

For each plant or animal addressed by the Plan, a *Species Account* was prepared. The Supergroup approved the list of 98 plant and animal species to be addressed by the Plan in 1996. The USGS then contracted with experts on each species, who prepared the species accounts for use in development of the Plan. A wildlife biologist or botanist possessing recognized expertise concerning the species in question authored each of these documents. These accounts describe the general status, habitat, life history, distribution, biological goals, and threats faced by each species, as well as a detailed bibliography. All species accounts were peer reviewed.

## **ARGUS MOUNTAINS KANGAROO RAT**

*Dipodomys panamintinus argusensis*

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**Management Status:** Federal: None  
California: None

### **General Distribution:**

The Argus Mountains kangaroo rat is one of five subspecies of *D. panamintinus* currently recognized (Hall, 1981; Intress and Best, 1990; Williams et al., 1993). *D. p. argusensis* occupies a limited range in the Argus Mountains of Inyo County, California. Of the other subspecies, *D. p. mohavensis* is the most widespread, and occupies much of the western half of the WMPA. The subspecies *leucogenys* intergrades with *mohavensis* in the Owens Valley area and ranges north into Nevada (Hall, 1946). The subspecies *panamintinus* occupies a limited range just northeast of the WMPA in the Panamint Range. The subspecies *caudatus* is widely separated from all other subspecies and occupies the Providence Mountains east of the WMPA. Some authors have suggested that the Argus Mountains kangaroo rat is isolated from other subspecies of *D. panamintinus* (Hall, 1981; Williams, 1986; Intress and Best, 1990), while others consider the range of this subspecies to be contiguous with that of *D. p. mohavensis* (Zeiner et al., 1990). *D. p. argusensis* is the only subspecies of the Panamint kangaroo rat for which the karyotype is unknown (Patton and Rogers, 1993), and additional genetic investigation is warranted.

### **Distribution in the West Mojave Planning Area:**

The Argus Mountains kangaroo rat (*D. p. argusensis*) is known only from the vicinity of Junction Ranch in the Argus Mountains (Huey, 1945), on China Lake Naval Air Weapons Station, which is within the WMPA. This location is on the western slopes of the Argus Range, approximately 3 miles SSW of Maturango Peak. No subsequent studies have defined its distribution further than the type locality.

### **Natural History:**

No studies regarding the natural history of the Argus Mountains kangaroo rat have been conducted and much of the following information is gathered from accounts of other subspecies. *D. panamintinus* is medium-sized for the genus, averaging 292 and 288 mm (11.5 and 11.3 inches) in total length for males and females respectively (Intress and Best, 1990). It has five toes on the hind foot. The tail averages 140% of the length of the head and body, is strongly bicolored, and is heavily crested. Dorsal coloration of the body is ashy-gray to brown tinged with cinnamon, while ventral coloration is white. Males are larger than females in most external and cranial measurements (Best, 1993). *D. panamintinus* can be distinguished from *D. deserti*, with which it may be sympatric, by smaller size and five rather than four toes on the hind foot. It can be distinguished from sympatric *D. merriami* by larger size, darker pelage and five rather than four toes on the hind foot, and from *D. microps* by rounded- rather than flat-surfaced incisors. The Panamint kangaroo rat follows a strongly seasonal pattern of reproduction, with a peak in early spring (Laabs et al., 1997).

### **Habitat Requirements:**

The type specimen of *D. p. argusensis* was collected in 1931 at 1745 m (5725 feet), but no specifics are given concerning habitat associations at this locality. Ecologically, the subspecies is expected to be most similar to *D. p. panamintinus* and *D. p. mohavensis*, which inhabit creosote scrub, saltbush scrub, joshua tree woodland and juniper woodland habitats (Intress and Best, 1990). They forage on seeds of forbs, shrubs and grasses (Zeiner et al., 1990) and on the green leaves of forbs (Jameson and Peeters, 1988). The Panamint kangaroo rat generally occupies areas with coarse sand or gravelly soils (Intress and Best, 1990).

### **Population Status:**

Recent data concerning the distribution and status of the Argus Mountains kangaroo rat are lacking. Live-trapping in suitable habitat at the type locality and in the general vicinity is needed to determine the current status of the subspecies. Genetic analysis to establish taxonomic relationships with other subspecies of *P. panamintinus* is also necessary.

### **Threats Analysis:**

The Argus Mountains kangaroo rat occupies a very limited range and is therefore vulnerable to human-related impacts as well as natural stochastic events. The entire range of the subspecies is within the China Lake Naval Air Weapons Station, so public access is limited in the area. Potential threats to *D. p. argusensis* include military operations and recreational use by base personnel. Analysis of human activities in the vicinity of the type locality should be reviewed to determine the degree of these potential threats. Wild horses and burros may pose a threat by removing shrub cover, collapsing burrows and competing for forage.

### **Biological Standards:**

The degree of vulnerability of this subspecies depends in part on the size of its range and the frequency of human impacts. Trapping studies near the type locality and in the potential zone of contact with *D. p. mohavensis* is necessary to clarify current distribution and status. In addition, its habitat requirements need to be more clearly defined. Due to its very small range, conservation efforts must focus on the type locality. Military operations in this area should be reviewed to determine their effects on the subspecies.

