Western mastiff bat, *Eumops perotis*

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Description: *Eumops perotis* is one of four molossids which occurs in California. The molossids are distinguished from all other bat species by the presence of a "free-tail," which extends visibly beyond the edge of the interfemoral (=tail) membrane. *E. perotis* is distinguished from the other molossids on the basis of size. It is by far the largest bat species found in California. It has a wingspan of 53 to 56 cm, a forearm of 75-83 mm, and an adult weight of 60-72 g. The species with which it could most readily be confused is *Nyctinomops macrotis*, another molossid, with a forearm of 58-64 mm. Both have large bonnet-like ears, which extend forward over the eyes and are connected at the midline.

Taxonomic Remarks: *E. perotis* is in the family Molossidae. The California form of *E. perotis* was first described by Merriam (1890), and has been recognized as the subspecies *E. p. californicus* since 1932 (Sanborn 1932). The type locality is Alhambra, Los Angeles County. There are nine species currently recognized in the genus *Eumops* (*auripendulus*, *bonariensis*, *dabbenei*, *glaucinus*, *hansae*, *maurus*, *perotis*, *trumbulli*, and *underwoodi*), and two subspecies of *E. perotis* (*californicus* and *perotis*)(Eger 1977). Most species have their centers of distribution in Mexico, Central and/or South America; three (*glaucinus*, *underwoodi*, and *perotis*) occur in the southern United States; only *E. perotis californicus* occurs in California, with the other subspecies, *E. p. perotis*, being confined to South America.

Distribution: *E. p. californicus* ranges from central Mexico across the southwestern United States (parts of California, southern Nevada, southwestern Arizona, southern New Mexico and western Texas) (Bradley and O'Farrell 1967, Eger 1977, Hall 1981). Recent distributional information for California is summarized below (from Pierson and Rainey 1996b, c).

Historically, *E. perotis* was known to be broadly distributed in southern California, from the Colorado River to the coast, with records concentrated in the Los Angeles basin and San Diego County (Cockrum 1960, Eger 1977). The most northern records for which specimens were available was a single animal from the San Francisco Bay area (Hayward, Alameda County) (Sanborn 1932) and several records from Yosemite Valley in Yosemite National Park (Natural History Museum, Yosemite National Park). There were also observations of several *E. perotis* at Hetch Hetchy Reservoir in Yosemite National Park (Vaughan 1959), and of a single animal (specimen not available), presumed to be a vagrant, found in 1973 in Butte County, near Oroville (A. Beck pers. comm., Eger 1977).

Although *E. perotis* is a colonial species, it is striking how few of the available records represent colony sites. Most colony records are from southern California. Early in this century, Howell (1920a, 1920b) located several in buildings in the Los Angeles basin (e.g., in Azusa, Colton, and Covina). In the 1940s, Krutzsch (1943, 1945, 1948, 1955) identified two colonies in San Diego County. Additional significant locality records were contributed by Vaughan (1959) who monitored 22 sites, including eight colonies, located primarily in southern California. Leitner (1966) also focused his research on a colony located in a building at Citrus Junior college in Azusa in the Los Angeles basin. D. Constantine (pers. comm.) knew of a colony in a church in Highland in the 1960s. K. Stager (pers. comm.) reported a very large colony eliminated by an exterminator from a house in downtown Los Angeles in the early 1950s. Historically there were only three records of colonial roost sites north of the Los Angeles basin, all located in the 1940s and 1950s by researchers associated with the Museum of Vertebrate Zoology at the University of California, Berkeley -- a colony on the west side of the Central Valley in San Benito County (Dalquest 1946), one in Kern

County near McKittrick (Krutzsch 1955), and one in the Kern River drainage east of Bakersfield (Koford 1948, Krutzsch 1955).

