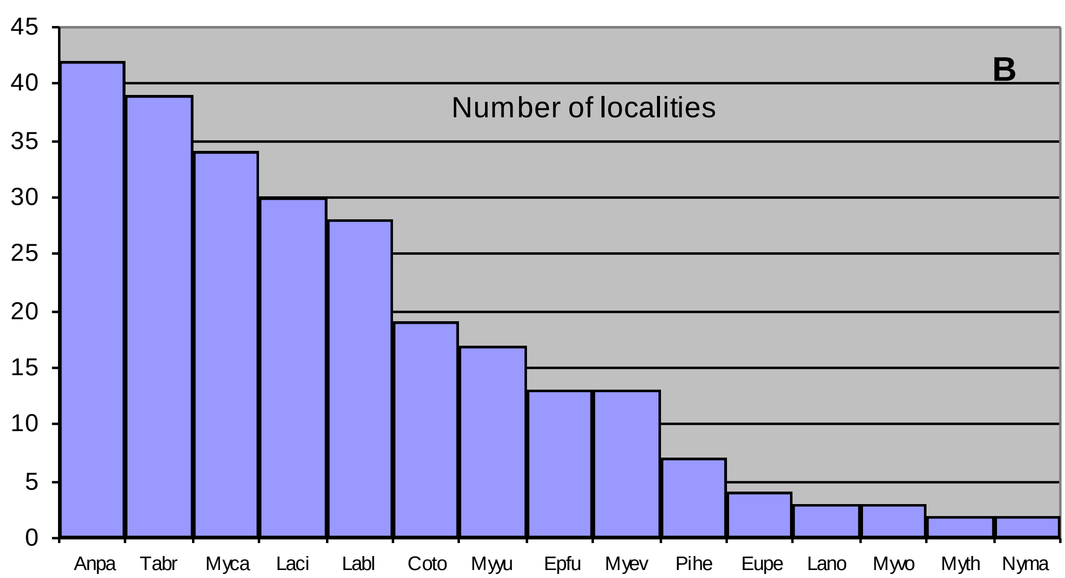

Figure 2. Total number of bat call sequence identifications for all sampling sites and dates on Site 300. (Acronyms for species and species groups are in the Appendix III legend.)

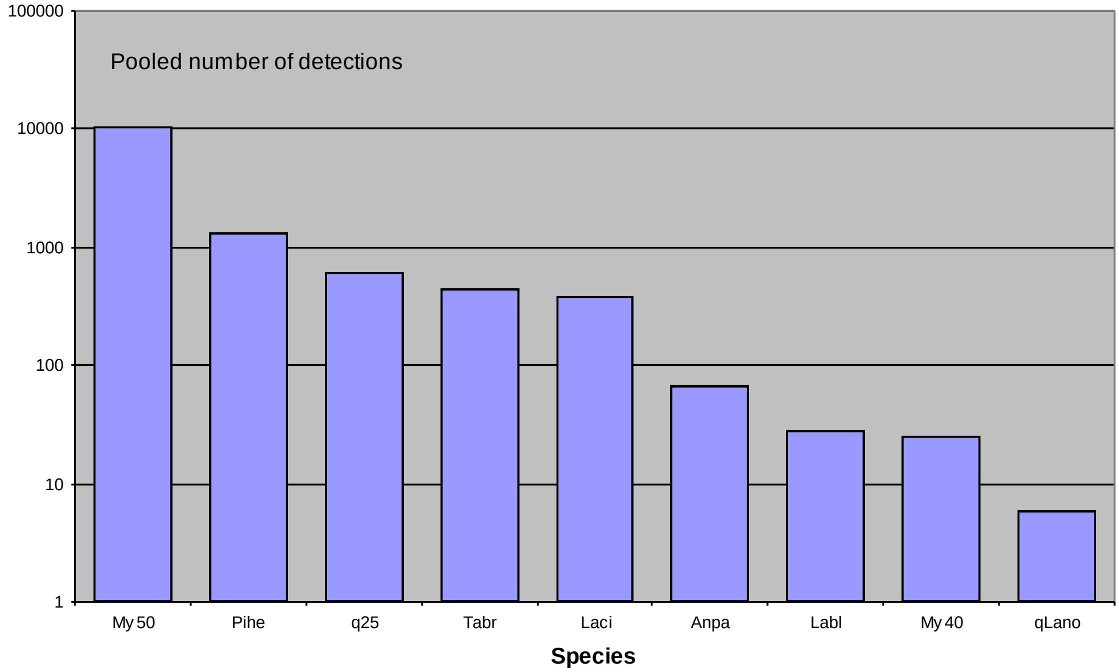

Figure 3 **A**, **B** and **C**. Counts of identified bat call sequence files at Site 300 localities sampled simultaneously for nine nights (10/28-11/5/2002).Number beneath locality name is site number (Appendix II). Line graph in each is total files per site for entire sampling interval. Bar graph is mean number of sequence files per night (+/- 1 S.E.) Bold numbers is total nights sampled at the site named below (50 & 51 are less than others because of insect noise). **A** is a log plot.