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## **NELSON BIGHORN SHEEP**

*Ovis canadensis nelsoni*

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**Management Status:** Federal: None  
California: Fully protected within the WMPA(CDFG, 1998)

### **General Distribution:**

Bighorn sheep were originally distributed from Baja California to Texas in the south to the Canadian Rockies in the north, with the eastern boundary reaching western Nebraska and the western boundary in California extending from Mount Shasta in the north to the crest of the central and southern Sierra Nevada to the Transverse Ranges and the east side of the Peninsular Ranges in the south (Cowan, 1940). Traditional taxonomy dating back more than half a century (Cowan, 1940) broke bighorn sheep from the southwestern desert region into four subspecies, one of which, the Nelson Bighorn (*Ovis canadensis nelsoni*), included bighorn from the Transverse Ranges through most of the desert mountain ranges of California, including the WMPA, and adjacent Nevada and northern Arizona to Utah (Shackleton, 1985). Recent research (Ramey, 1993, 1995; Wehausen and Ramey, 1993) has found a lack of support for Cowan's (1940) desert subspecies and instead has found previously unrecognized north-south variation of the Nelson Bighorn (Wehausen and Ramey, 1993, 1999). The transition between the southern (warm desert) and the northern (cold desert) forms occurs in the middle of the WMPA, with I-15 east of Barstow representing the approximate boundary (Wehausen and Ramey, 1999). Whether these differences warrant taxonomic recognition remains to be determined, but they should be considered in conservation actions where possible and appropriate. However, within the WMPA no populations north of I-15 persist that have not been reintroduced or augmented with sheep from south of I-15.

### **Distribution in the West Mojave Planning Area:**

Within the WMPA, 16 bighorn sheep populations are known to have existed as defined by mountain range complexes, or portions of one of these ranges. Five of these 16 areas no longer contain populations, three have been reintroduced, and two have been augmented with sheep from another population (Bleich et al., 1990a; Table 1, Figure 1). For the past decade, bighorn sheep populations in California have been viewed in a metapopulation context (Schwartz et al., 1986; Bleich et al., 1990b, 1996). Within the WMPA there are three metapopulations whose geographic boundaries are now formed by major fenced highways (I-15 and I-40) -- the south, central, and north Mojave Desert metapopulations (Torres et al., 1994, 1996).

### **Natural History:**

Bighorn sheep have a large rumen, relative to body size (Krausman et al., 1993), which allows digestion of grasses, even in a dry state (Hanly, 1982). This gives them flexibility to select diets that optimize nutrient content from available forage. Consequently, bighorn sheep feed on a large variety of plant species and diet composition varies seasonally and among locations. The nutritional quality of their diet depends on growth activity of forage species and varies greatly

among seasons, years, and locations (Wehausen and Hansen, 1988; Wehausen, 1992a), and is influenced greatly by precipitation and temperature (Wehausen, 1992b).

While diet quality in the Mojave Desert varies greatly among years, it is most predictably high in late winter and spring (Wehausen, 1992a), and this period coincides with the peak of lambing. Desert bighorn have a long lambing season that can begin in December and end in June in the Mojave Desert, and a small percentage of births commonly occur in summer as well (Thompson and Turner, 1982; Bunnell, 1982; Wehausen, 1991). Within the WMPA, the bighorn occurring north of I-15 have a later initiation of the lambing season than those further south (Wehausen and Ramey, 1999; Wehausen, 1991).

The primary breeding season in the WMPA occurs between August and November (Bleich et al., 1997), and the gestation period for bighorn sheep is about 174 days (Hass, 1995).

### **Habitat Requirements:**

Basic to the biology of bighorn sheep is their agility on steep rocky terrain, an adaptation used to escape predators. Short legs, low center of gravity, and general stocky build are components aspects of this adaptation, but compromise fleetness necessary to predictably outrun coursing predators on less precipitous terrain. Consequently, within the desert, preferred habitat of bighorn is primarily on or near mountainous terrain above the desert floor. Also fundamental to the biology of bighorn sheep is the use of eyesight as the primary sense for detecting predators at sufficient distances to assure adequate time to reach safe terrain (Bleich et al., 1990b). Thus, preferred habitat of bighorn sheep is visually open, as well as steep and rocky. Because of scant rainfall and hot summer temperatures that limit most vegetation to low stature, most Mojave Desert mountain ranges satisfy these habitat requirements well.

Radio telemetry studies of bighorn sheep in various southwestern deserts, including the Mojave Desert of California, have found considerable movement of these sheep between mountain ranges (Bleich et al., 1990b). This is especially true of males, but also of ewes (Bleich et al., 1996). Within individual mountain ranges, populations often are small (Table 1). Levels of inbreeding could be high in such populations, but intermountain movements provide a genetic connection with a larger metapopulation, and this will counteract potential inbreeding problems (Schwartz et al., 1986; Bleich et al., 1990b). Intermountain movements also are the source of colonization of vacant habitat, which is fundamental to metapopulation dynamics and persistence. Colonization by ewes is the slow link in this process, but has recently been documented in two Mojave Desert ranges in California (Bleich et al., 1996; Torres et al., 1996). Consequently, intermountain areas of the desert floor that bighorn traverse between mountain ranges are as important to the long term viability of populations as are the mountain ranges themselves (Schwartz et al., 1986; Bleich et al., 1990b, 1996).

Surface water is another element of desert bighorn habitat considered to be important to population health (Turner and Weaver, 1980). Male and female bighorn sheep inhabiting desert ecosystems can survive without consuming surface water (Krausman et al., 1985), and males appear to drink infrequently in many situations (Jaeger et al., 1991; Bleich et al., 1997); however, there are no known large populations of bighorn sheep in the desert region that lack access to surface water.

It is common for males and females to segregate and occupy different habitats outside the breeding season (Bleich et al., 1997). Females tend to choose particularly steep, safe areas for bearing and initial rearing of lambs. In some situations they may even migrate to adjacent

mountain ranges for this purpose (Jaeger, 1994). Areas of steep limestone are commonly preferred lambing areas if available. Males frequently occupy much less precipitous habitat during the lamb-rearing season (Bleich et al., 1997).