Recent surveys (Pierson and Rainey 1996b, c) have changed the distributional picture for *E. perotis*. It is now apparent that the species is more widely distributed than was previously realized, and significant populations occur in areas for which only single or scattered records were previously available. This species is now known to have a range that extends almost to the Oregon border, with a number of new localities in the western Sierra Nevada foothills and eastern Trinity Alps. Although there were very few records for the Coast Range prior to the 1990s, multiple animals, suggesting resident populations, have now been detected at several localities in the Coast Range south of San Francisco. Historically the only indication that *E. perotis* occurred in the Sierra Nevada was several lower elevation records (Koford 1948, Vaughan 1959). It is now known that significant populations of *E. perotis* occur in many of the Sierra Nevada river drainages, particularly in the central and southern Sierra, i.e., the Stanislaus, Tuolumne, Merced (North and South Forks), San Joaquin, Kaweah, Tule, and Kern rivers. Substantial populations and roost sites have been located in basaltic table formations in the western Sierra foothills, particularly on the lower San Joaquin and Stanislaus Rivers (W. Philpott, T. Rickman, D. York pers. Comm.). Although the largest populations appear to occur at lower elevations, animals have been detected in the warm season as high as 2,600 m elevation in Yosemite National Park (Pierson and Rainey 1996c), and at 2,000 m in Giant Forest (Pierson and Heady 1996). There are no historic records east of the Sierra Nevada crest, but recent (albeit infrequent) acoustic detections at several localities suggest that this species occurs in some of the Mojave Desert mountain ranges (e.g., Coso, Granite and Panamint Mountains) (P. Brown pers. comm.). Also, the species was heard once in Bishop, during the summer of 1996 (P. Brown pers. comm.).

Unlike some molossid species (e.g., *Tadarida brasiliensis*) which undergo long distance seasonal migrations, *E. perotis* appears to move relatively short distances seasonally. Like other molossids, it does not undergo prolonged hibernation, and appears to be periodically active all winter. Although in southern California local populations may change roost sites, they likely remain in an area year-round (Howell 1920a, Krutzsch 1948 and 1955, Leitner 1966, Barbour and Davis 1969). On the western side of the Sierra Nevada, the species likely moves down the river drainages as the weather cools, concentrating during the winter in areas which experience prolonged periods of above freezing temperatures (below 300 m). For example, winter surveys on the Kern River revealed that animals were not occupying a summer roost site at 580 m, but were concentrated near the mouth of the canyon at ca. 245 m (Pierson and Rainey 1996b). Reliable observers have documented that populations are present throughout the winter at three basaltic table mountain formations (near Oroville, Jamestown and Fresno) (B. McMurtry, W. Philpott, T. Rickman, D. York pers. comm.).

Life History: Unlike vespertilionids which mate in the fall, North American molossids, including *E. perotis*, appear to mate in the spring and give birth to a single young in early- to mid-summer. Available data suggest, however, that although most *E. perotis* young are born by early July (Krutzsch 1955), parturition dates vary extensively (Barbour and Davis 1969), and births are not synchronous, even within colonies (Cockrum 1960). Juveniles with open epiphyses were captured in mid-August in Yosemite National Park, and in the Coast Range in mid-September (Pierson and Rainey 1996b). An individual, still identifiable as a juvenile, was also captured in the Coast Range in late November (L. Thompson pers. comm.). A lactating female was caught in Anza Borrego Desert State Park in early July, and a series of lactating females in Yosemite Valley in early September (Pierson and Rainey 1996b, c). In a different year, a post-lactating female was caught in Wawona, Yosemite National Park in mid-August (Pierson and Rainey 1995). A series of animals killed by the San Bernardino County Health Department on August 20, 1992, included five

post-lactating females, and three juveniles with open epiphyses (P. Brown pers. comm.).

E. perotis is colonial, but colony size is generally small (fewer than 100 animals) (Barbour and Davis 1969). Howell (1920a) considered even 20 to be a large roost. Although maternity roosts for most bat species contain only adult females and their young, *E. perotis* colonies contain adult males and females at all times of year (Krutzsch 1955).

E. perotis emerges after dark, and its audible call can be heard flying every hour of the night. The animals are strong, fast fliers, with a likely extensive foraging range. The species has been heard in open desert, at least 15 mi (24 km) from the nearest possible roosting site (Vaughan 1959). Given the frequency with which multiple animals are detected together or in rapid succession, it is possible this species sometimes travels or forages in groups. Generally they move through an area fairly rapidly. An interval of intense acoustic activity will frequently be followed by silence, and foraging will not predictably reoccur at the same site on sequential nights.

The diet appears to be primarily moths (Lepidoptera). Ross (1967) reports that a sample of eight *E. perotis* from Arizona had eaten only large Lepidoptera (up to 60 mm) and a few Homoptera. Easterla and Whitaker (1972) found that in 18 specimens, almost 80% of the diet was Lepidoptera, and the rest predominantly Gryllidae and Tettigoniidae. At one locality in Arizona, 58% of the diet consisted of small (about 8 mm) hymenopterous insects (Ross 1961). In California, it appears that *E. perotis* feeds predominantly on moths (Lepidoptera), but also includes beetles (Coleoptera) and crickets (Gryllidae) in its diet (Whitaker et al. in prep.)