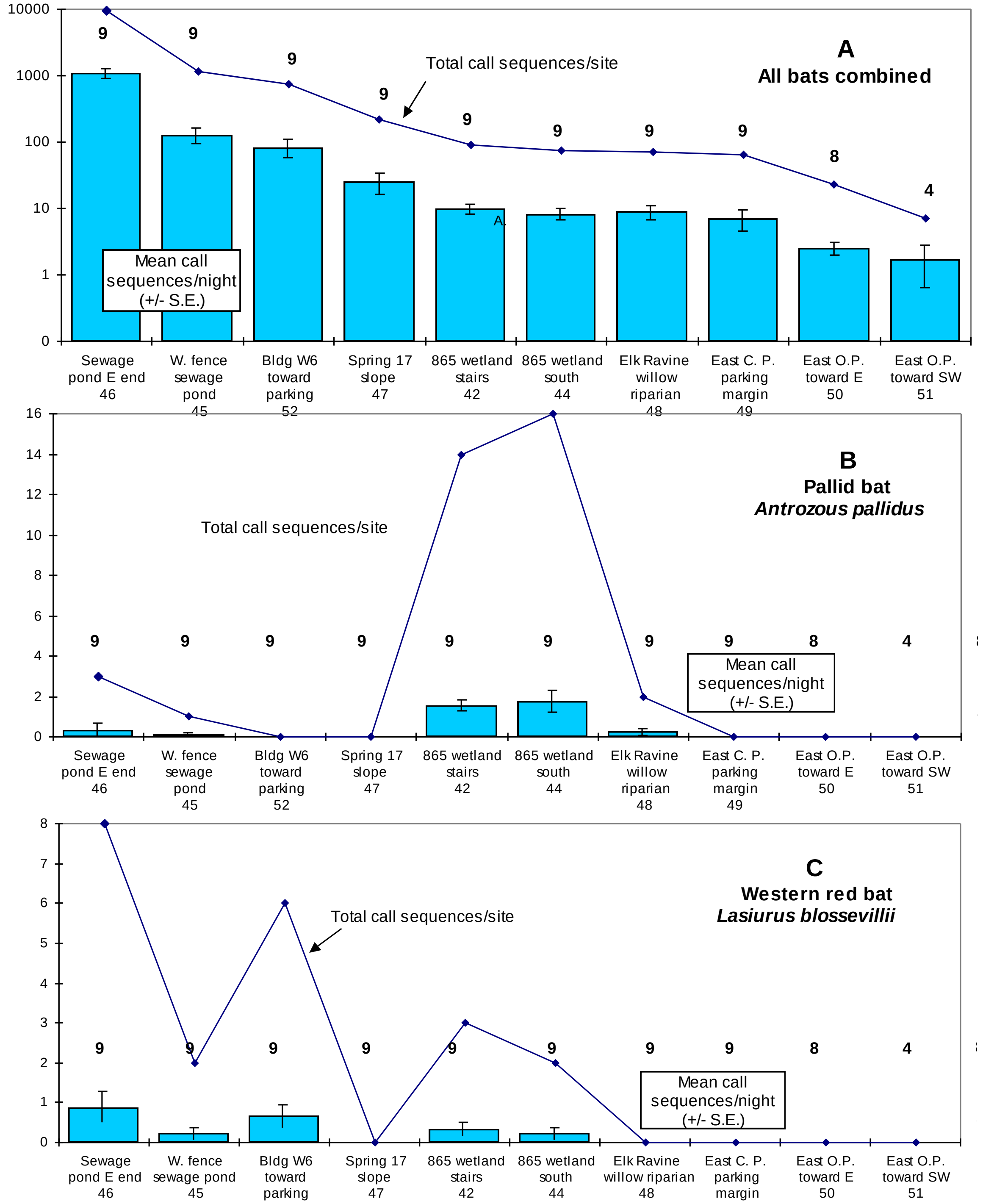

Table 1. Distribution of museum records by county, showing number of specimens and, in parentheses, approximate number of localities.

Species	**Alameda**	**Contra Costa**	**San Joaquin**	**Santa Clara**	**Stanislaus**	**Total Specimens**	**Total Localities**
Antrozous pallidus	108 (12)	55 (13)	4 (2)	114 (13)	14 (2)	295	42
Corynorhinus townsendii	48 (7)	13 (2)	2 (1)	13 (6)	3 (3)	79	19
Eptesicus fuscus	10 (6)	15 (3)		3 (2)	4 (2)	32	13
Lasionycteris noctivagans	3 (2)	1 (1)				4	3
Lasiurus blossevillii	12 (8)	4 (4)	10 (4)	21 (8)	13 (4)	60	28
Lasiurus cinereus	20 (14)	5 (5)		11 (9)	4 (2)	40	30
Myotis californicus	15 (12)	37 (12)		13 (6)	7 (4)	72	34
Myotis evotis	4 (2)	8 (6)		8 (6)		20	14
Myotis thysanodes	1 (1)			1 (1)		2	2
Myotis volans				2 (2)		3	3
Myotis yumanensis	72 (10)	1 (1)		5 (4)	18 (2)	96	17
Pipistrellus hesperus	0 (0)	18 (2)	8 (2)		5 (3)	31	7
Eumops perotis	1 (1)		1 (1)		2 (2)	4	4
Nyctinomops macrotis	1 (1)	1 (1)				2	2
Tadarida brasiliensis	92 (16)	46 (9)	33 (5)	121 (6)	6 (3)	298	39
TOTAL SPECIMENS	**387**	**204**	**57**	**311**	**76**	**1038**	

Table 2. Bats species known or possibly present at Site 300 or in the surrounding five county area. The Latin name and common name are followed by an acronym. Species in bold are those with specimens reported for the five counties. Status categories are FSS = USDA Forest service Sensitive; MSSC = California Department of Fish and Game Mammal Species of Special Concern; SC = U.S. Fish and Wildlife Service Special Concern (former C2 Candidate). An asterisk (*) indicates status is proposed.

SPECIES			STATUS
Observed in this study			
Vespertilionidae (mouse-eared bats)			
Antrozous pallidus	**Pallid bat**	**Anpa**	**FSS, MSSC, SC**
Lasiurus blossevillii	**Western red bat**	**Labl**	**FSS, MSSC***
Lasiurus cinereus	**Hoary bat**	**Laci**	
Myotis californicus	**California myotis**	**Myca**	
Myotis yumanensis	**Yuma myotis**	**Myyu**	**SC**
Pipistrellus hesperus	**Western pipistrelle**	**Pihe**	
Molossidae (free-tailed bats)			
Tadarida brasiliensis	**Mexican free-tailed bat**	**Tabr**	
Likely detection			
Vespertilionidae (mouse-eared bats)			
Lasionycteris noctivagans	**Silver-haired bat**	**Lano**	
Myotis volans	**Long-legged myotis**	**Myvo**	**MSSC*, SC**
May occur; not detected this study			
Vespertilionidae (mouse-eared bats)			
Corynorhinus townsendii	**Townsend's big-eared bat**	**Coto**	**FSS, MSSC, SC**
Eptesicus fuscus	**Big brown bat**	**Epfu**	
Myotis ciliolabrum	Small-footed myotis	Myci	SC
Molossidae (free-tailed bats)			
Eumops perotis	**Western mastiff bat**	**Eupe**	**MSSC, SC**
Unlikely to occur on Site 300			
Vespertilionidae (mouse-eared bats)			
Myotis evotis	**Long-eared myotis**	**Myev**	**SC**
Myotis thysanodes	**Fringed myotis**	**Myth**	**MSSC*, SC**
Molossidae (free-tailed bats)			
Nyctinomops macrotis	**Big free-tailed bat**	**Nyma**	**MSSC, SC**

Appendices

Appendix 1. List of museum collections with bat records for five county area around Site 300, with institutional acronym and number of specimens from each.