### **Threats Analysis:**

Potential threats must be approached from the standpoint of individual populations and metapopulations. Actions that impair the ability of bighorn sheep to move between mountain ranges (e.g. fencing along highways or other boundaries, canals, and high densities of human habitation) will limit the potential for natural colonization and gene exchange, both of which are key to metapopulation viability.

Causes of population losses within the WMPA are unknown. Many bighorn sheep populations have disappeared in California and over much of their range during the past 140 years (Buechner, 1960; Wehausen et al., 1987a). While there is no single cause for these losses, pneumonia contracted from domestic sheep probably has been the greatest factor. All native populations were extirpated from northeastern California, northern Nevada, southwestern Idaho, Oregon, and Washington (Buechner, 1960) -- a region of extensive domestic sheep grazing. Further north in Canada and Alaska, where domestic sheep grazing has not been economical, the distribution of native sheep remains essentially unchanged. The history of bighorn sheep is replete with examples of major die-offs following contact with domestic sheep (Goodson, 1982; Foreyt and Jessup, 1982). Experiments have repeatedly confirmed that bighorn sheep are not compatible with strains of respiratory bacteria that are carried by healthy domestic sheep (Onderka and Wishart, 1988; Foreyt, 1989; Callan et al., 1991). For individual populations of bighorn sheep, domestic sheep grazing has the potential for the greatest devastation if contact with bighorn sheep occurs. This threat will exist anywhere that stray domestic sheep have a possibility of finding occupied bighorn sheep habitat.

Considerable predation by mountain lions (*Felis concolor*) on bighorn sheep has been documented for the Kingston, Clark, and Granite Mountains (Jaeger, 1994; Wehausen, 1996). In the Granite Mountains this caused a steep population decline to very low numbers (Wehausen, 1996). These populations lie just east of the WMPA, but all support populations of native or introduced deer, they primary prey of mountain lions. Deer are absent in almost all bighorn ranges within the WMPA. A notable exception is the San Bernardino Mountains, where considerable lion predation on bighorn sheep has been recently documented and appears to be causing population decline (S. Torres, unpubl. data).

Amounts of fall and winter precipitation strongly influence spring diet quality and reproductive success of bighorn sheep in the deserts of California (Wehausen et al., 1987b; Wehausen, 1992b). Consequently, long drought periods have the potential to cause population declines. However, high survivorship and longevity of ewes where mountain lion predation is lacking will tend to carry populations through such periods of low reproductive success (Wehausen, 1992a).

A disease syndrome has been documented for some bighorn sheep populations in the Mojave and Sonoran deserts of California that results in an unusually high mortality of lambs in spring from pneumonia (DeForge and Scott, 1982; DeForge et al., 1982; Wehausen et al., 1987b). This disease process can persist for many years and result in substantial population declines (DeForge et al., 1995). As with drought, high longevity of females, coupled with a small

amount of recruitment, can carry populations through such episodes, provided that major recruitment pulses occur periodically (Wehausen, 1992a).

The etiology of this disease syndrome is not fully understood. Two gnat-born viruses causing hemorrhagic diseases (bluetongue, BT, and epizootic hemorrhagic disease, EHD), one influenza virus (parainfluenza - 3, PI-3) and a pox virus (contagious ecthyma, CE) have been implicated in this disease process (DeForge et al., 1982), and all but EHD have been isolated from sick lambs (J. DeForge, unpubl. data). In this disease syndrome lambs die of bacterial pneumonia, a secondary infection in a disease process apparently initiated by a virus. It is probable that some of the implicated viruses are also opportunists, rather than initiators. The ultimate cause of this disease process is the initiating organism, but the specific organism remains unknown. Wehausen (1992a) noted for two populations in the Mojave Desert suffering from this disease syndrome that there was a negative relationship between spring diet quality and lamb survival. This is contrary to the expected relationship based on nutrition, and suggests that an insect vector population that benefits from rainfall is involved; thus, the two insect-vectored hemorrhagic viruses are likely candidates. Also supporting this idea of involvement of an insect vector are findings that this disease syndrome can disappear following a very dry year (Wehausen et al., 1987b). This also occurred in two populations following 1990 (Wehausen, 1992a; DeForge et al., 1995). Cattle have long been associated with BT and were thought to serve as the virus reservoir; however, this role of cattle is no longer supported (Barrat-Boyes and MacLachlan, 1995). The role that cattle may play in this disease process that causes high mortality of bighorn lambs is not clear.

Competition for surface water is another factor thought to cause population declines. Usurpation of water sites by humans is an obvious example. Bighorn sheep can show a general social intolerance of large ungulates like cattle (Horejsi, 1975; Wilson, 1975), and the potential influences of cattle and feral burros also have been considered in this light. Both of these non-native species have been inferred to cause bighorn to abandon use of water sources (Dunn and Douglas, 1982; Wehausen, 1988; Dunn, 1993). However, such displacement constitutes competition only if water thereby becomes in short supply for the bighorn resulting in population decline. This has not been documented, and Wehausen and Hansen (1986) and King and Workman (1984) noted that cattle and bighorn largely remain spatially separated due to different habitat preferences. This niche separation is less for burros and, where they occur at high population densities, this feral equid may compete with bighorn sheep for forage and/or water in some situations. However, a negative influence of burros on bighorn sheep demography has not been shown as support for true competition.

Loss of surface water sources within existing and historic bighorn sheep ranges may diminish the viability of existing populations or the potential for successful reintroduction or natural colonization where this species is absent. The influence of the loss of any particular water source will depend on the number of water sources available to bighorn sheep. Water sources can be lost to bighorn sheep due to various causes, including domestic and feral stock use.