Habitat: 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. It is found in a variety of habitats, from desert scrub to chaparral to oak woodland and into the ponderosa pine belt.

E. perotis is primarily a crevice dwelling species. Natural roosts are often found under large exfoliating slabs of granite, sandstone slabs or in columnar basalt, on cliff faces or in large boulders (Dalquest 1946, Krutzsch 1955, Vaughan 1959). A number of roosts have also been located in appropriately proportioned cracks in buildings (Howell 1920a, Barbour and Davis 1969). Roosts are generally high above the ground, usually allowing a clear vertical drop of at least 10 ft (3 m) below the entrance for flight (Vaughan 1959, Barbour and Davis 1969). Roosts recently located in California were in exfoliating granite, sandstone, or columnar basalt (Pierson and Rainey 1996b). In all cases the bats are in a crevice at least 3.5 m above the ground.

Due to its audible echolocation call, *E. perotis* can be readily detected in foraging areas. In California, it is most frequently encountered in broad open areas. Its foraging habitat includes dry desert washes, flood plains, chaparral, coastal sage scrub, oak woodland, open ponderosa pine forest, grassland, and agricultural areas.

Status: Class II. Recent surveys have shown that *E. perotis* is more widely distributed, particularly in the Sierra Nevada foothills, than was previously realized (Pierson and Rainey 1996b). The discovery of a number of new localities was likely due to improved detection techniques (i.e., monitoring distinctive audible echolocation), rather than an expanding geographic range. Although researchers had made reference to the audible calls of *E. perotis* (e.g., Vaughan 1959), this characteristic had not been previously used as a survey tool.

Assessing the status of *E. perotis* populations presents certain challenges. Unlike many species

which exhibit great roost fidelity, and whose status can be tracked by monitoring colony size at roost sites (e.g., *Corynorhinus townsendii* and several *Myotis* species [Stihler and Hall 1993, Pierson and Rainey 1996a]), *E. perotis* may occupy roost sites in an unpredictable fashion. Krutzsch (1948) followed the Barrett Junction roost over a period of 11 years, and the population varied from 10 to 60 at comparable times of year. Certain roost sites, or series of roost sites, may be critical to particular populations, but not enough is known about the roosting ecology of this species to determine roosting patterns.

An absence of historical records makes it impossible to assess current trends for this species in most areas. In the recent surveys, a paucity of detection events along the north rim of the Los Angeles basin, in an area relatively rich in historic records, does suggest population declines. Although there was a very large colony (200-300 animals) in Azusa in the 1960s, there was no evidence acoustically that the species still occurs in Azusa, nor in the adjacent drainage leading into the San Bernardino Mountains. Likewise, no bats were detected in repeated acoustic surveys in Altadena and Pasadena. A roost in Highland, which had 40-50 adults in 1969 (D. Constantine pers. comm.), had only three bats in September 1992. With the exception of the north rim of the Los Angeles basin, *E. perotis* was detected in most sampled areas for which there were historic records.

There are a number of potential threats to the roosting and foraging habitat of *E. perotis*, which are discussed in detail in Pierson and Rainey (1996b). The following is a summary:

Urban/suburban Expansion. The loss of foraging habitat in the Los Angeles basin is likely primarily responsible for what appears to be a decline in *E. perotis* populations in this area. The numerous creek drainages flowing into the Los Angeles basin from the San Bernardino and San Gabriel mountains provided the kind of floodplain, desert wash vegetation, which appears in other settings to be ideal foraging habitat for this species. Most of that habitat has now been lost to urban/suburban development and associated watercourse channelization.

In San Diego County, for example, where houses are situated among boulder jumbles, people can be brought into close contact with these bats, which due to their size and loud vocalizations, are evident when present. Thus colonies in close proximity to human dwellings become vulnerable to disturbance and vandalism of their roosts.

Pest Control Operations. Extermination of colonies by pest control operators and public health departments has also been responsible for the elimination of many *E. perotis* in the Los Angeles basin. In this area, where building roosts are relatively more common, these large and noisy bats are very vulnerable to the hysteria which often surrounds bat colonies. K. Stager (pers. comm.) described a situation in a building near the Los Angeles County Museum in which "3 wash tubs full" of *E. perotis* were killed by exterminators in the 1950s. The only two recent colonies known for the Los Angeles basin (a school in Rancho Cucamonga and the Norco City Hall) came to our attention because both colonies were eliminated by public health officials.