California Academy of Sciences, San Francisco, CA	CAS	224
Carnegie Museum of Natural History, Pittsburgh, PA	CM	20
California State University, Humboldt, CA	CSUH	1
Cornell University, Ithaca, NY	CU	3
University of Kansas, Lawrence, KA	KU	11
Los Angeles County Museum. Los Angeles, CA	LACM	56
Louisiana State University Museum of Zoology, Baton Rouge, LA	LSUMZ	1
Museum of Comparative Zoology, Harvard University, Cambridge, MA	MCZ	6
Moore Laboratory of Zoology, Occidental College, Los Angeles, CA	MLZ	1
University of New Mexico, Albuquerque, NM	MSB	14
Michigan State University, East Lansing, MI	MSU	11
Museum of Vertebrate Zoology, University of California, Berkeley, CA	MVZ	644
Royal Ontario Museum, Toronto, Ontario	ROM	1
Santa Barbara Museum of Natural History, Santa Barbara, CA	SBMNH	2
San Diego Natural History Museum, San Diego, CA	SDNHM	1
Texas A & M, College Station, TX	TCWC	14
University of Alaska Museum, Fairbanks, AK	UAM	2
University of California, Santa Barbara, CA	UCSB	3
University of Michigan, Ann Arbor, MI	UM	8
United States National Museum, Washington, DC	USNM	4
University of Washington-Washington State Museum, Seattle, WA	UW-WSM	4
University of California, Davis, CA	WFBZ	7
	TOTAL	**1038**

Appendix II. List of sampling stations by date. Coordinate datum is NAD27 CONUS

Date	Site #	Locality	Lat	Long
ACOUSTIC STATIONS				
15-May-02	1	Spring #12, NE of stream crossing	N 37.64297	W 121.55751
	2	Spring #12, below road	N 37.64222	W 121.55793
	3	Spring #12, beside stream	N 37.64283	W 121.55770
	4	Spring #12, east of stream crossing	N 37.64264	W 121.55760
	5	(West) Sewage pond, north berm	N 37.63536	W 121.49492
	6	Ambrosino Pond (vernal pool)	N 37.67206	W 121.56537
	7	West O.P.	N 37.66644	W 121.55655
	8	865 complex , Roadside wetland by stair	N 37.67160	W 121.54328
	9	Bldg 865B uphill side	N 37.66807	W 121.54361
	10	812 Complex, drop tower	N 37.64560	W 121.54631
	11	West CP	N 37.64983	W 121.54284
	12	Guard post at main parking	N 37.63403	W 121.50180
	13	SW. entrance 50 m inside gate		
	14	Large clearing	N 37.64185	W 121.49109
	15	Corral Hollow Rd. Bridge	N 37.64014	W 121.49031
	16	cliffs abv drainage and net site	N 37.64763	W 121.56098
	17	Spring #12 area up drainage, Net site	N 37.64874	W 121.56111
	18	oaks near vehicle and net site	N 37.64563	W 121.56152
16-May-02	19	Spring #6, Willows	N 37.65637	W 121.52523
	20	Spring #17, uphill on rock	N 37.65741	W 121.51879
	21	Gooseberry Cyn cliffs, S. end, S. Cyn	N 37.65146	W 121.51833
	22	Gooseberry Cyn cliffs, entrance rock cavity	N 37.65153	W 121.51761
	23	Gooseberry Cyn cliffs, drainage overlook	N 37.65256	W 121.51700
	24	Gooseberry saddle	N 37.65771	W 121.51970
	25	abv nets	N 37.65735	W 121.51817
	26	near nets	N 37.65620	W 121.51863
	27	up drainage from Spring #14	N 37.63459	W 121.51424
	28	East O.P., towards east, margin of paved area	N 37.67448	W 121.53892
	29	H.E. ponds	N 37.63602	W 121.51114
	30	Bldg 802		
	31	Bldg 845		
	32	Bldg 855 (850?)		
	33	Bldg 854		
	34	SW. margin, on track, 40m NNE Gate	N 37.64035	W 121.49116
	35	North Spring, stream side	N 37.64534	W 121.49112
	36	Pond N of Corral Hollow Rd.	N 37.63273	W 121.53796

Appendix II. continued Sampling stations by date.

19-Jul-02	37	Elk Ravine, Rock cavity	N 37.65153	W 121.51766
	38	Elk Ravine, Upstream fire road crossing	N 37.65256	W 121.51700
	39	Spring #17, Above	N 37.65739	W 121.51820
	40	Spring #17, Overlooking spring	N 37.65737	W 121.51869
	28	East O.P.	N 37.67448	W 121.53892
	8	865 complex , Roadside wetland by stair	N37.67160	W 121.54328
	41	West O.P., downslope	N 37.66639	W 121.55679
	1	Spring #12, NE of stream crossing	N 37.64297	W 121.55751
	2	Spring #12, below road	N 37.64222	W 121.55793
	3	Spring #12, beside stream	N 37.64283	W 121.55770
	42	Outside fence at sewer treatment pond	N 37.63446	W 121.49623
28-Oct-02	43	Sewage pond-E end pumphouse platform	N37.63538	W121.49415
	44	Spring #17, slope abv drainage channel	N37.65782	W121.51898
	45	Elk Ravine riparian below 812 complex	N37.65607	W121.52462
	46	East C.P. Parking, utility platform	N37.65317	W121.52623
	8	865 complex , Roadside wetland by stair	N37.67160	W 121.54328
	47	Bldg 865 wetland, down drainage	N37.67058	W121.54243
	28	East O.P., towards east, margin of paved area	N 37.67448	W 121.53892
	48	East O.P., southwest of crest	N37.67417	W121.53921
	49	Sewage Treatment Pond, W. fence line	N37.63450	W121.49605
	50	nr. Bldg. W6, toward lighted parking area	N37.63382	W121.50430

NETTING STATIONS

15-May-02	12	Spring #12, beside stream, multiple nets	N 37.64283	W 121.55770
	17	Draney Canyon, multiple nets	N 37.64874	W 121.56111
16-May-02	26	near Spring #17, multiple nets	N 37.65620	W 121.51863

Appendix III. Number of sequence files by species or species groups for each sampling session. Anpa = *A. pallidus*, Labl = *L. blossevillii*, Laci = *L. cinereus*, Pihe = *P. hesperus*, Tabr = T. brasiliensis, My40 = 40 kHz Myotis (most likely M. volans), My50 = 50 kHz Myotis (M. californicus or M. yumanensis), Q25 = 25 kHz species (E. fuscus, L. noctivagans, or T. brasiliensis), qLano = possible L. noctivagans. Total detections include some additional files that were not identified to species or the major species groups.

Date	Site #	Station	Anpa	Labl	Laci	Pihe	Tabr	My40	My50	Q25	QLano	Total Detections
15-May-02	1	Spring #12, NE of stream crossing	1		1	10			2			16
	2	Spring #12, below road	1		1	9			23	1		46
	3	Spring #12, beside stream	1	2	2	16			20	1		47
	4	Spring #12, east of stream crossing			1	12			2			19
	5	(West) Sewage pond, north berm			4	24		1	467	11		512
	6	Ambrosino Pond (vernal pool)										0
	7	West O.P.										0
	8	865 complex , Roadside wetland by stair				3						3
	9	Bldg 865B uphill side				1						1
	10	812 Complex, drop tower										0
	11	West CP										0
	12	Guard post at main parking					79			8		91
	13	SW. entrance 50 m inside gate	1						3			4
	14	Large clearing							1			1
	15	Corral Hollow Rd. Bridge	1							1		2
	16	cliffs abv drainage and net site				3						3
	17	Spring #12 area up drainage, Net site				30						34
	18	oaks near vehicle and net site			5	38			4			57
		5/15 Total	**5**	**2**	**14**	**146**	**79**	**1**	**522**	**22**	**0**	**826**
16-May-02	19	Spring #6, Willowa				2						3
	20	Spring #17, uphill on rock				29						37
	21	Gooseberry Cyn cliffs, S. end, S. Cyn				8				1		18
	22	Gooseberry Cyn cliffs, entrance rock cavity										2
	23	Gooseberry Cyn cliffs, drainage overlook				64						65
	24	Gooseberry saddle				134						134
	25	abv nets				2						2
	26	near nets				2						2
	27	up drainage from Spring #14										0
	28	East O.P., margin of paved area								1		1
	29	H.E. ponds										0
	34	SW. margin, on track, 40m NNE Gate	2		1	21		5	51	9		115
	35	North Spring, stream side				61			11	2		78
	36	Pond N of Corral Hollow Rd.			1	7			144	4		168
		5/16 Total	**2**	**0**	**2**	**330**	**0**	**5**	**206**	**17**	**0**	**606**

Appendix III. (continued) Number of sequence files by species or species groups for each sampling session.