### **Biological Standards:**

Bighorn sheep have suffered considerable population declines in the past 140 years, as evidenced by vacant habitat within the WMPA. In addition, metapopulations have been fragmented (Bleich et al., 1996). Long term viability of these metapopulations will be best ensured by preventing further population losses and fragmentation, and by restoring populations in vacant historic habitat. Artificial enhancement of populations (e.g. water developments) may be necessary in some cases to promote natural and induced colonization.

BLM (1992) issued an Instruction Memorandum on the management of domestic and bighorn sheep based on the consensus of a workshop representing all concerned parties. That document stated that:

“No domestic sheep grazing should be allowed within buffer strips less than 9 mi. (13.5 km) surrounding desert bighorn habitat, except where topographic features or other barriers prevent physical contact.”

“Domestic sheep trailed and grazed outside the 9 mi. (13.5 km) buffer and in the vicinity of desert bighorn ranges should be closely managed and carefully herded.”

These recommendations should be adhered to with the goal of preventing any contact between domestic and bighorn sheep to prevent further losses of populations from this cause.

Key water sources within current and historic bighorn sheep habitat should be closely monitored and enhanced as needed to ensure reliable provision of water during the summer months. Since water sources may also enhance the populations of predators of bighorn sheep (S. Cunningham, pers. comm.), this should be limited to a number deemed adequate to sustain each bighorn sheep population. Water enhancement in mountain ranges may promote development of large bighorn populations in some situations. These large populations, in turn, may produce natural colonists that reestablish populations in vacant habitat, and provide reintroduction stock to reestablish populations.

Desert bighorn metapopulations in the WMPA have already suffered considerable fragmentation from fenced highways, aqueducts, and losses of some populations (Bleich et al., 1996). Further division of metapopulations should not be allowed and historic habitat should be restocked to maximize connectivity and the number of populations in remaining metapopulations when reintroduction stock is available. Bleich et al. (1990) made specific recommendations on this that apply to the WMPA, and concluded that existing metapopulations can remain viable if adequately managed, including maintenance of intermountain travel corridors. Nevertheless, opportunities to reestablish connections across recent artificial barriers that now define metapopulations should be considered.

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Table 1. Mountain ranges in the WMPA known to have supported bighorn sheep populations, and population status in 1995 (Torres et al. 1994, 1996). Classification codes are: E=extinct; R=reintroduced population; A=augmented native population; N=ative population.

<b>Mountain Range</b>	<b>Classification</b>	<b>Size</b>
<b>A. North Mojave Metapopulation</b>		
Coso	E	0
Argus/Slate	R	51-100
Eagle Crags	R	<25
Granite/Quail	E	0
Avawatz	A	51-100
Soda	E	0
<b>B. Central Mojave Metapopulation</b>		
Cady	N	25-50
<b>C. South Mojave Metapopulation</b>		
Bullion	R	<25
Newberry/Ord	N	25-50
Rodman	E	0
Sheephole	A	51-100
Pinto	E	0
Queen	N	25-50
Little San Bernardino	N	101-150
South San Bernardino	N	101-150
North San Bernardino	N	<25

## **CALIFORNIA LEAF-NOSED BAT**

*Macrotus californicus*

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**Management Status:** Federal: USFWS Species of Concern  
California: Species of Special Concern (CDFG, 1998)

### **General Distribution:**

The California leaf-nosed bat is the most northerly representative of the Phyllostomidae, a predominantly Neotropical family. This species occurs in the Lower Sonoran life zone in the deserts of California, southern Nevada, Arizona and south to northwestern Mexico (Sonora and Sinaloa) and Baja California (Brown, 1999; Greenbaum and Baker, 1976; Hall, 1981). Earlier in this century, California leaf-nosed bats were collected in several locations across southern California (Anderson, 1969). As recently as 20 years ago, it was observed in south central San Diego County (west of the Laguna Mountains) (P. Brown pers. obs.). Since 1969, Brown has conducted extensive surveys for roosts in southern California. No current roosts are currently known for *Macrotus* outside of the lower elevation desert areas of Imperial, San Diego, Riverside and San Bernardino Counties. The largest colonies are found primarily in the mountain ranges bordering the Colorado River basin, with recent records occurring west to the Eagle Mountains, Riverside County and Anza Borrego (D. Stokes, pers. comm.). A few individual males were found recently in the Avawatz Mountains, south of Death Valley, approximately 160 km north of the next known roost. (Brown and Berry, 2002 data)

### **Distribution in the West Mojave Planning Area:**

The largest roosts of California leaf-nosed bats are located east and south of the WMPA in the Colorado Desert at elevations below 3000 feet (900 m) elevation, and usually in mines in close proximity to desert wash vegetation (Brown and Berry, 1998). A few colonies have been discovered in mines in Joshua Tree National Park and adjacent BLM land on the north edge of Pinto Basin (Brown and Berry, 2000a; Brown, 1993). Directly east of the WMPA, two large colonies are located in mines in the Ship Mountains, one in the Old Woman Mountains and one small roost in the south end of the Bristol Mountains north of Amboy (Brown and Berry 2000b).

### **Natural History:**

The California leaf-nosed bat can be distinguished from all other western bat species by a combination of large ears  $> 0.96$  in ( $>25$  mm), gray pelage and a distinct leaflike projection from tip of the nose, which is erect and lanceolate (Hoffmeister, 1986). Two other bats with leaf-shaped nose projections in California (*Choeronycteris mexicana* and *Leptonycteris curasoae*) have shorter ears.