Water Storage and Development. The same canyons which offer suitable cliff habitat for *E. perotis* also provide basins for storage reservoirs and other water projects. Almost every river which drains the west side of the Sierra Nevada has one or more such reservoirs. It is almost certain that roosting and foraging habitat has been lost at many of these sites (e.g., Hetch Hetchy Reservoir), and is threatened at others (e.g., Los Banos Creek). *E. perotis* has also frequently been detected foraging in the vicinity of reservoirs (e.g., Tulloch Lake, Lake Kaweah, Lake Success), so it is also possible that reservoirs create foraging habitat. The situation needs further evaluation.

Highway Projects. For obvious reasons, substantial cliffs generally occur where they have been carved by river systems. River drainages, because they frequently offer the easiest routes through mountain ranges, are also favored corridors for highway construction. Such construction commonly entails blasting of cliff faces, either for initial highway construction or later improvements (i.e., widening and straightening). Since bats are frequently overlooked in the environmental assessment process, cliff roosting species, such as *E. perotis*, are at risk of both direct impacts from blasting, and long-term loss of roosting habitat from cliff modifications.

Recreational Climbing. There has been an exponential increase in recreational rock climbing in the west in recent years. A recent informal survey by personnel at Yosemite National Park has documented 3,000 new climbing routes within the park, where the unsanctioned use of various technical aids has made previously unclimbable areas accessible (Dept. of Resource Management, Yosemite National Park, pers. comm.). The popular sites, such as El Capitan in Yosemite Valley, literally experience climbing traffic jams, with 20-30 climbers on the face at once. Similarly, columnar basalt cliffs, which occur along the western base of the Sierra Nevada, until recently considered too hot and unpleasant for climbing, have experienced increasingly heavy use since about 1990. Although no information is available regarding what proportion of the crevices used by climbers offer suitable roosting sites for *E. perotis*, it is reasonable to presume that hands or temporary climbing aids inserted into a roost crevice would be cause for disturbance and possible abandonment of a site. If climbers camp overnight on ledges beneath roosts, noise and light could potentially disturb nursery sites. Also, climbers may alter cliff habitat, dislodging unstable rock and clearing ledges.

Mining and Quarry Operations. Mining and quarry operations which impact cliff habitat could potentially remove roosting habitat for *E. perotis*. Additionally, the noise generated by active mining and quarry operations could disturb roosting bats. Quarries may create cliffs, however. One of the colony sites monitored by Vaughan (1959) was in a quarry west of Riverside.

Grazing/Meadow Management. Whereas a number of bat species appear to forage predominantly over water, or along vegetation edges (e.g., riparian zones, forest edges), *E. perotis* frequently forages in open areas, including meadows. To the extent that excessive grazing and trampling of meadows by livestock alters the insect productivity (particularly for lepidopterans), it may impact the foraging habitat of *E. perotis*, and could adversely affect local populations.

Pesticide Spraying and Environmental Contaminants. Pesticides have been shown to have detrimental effects on bat populations (Clark 1981, Clark et al. 1978, 1983). Persistent chlorinated hydrocarbons are now banned. While the shorter half-life organophosphates, now in wide use, are known to have negative impacts on raptors (Wilson et al. 1991), their effect on bats has not been investigated. Short-term neurotoxic insecticides could be lethal or impair maneuverability, leading to reduced foraging efficiency and increased vulnerability to predators. Lepidopteran-specific agents like *Bacillus thuringensis* result in significant, if short-term, reduction in the prey base for species like *E. perotis* that rely heavily on moths (Sample et al. 1993).

Sensitivity to Human Disturbance. No data are available on the sensitivity of *E. perotis* to human disturbance. Most bat species, however, are sensitive to human intrusion into roost sites, particularly during the maternity season.

Management Recommendations: Recent surveys expanded the known range of *E. perotis*, and suggest that additional surveys should be conducted, particularly in the Coast Range, at higher altitudes in the Sierra Nevada, and on the east side of the Sierra Nevada.