Date	Site #	Station	Anpa	Labl	Laci	Pihe	Tabr	My40	My50	Q25	QLano	Total Detections
19-Jul-02	1	Spring #12, NE of stream crossing	1			19			18	1		58
	2	Spring #12, below road	1			30			35	1		77
	3	Spring #12, beside stream				15			30			57
	8	865 complex , Roadside wetland by stair	3			2						10
	28	East O.P.								1		4
	37	Elk Ravine, Rock cavity	2		1	2				3		31
	38	Elk Ravine, Upstream fire road crossing	6			8	1		1	1		25
	39	Spring #17, Above	3			1						6
	40	Spring #17, Overlooking spring	1			5			1			8
	41	West O.P., downslope					1			1		2
	42	Outside fence at sewer treatment pond		3	4	29	4	11	451	68		633
		7/19 Total	**17**	**3**	**5**	**111**	**6**	**11**	**536**	**76**	**0**	**859**
28-Oct-02	8	865 complex , Roadside wetland by stair	2	1	6	4				17		34
	28	East O.P., towards east, margin of paved area	1			2			4	1		21
	43	Sewage pond-E end pumphouse platform		2	15	99	6	7	1586	10		1734
	44	Spring #17, slope abv drainage channel	3	1		73				1		84
	45	Elk Ravine riparian below 812 complex	1			2			4	1		21
	46	East C.P. Parking, utility platform								1		6
	47	Bldg 865 wetland, down drainage	4	1	1	1						10
	48	East O.P., southwest of crest										1
	49	Sewage Treatment Pond, W. fence line			16	44	8		80	51		199
	50	nr. Bldg. W6, toward lighted parking area		2	1	1	48		9	27		171
		10/28 Total	**11**	**7**	**39**	**226**	**62**	**7**	**1683**	**109**	**0**	**2281**

Appendix III. (continued) Number of sequence files by species or species groups for each sampling session.

Date	Site #	Station	Anpa	Labl	Laci	Pihe	Tabr	My40	My50	Q25	QLano	Total Detections
29-Oct-02	8	865 complex, Roadside wetland by stair	1			3				5		12
	28	East O.P., towards east, margin of paved area	1			1			1			9
	43	Sewage pond-E end pumphouse platform	3		4	108	3	1	2007	6		2149
	44	Spring #17, slope abv drainage channel				37						40
	45	Elk Ravine riparian below 812 complex	1			1			1			9
	46	East C.P. Parking, utility platform				1				1		7
	47	Bldg 865 wetland, down drainage	2		1	2				3		12
	48	East O.P., southwest of crest										0
	49	Sewage Treatment Pond, W. fence line			9	19	44		54	79	2	285
	50	nr. Bldg. W6, toward lighted parking area			18	36	24		7	16		213
		10/29 Total	**8**	**0**	**32**	**208**	**71**	**1**	**2070**	**110**	**2**	**2736**
30-Oct-02	8	865 complex, Roadside wetland by stair	1	1	2		4			5		19
	28	East O.P., towards east, margin of paved area								3		3
	43	Sewage pond-E end pumphouse platform			2	3	5		728	3		745
	44	Spring #17, slope abv drainage channel				11	1		1			14
	45	Elk Ravine riparian below 812 complex										3
	46	East C.P. Parking, utility platform				1				1		7
	47	Bldg 865 wetland, down drainage	1							1		4
	48	East O.P., southwest of crest			1		2			1		5
	49	Sewage Treatment Pond, W. fence line	1				7		26	2		47
	50	nr. Bldg. W6, toward lighted parking area		2	4				1			17
		10/30 Total	**3**	**3**	**9**	**15**	**19**	**0**	**756**	**16**	**0**	**864**

Appendix III. (continued) Number of sequence files by species or species groups for each sampling session.

Date	Site #	Station	Anpa	Labl	Laci	Pihe	Tabr	My40	My50	Q25	QLano	Total Detections
31-Oct-02	8	865 complex , Roadside wetland by stair	2		1					4		7
	28	East O.P., towards east, margin of paved area							1	2		6
	43	Sewage pond-E end pumphouse platform			4	1	7		769	6		791
	44	Spring #17, slope abv drainage channel				1						2
	45	Elk Ravine riparian below 812 complex							1	2		6
	46	East C.P. Parking, utility platform					2			4		7
	47	Bldg 865 wetland, down drainage			5		1			1		9
	48	East O.P., southwest of crest								1		1
	49	Sewage Treatment Pond, W. fence line			3	2	4		12	7		42
	50	nr. Bldg. W6, toward lighted parking area			5		1			5		31
		10/31 Total	**2**	**0**	**18**	**4**	**15**	**0**	**783**	**32**	**0**	**902**
01-Nov-02	8	865 complex , Roadside wetland by stair	3		1					1		6
	28	East O.P., towards east, margin of paved area							1			4
	43	Sewage pond-E end pumphouse platform			3	3	8		697	6		720
	44	Spring #17, slope abv drainage channel				1						4
	45	Elk Ravine riparian below 812 complex							1			4
	46	East C.P. Parking, utility platform			1					1		3
	47	Bldg 865 wetland, down drainage	3	1		2				1		12
	49	Sewage Treatment Pond, W. fence line			2		6		18	3	1	41
	50	nr. Bldg. W6, toward lighted parking area		1	5		4			3		27
		11/01 Total	**6**	**2**	**12**	**6**	**18**	**0**	**717**	**15**	**1**	**821**

Appendix III. (continued) Number of sequence files by species or species groups for each sampling session.