Unlike vespertilionids, this species neither hibernates nor migrates, has a narrow thermal-neutral zone, and is incapable of lowering its body temperature to become torpid. No special physiological adaptations occur in *Macrotus* for desert existence, and behavioral adaptations such as foraging methods and roost selection contribute to their successful exploitation of the temperate zone desert (Bell et al., 1986). To remain active yearlong in the temperate zone

deserts, *Macrotus* uses warm diurnal roosts in caves, mines and buildings with temperatures that often exceed 80 F (27 C). Depending on the season, they roost singly or in groups of up to several hundred individuals, hanging separately from the ceiling, rather than clustering. Often the bats hang from one foot, using the other to scratch or groom themselves. Most diurnal winter roosts are in warm mine tunnels that are at least 330-ft (100 m) long. At this season, the large colonies of over 1000 bats may contain both males and females, although the sexes may also roost separately. The consistent feature of the areas in the mines used by the bats is warmth and high humidity with no circulating air currents. The temperature of the mines is usually warmer than the annual mean temperature, and the mines may be located in geothermally heated rock formations. Except for the approximately two hour-nightly foraging periods, in winter *Macrotus* inhabits a stable warm environment. Although longevity in this species does not approach the 30 or more years documented for temperate zone vespertilionid bats, banded *Macrotus* in California have been recaptured after 14.5 years (Brown and Berry, 2002).

Utilizing different mines or areas within a mine separate from those occupied in the winter, females congregate in the spring and summer in maternity colonies averaging 100 to 200 bats (Barbour and Davis 1969, Vaughan 1959), although colonies of over 500 and under ten individuals are also found. Usually a single "harem" male is associated with clusters of five to 25 females, even in the larger roosting aggregations. The "harem" males perform wing flapping that appears to be the same as the fall courtship display, and they will drive intruding males away from their cluster. (Brown and Berry 1991). Other roosts will contain only "bachelor" males. . The single young (weighing 25-30% of the mother's mass) are born between mid-May and early July, following a gestation of almost 9 months. This species exhibits "delayed development" following ovulation, insemination and fertilization in September (Creighton and Krutzsch 1985; Bleir 1975; Bradshaw, 1962). In March, with increased temperatures and insect availability, embryonic development accelerates. Since the newborn bats are poikilothermic, the maternity colony is located fairly close to the entrance, where temperatures exceed 90 F (32 C) and daytime outside temperatures can reach over 120 F (49 C) in the summer. This allows the bats to use shallow natural rock caves that would be too cold for a winter roost. In late summer, after the young are independent, the maternity colonies disperse (Brown and Berry, 2002). In the fall, males aggregate in display roosts and attempt to attract females with a courtship display consisting of wing flapping and vocalizations. Aggression between males occurs at this time. The areas used as "lek" sites are usually in or near a mine that had been occupied by a maternity colony (Berry and Brown, 1995).

California leaf-nosed bats feed primarily on large moths and immobile diurnal insects such as butterflies, grasshoppers and katydids, which they glean off surfaces (Anderson, 1969; Huey, 1925; Stager, 1943; Vaughan, 1959). Although *Macrotus* can echolocate, they appear to forage utilizing prey-produced sounds and vision, even at low ambient light levels. The strategy of gleaning larger prey from the substrate as compared to aerial insectivory appears to reduce the total time and energy necessary for foraging (Bell, 1985; Bell and Fenton, 1986). Radio-telemetry studies of *Macrotus* in the California desert show that the bats forage almost exclusively among desert wash vegetation within 2 miles (3.2 km) of their roost. The bats emerge from their roosts 30 or more minutes after sunset, and fly near the ground or vegetation in slow, maneuverable flight (Vaughan, 1959; Brown et al., 1993c). Shallow caves and short mine prospects are used by both sexes as night roosts between foraging bouts at all seasons, except for the coldest winter months. Night roosts are often identified by the large amount of guano and the culled inedible insect remains (lepidopteran and orthopteran wings).

### **Habitat Requirements:**

California leaf-nosed bats occur in lowland Sonoran desert habitat in California below 3000 feet (900 m) in elevation in close proximity to desert wash vegetation (Brown et al 1993b, Brown and Berry, 2002). This species is dependent on either caves or mines for roosting habitat. Occasionally it has been found night roosting in buildings or bridges (e.g., P. Brown and Berry, 2002; Constantine, 1961; Hatfield, 1937), all major maternity, mating, and overwintering sites are in mines or caves. During extensive field investigations of this species over the last 33 years, Brown and Berry (2002) found that almost all currently known day-roost sites are in abandoned mines in California. The exceptions are two small maternity colonies of less than 10 bats in natural small caves. Several caves, which were used earlier in the century and which may have sheltered hundreds of bats (Grinnell, 1918; Howell, 1920), have been abandoned due to human disturbance and development or habitat alteration in the vicinity.

Due to restrictive temperature requirements, California leaf-nosed bats seek out mines that provide roost temperatures of approximately 80 F (27 C). In the summer, bats roost relatively close to the mine portal, often within the twilight zone, since external temperatures in the summer in the low desert usually exceed 100 F (38 C). [PB-These following two sentences are still too close to the State account and need just a little more work] All known winter roosts are in the California Desert are in geothermally heated mine workings and the areas used by the bats may be over a half-mile underground. (Brown and Berry, 2002). Thirty-three years of studies with banded bats indicates that distances traveled between summer and winter roosts are generally within 8 km (Brown et al. 1993b, Brown and Berry, 2002). Different areas of the same mine complex are often used during different seasons. In the fall, particular sites (often in or near the maternity colonies) are utilized extensively for courtship and mating (Berry and Brown, 1995).

In several radio-telemetry studies Brown et al. (1993c) showed that *Macrotus* forage primarily among desert wash vegetation, generally within one to three miles of the roost. The close proximity of foraging areas to the roost is most important in winter, when the bats forage closer to the roost and are above ground for shorter periods than in the summer.