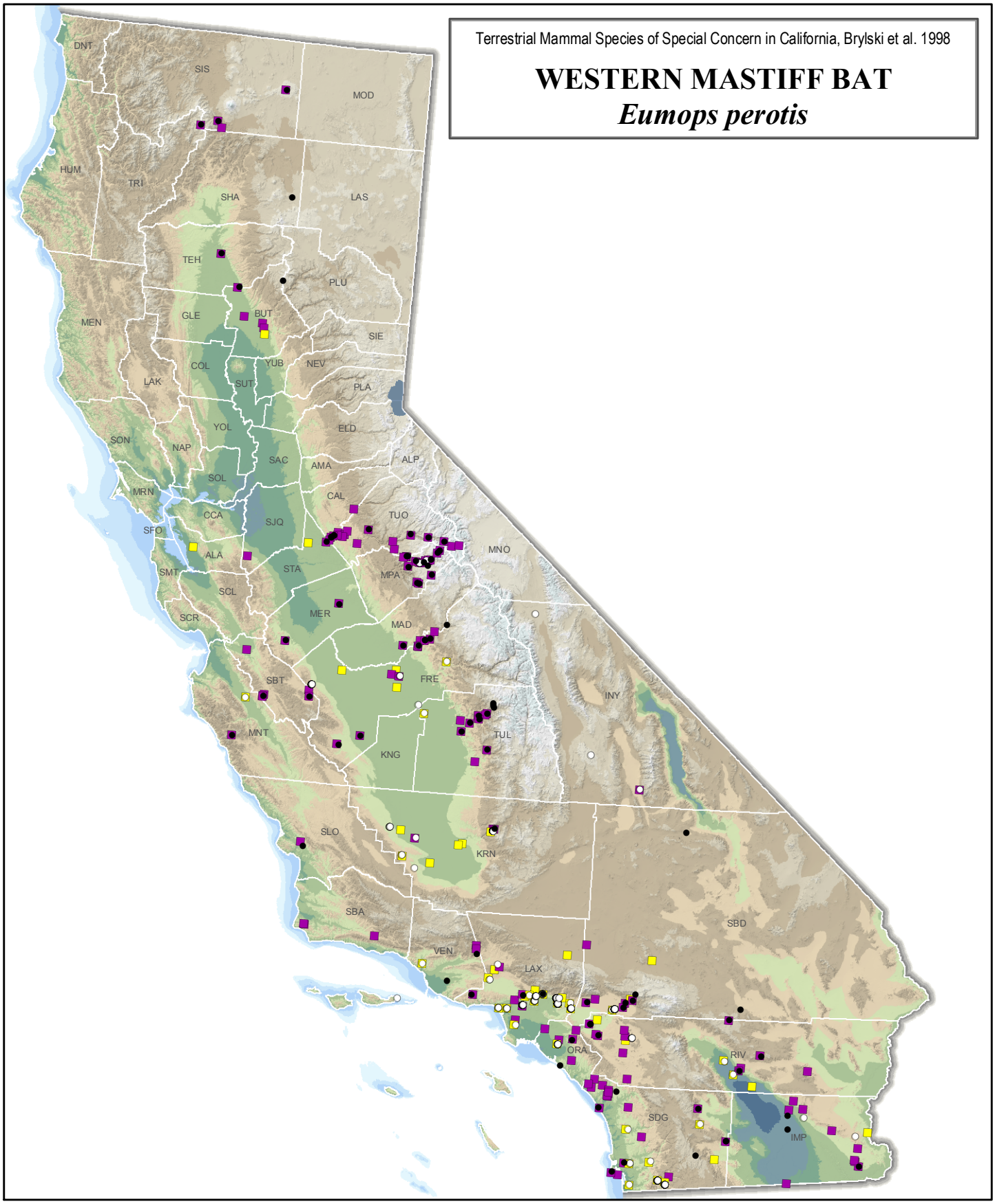
More information is needed on the spatial and temporal distribution of populations. It is not known how loyal colonies are to particular roost sites, and thus whether single roost sites, or roosting areas need to be monitored and protected. Studies need to be conducted to assess the impact of certain human activities, particularly recreational climbing, in the vicinity of roost sites.

Recent surveys identified a number of significant populations. Methods need to be developed for assessment and ongoing monitoring of population size.

Terrestrial Mammal Species of Special Concern in California, Brylski et al. 1998

WESTERN MASTIFF BAT

Eumops perotis



Locations verified by authors
(captures, observations, museum records)

- • Post - 1978
- ○ 1978 and before
- ■ CNDDB 1979 -1998
- ■ CNDDB 1978 and before

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