Date	Site #	Station	Anpa	Labl	Laci	Pihe	Tabr	My40	My50	Q25	QLano	Total Detections
02-Nov-02	8	865 complex , Roadside wetland by stair	2		2	1	3			1		11
	28	East O.P., towards east, margin of paved area			1	6			2			11
	43	Sewage pond-E end pumphouse platform		3	28	4	6		571	15		642
	44	Spring #17, slope abv drainage channel			3	17						21
	45	Elk Ravine riparian below 812 complex			1	6			2			11
	46	East C.P. Parking, utility platform			2					1		6
	47	Bldg 865 wetland, down drainage			4					3		8
	49	Sewage Treatment Pond, W. fence line		1	31	2			23	9		82
	50	nr. Bldg. W6, toward lighted parking area			23		2		4			49
		11/02 Total	**2**	**4**	**95**	**36**	**11**	**0**	**602**	**29**	**0**	**841**
03-Nov-02	8	865 complex , Roadside wetland by stair	2		3							9
	28	East O.P., towards east, margin of paved area			3	5			2		1	14
	43	Sewage pond-E end pumphouse platform		1	23	51	17		724	29	1	865
	44	Spring #17, slope abv drainage channel	3	1	1	21				1		36
	45	Elk Ravine riparian below 812 complex			3	5			2	1		14
	46	East C.P. Parking, utility platform				1				1		4
	47	Bldg 865 wetland, down drainage	4		3	1				6		16
	49	Sewage Treatment Pond, W. fence line			22	24	54		35	64		253
	50	nr. Bldg. W6, toward lighted parking area		1	46	6	26			36	1	162
		11/03 Total	**9**	**3**	**104**	**114**	**97**	**0**	**763**	**138**	**3**	**1373**

Appendix III. (continued) Number of sequence files by species or species groups for each sampling session.

Date	Site #	Station	Anpa	Labl	Laci	Pihe	Tabr	My40	My50	Q25	QLano	Total Detections
04-Nov-02	8	865 complex , Roadside wetland by stair	1	1			1		1			5
	28	East O.P., towards east, margin of paved area				2						4
	43	Sewage pond-E end pumphouse platform		2	2	51	11		1141	18		1237
	44	Spring #17, slope abv drainage channel				7						7
	45	Elk Ravine riparian below 812 complex				2			1			4
	46	East C.P. Parking, utility platform										1
	47	Bldg 865 wetland, down drainage	2							1		3
	49	Sewage Treatment Pond, W. fence line		1	8	6	23		43	9		122
	50	nr. Bldg. W6, toward lighted parking area			20	1	9			6		58
		11/04 Total	**3**	**4**	**30**	**69**	**44**	**0**	**1186**	**34**	**0**	**1441**
05-Nov-02	8	865 complex , Roadside wetland by stair			2	1						4
	43	Sewage pond-E end pumphouse platform			5	23	7		767	8		819
	44	Spring #17, slope abv drainage channel				14						14
	46	East C.P. Parking, utility platform					3			1		27
	47	Bldg 865 wetland, down drainage								1		1
	49	Sewage Treatment Pond, W. fence line			14	5	5		38	5		80
	50	nr. Bldg. W6, toward lighted parking area			11		7		5			29
		11/05 Total	**0**	**1**	**60**	**50**	**54**	**0**	**853**	**30**	**0**	**974**
		Grand Total	**68**	**28**	**392**	**1308**	**444**	**25**	**10634**	**613**	**6**	**13698**

Appendix IV

Example bat acoustic sequence files from Site 300

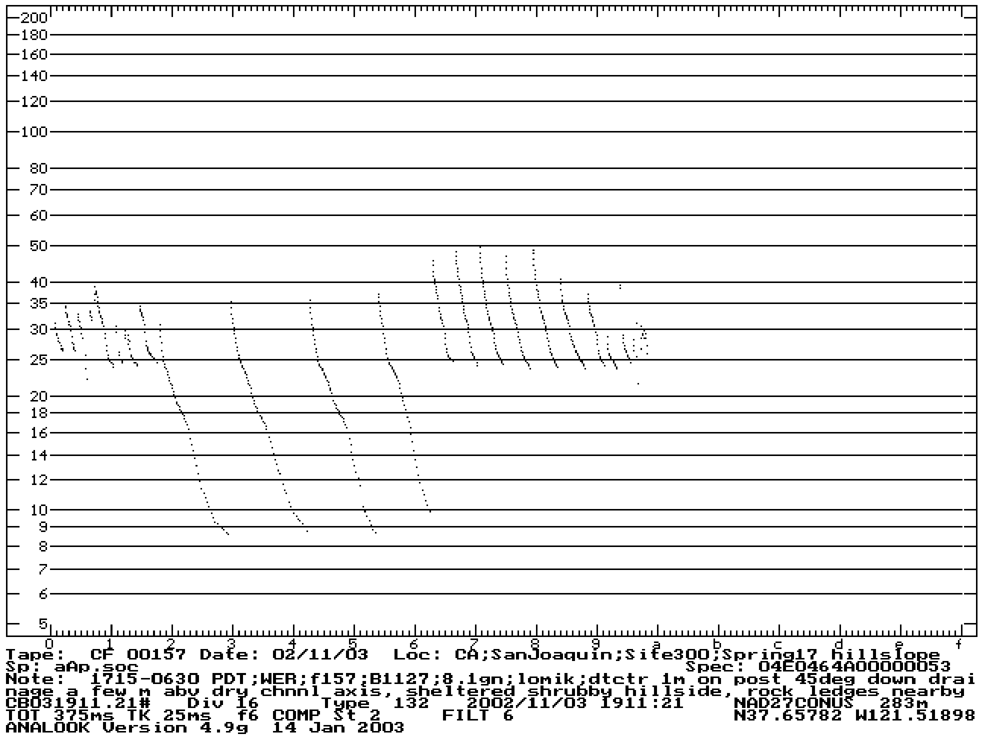

Fig. A1. Pallid bat (*Antrozous pallidus*) sequence with audible ‘directive ‘calls from near Spring 17 (3 Nov 2002).