### **Population Status:**

Within the past 50 years, the range of California leaf-nosed bats has contracted, and the species no longer occurs outside of desert habitats in California. A variety of factors have contributed to this decline: the primary factors are roost disturbance and the destruction of foraging habitat, followed to a lesser extent by renewed mining in historic districts and the closure of mines for hazard abatement.

The following draws in part from Brylski et al. (2002). As documented by literature and museum records, this species occurred in western San Diego, northwest Los Angeles, and western Riverside counties at the turn of the century (Grinnell, 1918; Howell, 1920; Krutzsch, 1948). Despite extensive surveys over the past 33 years (Brown and Berry, 2002), almost no *Macrotus* were found at any of the historic localities. A small roost was found near Lake Barrett (in 1978), and three individuals were observed in a natural cave in the Coachella Valley (in 1993), near the current city of La Quinta. The La Quinta roost, reported by Grinnell (1918) to contain at least 300 bats in 1908, is now surrounded near a golf course and luxury homes. Only remnants of desert wash vegetation remain in the vicinity. All of the other historic cave roosts receive heavy recreational use. The complex of caves near the Salton Sea (Bat Cave Buttes) reported to have multiple colonies of up to 200 each early in the century (Howell 1920b) has been heavily vandalized and no longer contain *M. californicus*. The historic roost at Owensmouth on the Los

Angeles/Ventura County line is surrounded by housing developments, and is a local party spot. The Santa Susanna roost is in the middle of a large housing tract. The Santa Margarita Ranch location is now Camp Pendleton, and the historic roosting site has not been located (Brown and Berry 2002)

In California, the surveys of Brown and Berry (2002) documented about 20 maternity colonies, and about the same number of winter roosts. In some cases the winter and summer colonies inhabit the same mine, or they may use different mines within a mountain range. The largest roosting aggregations are found in the mountain ranges along the Colorado River. The largest roosts, with over 2,000 bats each, are in mines in southeastern California along the Colorado River. Recreation use is heavy in the area around the largest winter roost in California where two of the three historic entrances were closed by the claimant for hazard abatement in 1985. This changed the airflow and temperatures in the mine, and made it unsuitable as a maternity roost. The mine has been gated by BLM and is now occupied by almost 2000 leaf-nosed bats, but only in the winter.

The WMPA is at the northwestern edge of the current range of California leaf-nosed bats in California. Several maternity and winter colonies were discovered by Brown (1993, Brown and Berry 2000a) in mines in Joshua National Park and on BLM lands surrounding Pinto Basin. With additional surveys, more roosts might be discovered in the many mines in this area.

### **Threats Analysis:**

Potential threats to the California leaf-nosed bat are usually human-related, and include loss or disturbance to roosts and destruction of foraging habitat (Brown and Berry, 1991b). Almost all known roosts are in warm mines. As with most bat species, human entry can cause the bats to abandon the roost, even if non-volant young are present (P. Brown, pers. obs.). Since *Macrotus* only have a single baby each year, reproductive failure in a population can have serious consequences. Human disturbance of roosts is at least in part responsible for the disappearance of this species from historic cave roosts in Southern California near Chatsworth, Dulzura, La Quinta and the Salton Sea. These colonies were in shallow natural caves that invited human exploration, and they are currently littered with shotgun shells and other trash (Brown and Berry, 2002). Often bats are intentionally disturbed in attempts to kill them or make them fly (P. Brown, pers. obs.). Bats moved into mines after they were abandoned, partially in response to disturbance in caves. Now recreational mine exploration is on the increase, and mines far from roads are now accessible due to the proliferation of off-highway vehicles (OHV). An added incentive for human entry is the growing collectible market for mine artifacts, luring collectors into relatively inaccessible underground areas favored by the bats. Even scientists with valid research permits can disturb colonies if the roost is entered too frequently or at a critical season (i.e. when young are present, P. Brown pers. obs.). At the beginning of the twentieth century, museum collecting took a toll on the few known leaf-nosed bat colonies (Grinnell, 1918; Howell, 1920). Whether the motive is mine exploration, scientific research or intentional vandalism, the result may be permanent roost abandonment.

Closure of abandoned mines for public safety and reclamation is widespread across the United States (Tuttle and Taylor, 1994). Usually closures are conducted near populated or recreational areas, and often without any surveys for bats or other wildlife (such as desert tortoises) using the mine (C. Brown et al., 1993; Brown et al., 1992). Closure can directly entomb bats if conducted during the day. Even if bats are excluded from a mine prior to closing (Brown, et al. 2001; Brown and Berry, 1997), they may not have a suitable alternate roost in the vicinity, and the local population may be extinguished. The mine containing the largest known colony of leaf-nosed bats

in California was almost closed for hazard abatement due to its proximity to a long-term winter campground on BLM land (Brown and Berry, 2002).

In many areas of the western United States, renewed mining in historic districts threatens mine-roosting bats (Brown, 1995a; Brown and Berry, 1997). Most new mining in the United States occurs in historic districts. Contemporary methods of exploration detect deposits missed by prior prospectors. Geologists entering mines to obtain samples may disturb roosting bats. Surface drilling during exploration may penetrate bat roosting areas in mines, and often mine entrances are inadvertently sealed by the bulldozing and blasting activities as drill roads and pads are constructed (Brown, 1995b; Brown et al., 1995b; Brown and Berry, 1997). The roads created to bring in drill rigs are subsequently used by recreational mine explorers to access heretofore remote sites. Mining procedures usually create an open pit and destroy the historic workings. Once a new gold mine is in production, uncovered cyanide ponds and pooled solution on top of heap leech pads can poison bats (Clark and Hothem, 1991). Foraging habitat is often removed during mining. In the Cargo Muchacho Mountains, the American Girl Wash was not mined, but gravel was removed from it to mix with cement, and waste rock dumps covered other portions of the wash. The numbers of leaf-nosed bats in mines not directly impacted by mining in the area declined by 90% (Brown et al., 1995a). At the end of mining, reclamation activities may close any remaining open historic mine workings to alleviate the company of future liability (Brown, 1995b; Brown and Berry, 1997).