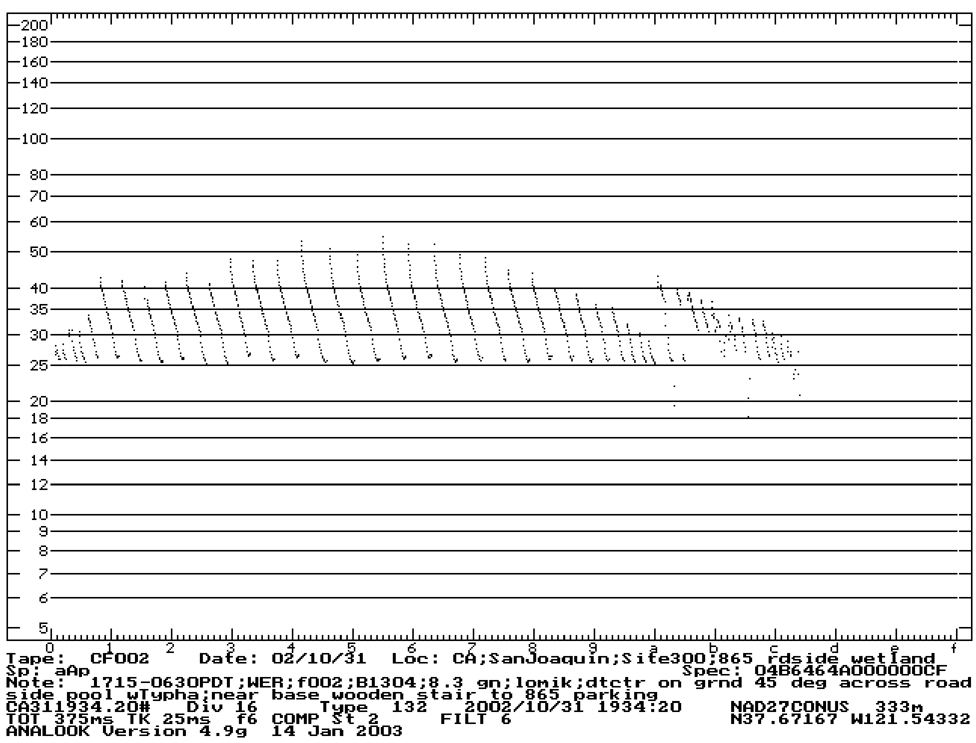

Fig. A2**.** Pallid bat (*Antrozous pallidus*) foraging sequence at Bldg 865 roadside wetland (31 Oct 2002).

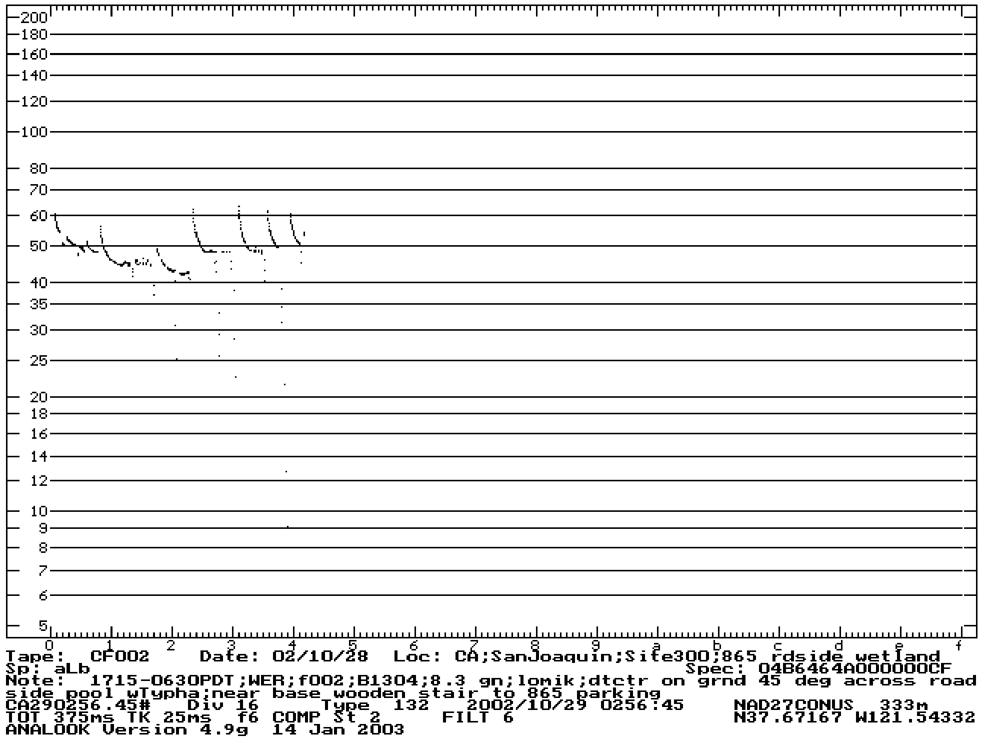

Fig. A3**.** Red bat (*Lasiurus blossevillii*) foraging sequence at Bldg 865 roadside wetland (29 Oct 2002).

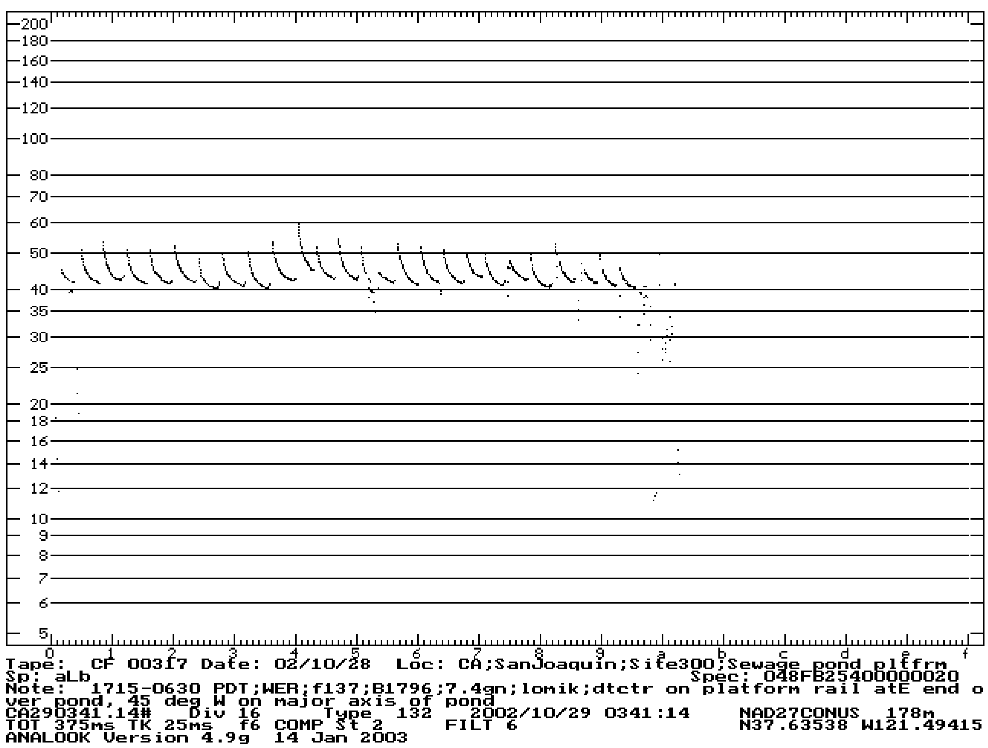

Fig. A4**.** Red bat (*Lasiurus blossevillii*) foraging sequence at sewage pond (29 Oct 2002).

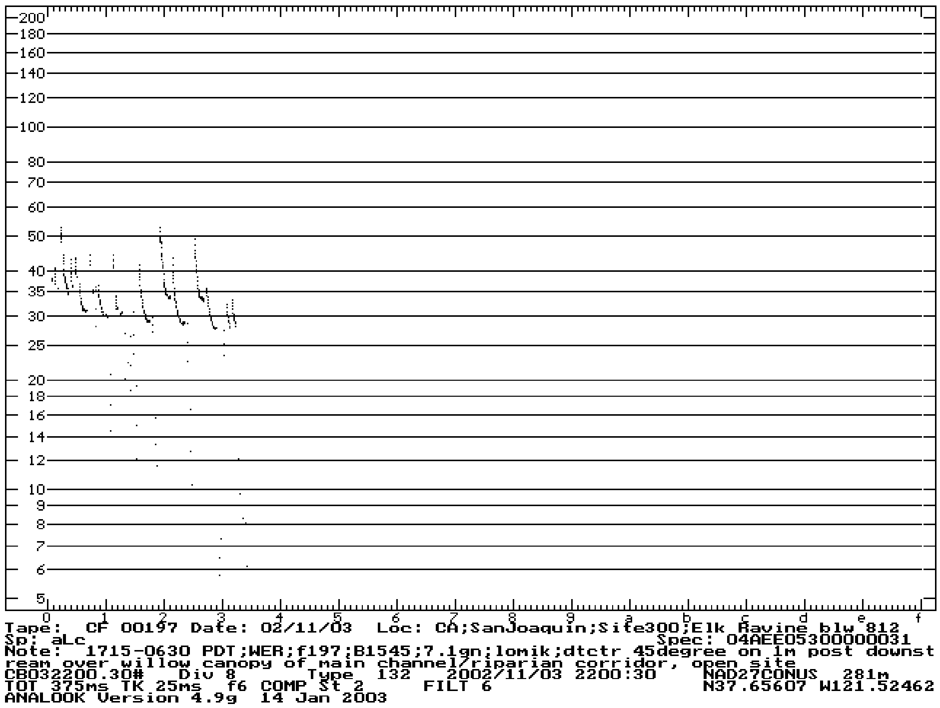

Fig. A5**.** Hoary bat (*Lasiurus cinereus*) foraging sequence in Elk Ravine riparian (3 Nov 2002).

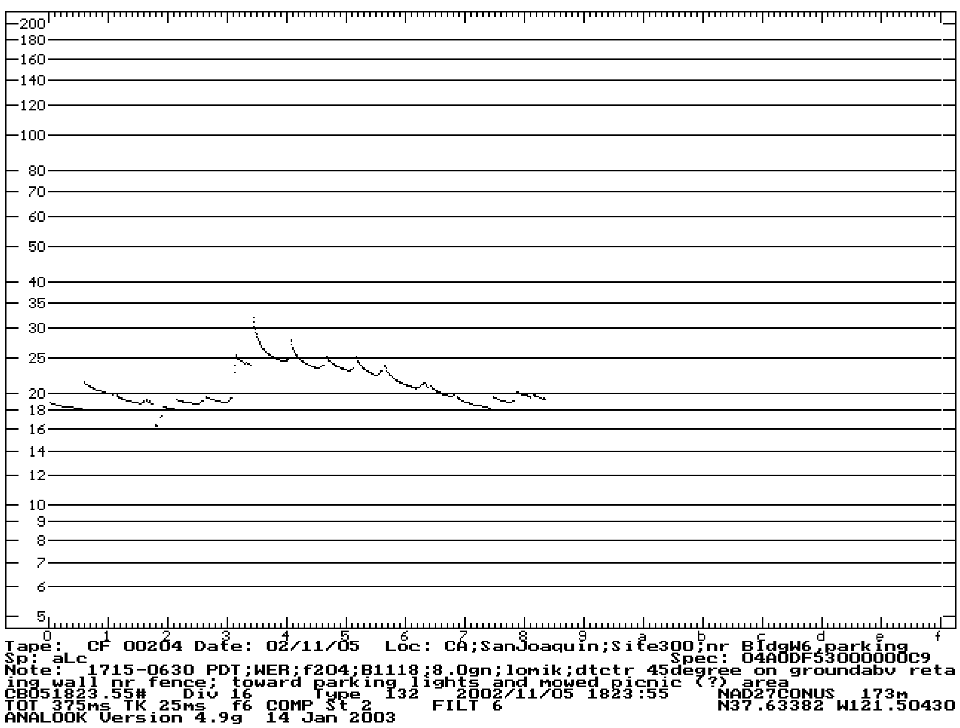

Fig. A6**.** Hoary bat (*Lasiurus cinereus*) sequence in General Services Area near Bldg W6 (5 Nov 2002).

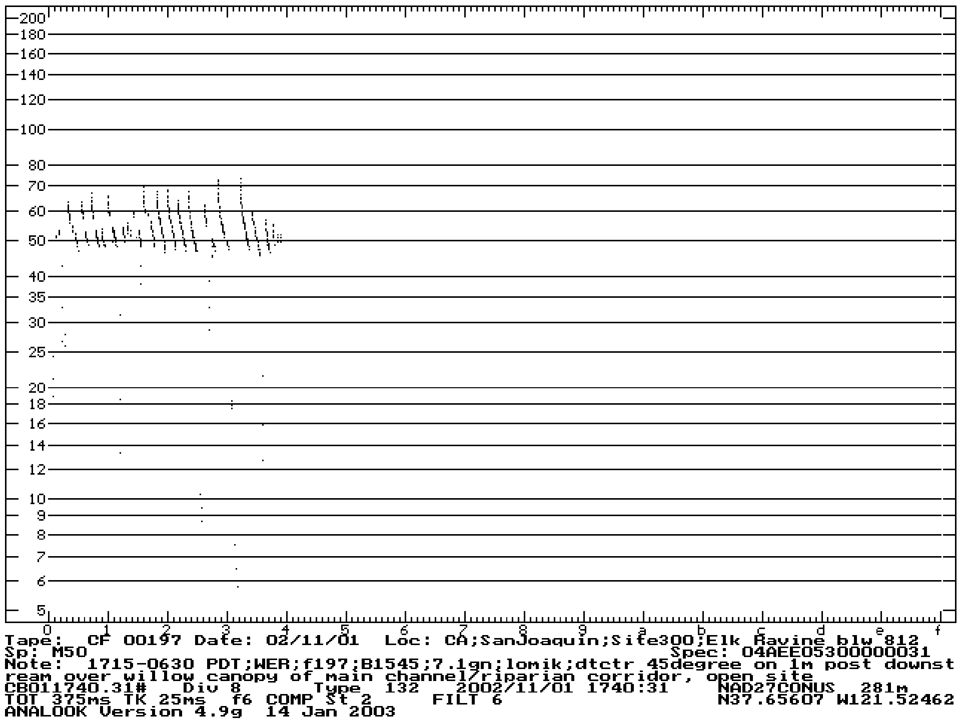

Fig. A7. 50 kHz *Myotis* (probably *Myotis californicus*) over Elk Ravine riparian (1 Nov 2002).