No gold mine has ever been stopped by bat issues. In the WMPA, two mines on BLM land north of Pinto Basin contained small colonies of California leaf-nosed bats (Brown, 1993). The claimant wished to remove ore underground by traditional methods. The BLM biologist recommended a seasonal restraint on mining to those times less critical to the bats (T. Egan, pers. comm.). When the claimant threatened suit, all restrictions were removed. In California, the only known leaf-nosed bat roosts closed by renewed mining were in the Picacho and Cargo Muchacho Mountains (P. Brown, pers. obs.), but this situation could change if mining becomes more profitable in historic districts (i.e., the price of gold increases or the cost of extraction decreases). While no large mining operations are currently in the WMPA, renewed activity is always a potential threat to bats roosting in mines.

Since California leaf-nosed bats forage in desert wash vegetation (smoke trees, ironwood and palo verde associations), the loss of this vegetative community can affect the survival of a colony. Radio-telemetry studies (Brown et al., 1993c) have demonstrated the importance of good foraging habitat within close proximity of roosts. Individuals from maternity colonies may forage within 3 miles (4.8 km) of a roost, but during cold winter nights the bats may not fly beyond a mile from the warm mines. Destruction of desert wash vegetation by a mining company adjacent to a winter roost caused abandonment of a mine in the Cargo Muchacho Mountains (Brown et al., 1993a, 1995a).

Although large areas of the WMPA are experiencing human colonization, these do not overlap with the current range of California leaf-nosed bats. Outside the WMPA, urban and suburban expansion has played a role in the elimination of *Macrotus* from areas in Los Angeles, San Diego and Riverside counties (i.e., Coachella Valley). The increase in population and recreational visitation to many desert cities does have a direct relation to the amount of people entering caves and abandoned mines in the vicinity. The urbanization of the Coachella Valley removed foraging habitat for *Macrotus* as desert washes were ripped and channelized (Brown and Berry, 2002; Brown et al., 1993c).

Landfills for urban refuse may be a future concern in the WMPA as the growth in the Antelope Valley demands more waste disposal sites. South of the WMPA, the Kaiser adit in the proposed Eagle Mountain landfill might eventually affect the leaf-nosed bats roosting there. Banding studies have documented that some female bats from a maternity colony in a mine on Joshua Tree National Park roost in the winter in the Kaiser adit (Brown, 1993).

Activities on military installations can effect California leaf-nosed bats through troop entry into mines and the degradation of wash vegetation by vehicular traffic.

### **Biological Standards:**

Mines on the eastern and southern edge of the WMPA should be surveyed for California leaf-nosed bats. Any roosts discovered should be fitted with bat gates following a baseline population assessment at different seasons. Installing gates in mine entrances that permit bat access, but prohibit human entry is the best method to protect the bats and the people (Tuttle and Taylor, 1994). Researchers using night vision equipment should conduct counts of bats exiting the mine at dusk. Periodic monitoring is necessary to determine if the gate has been breached, and if bats are using the mine. An inappropriate gate may discourage bat use, and modifications may be necessary. Sometimes a suitable mine within the range of leaf-nosed bats may not be used because of human disturbance, and gating the mine can encourage bat use. When a leaf-nosed bat colony is identified, limiting OHV activity (e.g., military and civilian) and other development projects in the vicinity (e.g., golf courses, road construction, and wash channelization) should protect desert wash vegetation.

If a mine is going to be destroyed by renewed mining, the best mitigation is to remove the bats from the mine at a non-critical period as determined by prior surveys of the site at all seasons (Brown et al. 2001). If an alternate roost exists off-site, it should be gated to provide secure future habitat. In a few cases (such as the American Girl Mine in the Cargo Muchacho Mountains), new underground habitat has been created and then gated at the end of mining activities (Pierson et al., 1991; Brown et al., 1993a, 1995a).

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## **FRINGED MYOTIS**

*Myotis thysanodes*

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**Management Status:** Federal: USFWS Species of Concern  
California: None

### **General Distribution:**

The fringed myotis ranges across most of Mexico, the western third of the United States and into southern British Columbia (Hall, 1981; Rasheed et al., 1995). This species occurs throughout California from the coast (including San Clemente Island) to over 5400 feet (1800 m.) in the Sierra Nevada. The majority of known localities are on the west side of the Sierra Nevada, although records exist for the high desert and east of the Sierra Nevada. Lactating females were recently captured near Coleville on the eastern slope of the Sierra Nevada (Brown and Berry 1998). One of the largest maternity colonies known for this species was discovered in a mine in the old Woman Mountains in the eastern Mojave Desert at an elevation of about 2500 feet (800m.) in creosote bush scrub habitat (Brown and Berry 2000).

### **Distribution in the West Mojave Planning Area:**

The fringed myotis typically occurs at higher elevations than found in the WMPA. Desert records for this species are from the Providence, New York and Clark Mountains, and from the Grapevine Range bordering Death Valley. The only record from within the WMPA is an adult male taken in pinyon pine habitat at Barker Dam in Joshua Tree National Park (specimen in MVZ, Berkeley). Although no breeding colonies are currently known from the WMPA, the recent discovery of the Old Woman Mountains roost suggests that with increased survey effort, one may be found in the West Mojave.