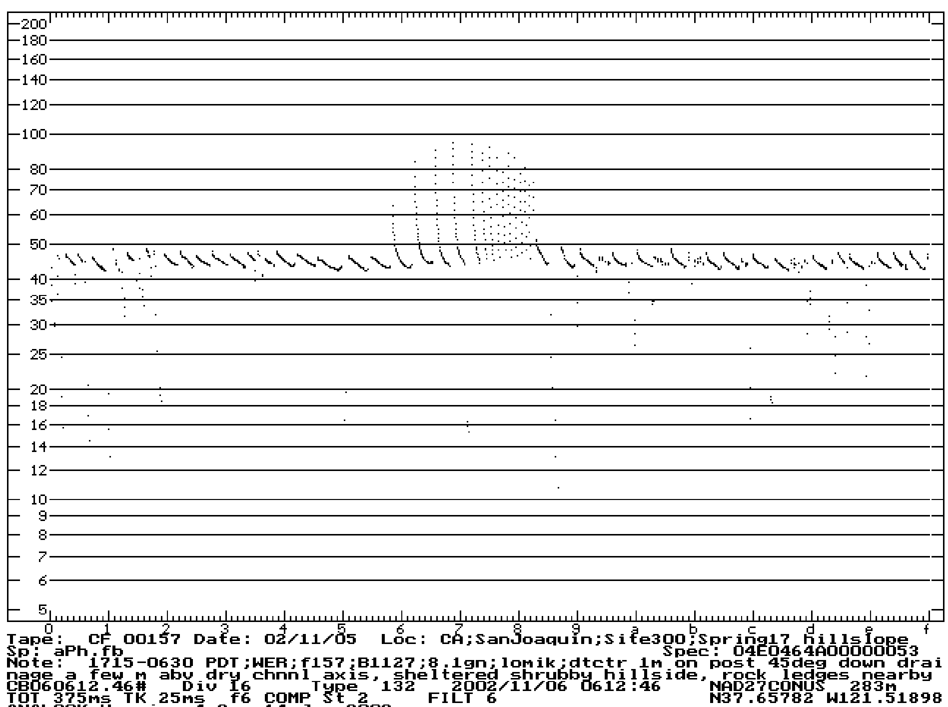

Fig. A8. Western pipistrelle (*Pipistrellus hesperus*) sequence with prey capture attempt (feeding buzz) near Spring 17 (6 Nov 2002).

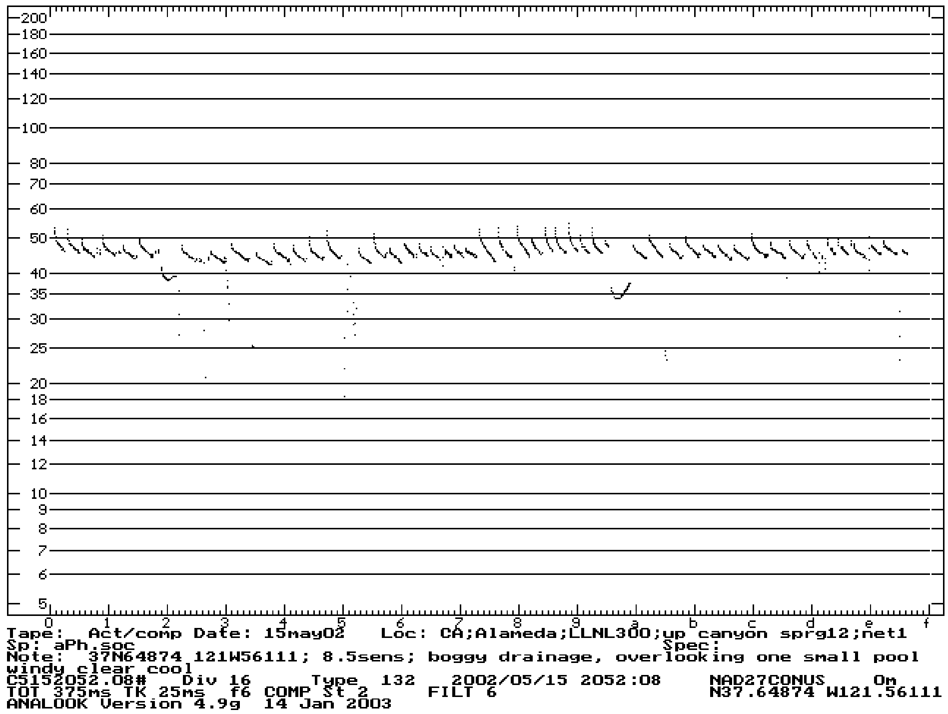

Fig. A9**.** Western pipistrelle (*Pipistrellus hesperus*) sequence with lower frequency social calls near Spring 12 (15 May 2002).

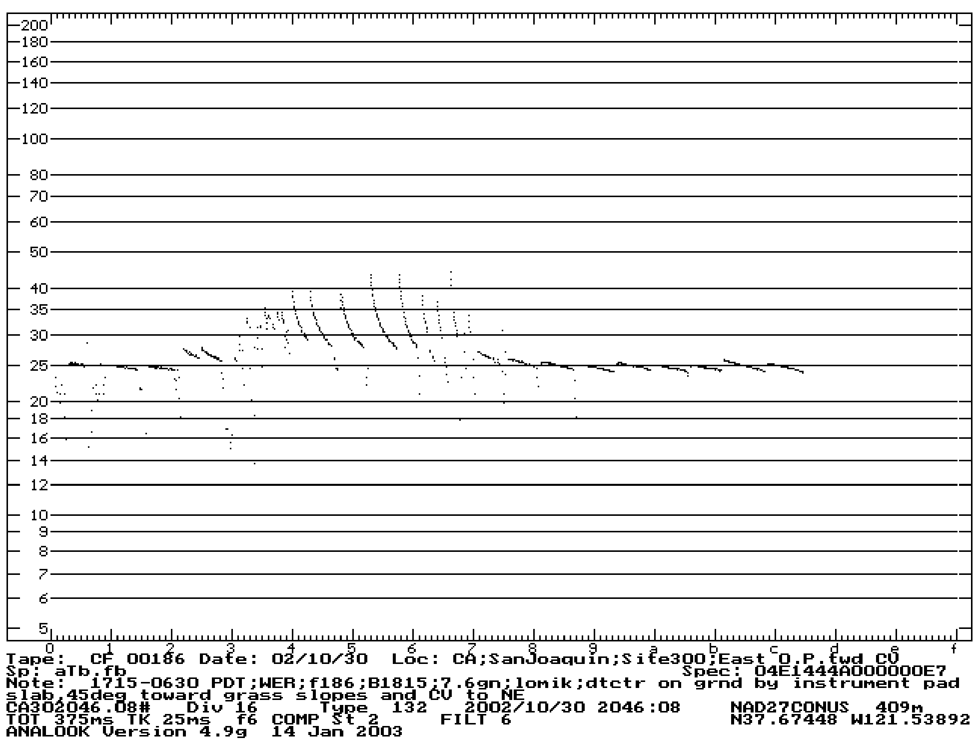

Fig. A10**.** Mexican freetail (*Tadarida brasiliensis*) sequence with fragmentary prey capture attempt at East O.P. (30 October 2002).