### **Natural History:**

The following draws partially from Brylski et al. (2002).

The fringed myotis is one of the larger *Myotis* species, the name referring to a well-developed fringe of hair on the posterior edge of the tail membrane. Like the long-eared myotis, (*Myotis evotis.*), it has relatively large ears, although the former species has no fringe on the tail membrane (Barbour and Davis, 1969)

Like other North American vespertilionids, fringed myotis mate in the fall after the maternity colony has disbanded. Sperm are stored in then uterus over the winter and ovulation, fertilization and implantation occur in the spring, followed by a pregnancy of 50-60 days. In a New Mexico colony, the birth of the single young occurred between 25 June and 7 July (O'Farrell and Studier, 1973). Parturition apparently takes place much earlier in California. In Napa County, females in late stage pregnancy have been captured in early May, and 10-14 day old juveniles have been found by the third week in May (Pierson and Rainey unpubl. data). The young are born without fur, but with their eyes open. They are capable of limited flight by 16.5 days postnatally, and full flight at 20.5 days (O'Farrell and Studier, 1973).

In some parts of the western United States, nursery colonies of several hundred adults occur (Barbour and Davis, 1969), and the colony in New Mexico studied by O'Farrell and Studier (1975) contained 1000-2000 individuals. Recent research on California colonies have documented only 10-20 adults (Pierson and Rainey, unpubl. data), although one colony of over 200 adults was found in a house at Big Bear Lake in the San Bernardino Mountains (P. Brown, pers.obs.). Another large colony, consisting of 200-300 bats was recently located in a mine in the Old Woman Mountains of the East Mojave Desert (Brown and Berry 2000). Large colonies have not been observed in the winter in California. Hibernating fringed myotis have been found in buildings and mine tunnels along the coast near the San Francisco Bay and in the coast range north of San Francisco. The few winter records suggest that the species is not migratory.

The diet of the fringed myotis appears to vary across its geographic range (Brylski et al. (2002)). In New Mexico, Black (1974) found that beetles were the primary prey, while in western Oregon (Whitaker et al., 1977), moths were consumed by three out of four animals examined. The diet also included phalangids (harvestmen), gryllids (crickets), tipulids (crane flies), and araneids (spiders). These non-flying taxa in the diet suggest a foraging style that relies at least partially on gleaning. Along the upper Sacramento River in California, fecal material collected from one fringed myotis contained predominantly coleopterans (beetles) and hemipterans (bugs, Rainey and Pierson, 1996).

### **Habitat Requirements:**

The following draws partially from Brylski et al. (2002).

As varied as the prey consumed is, the wide range of habitats occupied by fringed myotis, from desert scrub to high elevation conifer forest (O'Farrell and Studier 1980). Barbour and Davis (1969) found it to be one of the more common species in oak forest at 4500-5400 ft (1,500-1,800 m) elevation in the Chiricahua Mountains. Jones (1965) found fringed myotis occurred almost exclusively in evergreen forest over 6000 ft (>2,000 m) elevation in a study in the Mogollon Mountains of New Mexico and Arizona... This species was found predominantly at the highest elevation sampled, 7800 ft (2,600 m), in a long- term study in western New Mexico (Jones and Suttkus 1972).

In California, the relatively few records come from diverse habitats. The earliest specimens for the state (Grinnell, 1933) were collected between 1000 and 2700 feet (360 and 900 m) elevation, and Orr (1956) reviewed records from two localities near the coast (Carmel in Monterey County and Woodside in San Mateo County). Museum specimens exist for pinyon/juniper habitat in the higher elevation desert mountain ranges (Providence, New York, Kingston and Clark Mountains of San Bernardino County). Recent surveys in Southern California have documented their occurrence in coniferous forests in the San Bernardino, San Gabriel, and Laguna Mountains (P. Brown, pers. obs.; Simons et al. 2002, in prep.). The largest maternity colony currently known in California is in a mine in creosote bush scrub in the East Mojave Desert (Brown and Berry 2000). Other research in the upper Sacramento River (Rainey and Pierson, 1996), and the Sierra Nevada below 6000 feet (Pierson and Rainey, unpubl. data) have found fringed myotis in mixed deciduous/coniferous forest and in both redwood and giant sequoia habitat.

Fringed myotis roost in rock crevices, caves, buildings and mines (Barbour and Davis, 1969; O'Farrell and Studier, 1980; Simons et al., 2002). In California, most roosts have

been found in buildings (e.g., Orr, 1956), including the type locality at Old Fort Tejon (Miller, 1897). The only cave in California for which there are multiple records is Clough Cave in Sequoia National Park (Brylski et al. 2002), although other western states, maternity colonies occupy caves (e.g., Baker, 1962; Easterla, 1966; Judd, 1967). Mines are cave analogues. Pierson and Rainey (pers. comm.) located two small maternity roosts in mines (ca. 10 adult females each) in the coast range north of San Francisco. P. Brown (pers. obs.) discovered a maternity colony of about 50 adults in a mine in the southern Sierra foothills in Kern County, and the roost of 200-300 adults in the mine in the Old Woman Mountains (Brown and Berry 2000).

Radio-telemetry provided a means to locate hidden roosting bats in a study in the Laguna Mountains of San Diego County (Miner et al., 1996). Five roosting fringed myotis were discovered in separate rock crevices on cliff faces. One post-lactating female roosted in a south-facing cliff face in chaparral and commuted nightly almost 7.9 miles (12.8 km) and 2000 feet (700 m) to forage in higher elevation black oak and Jeffrey pine forest. Other radio-tracking research within the past few years in Oregon and Arizona has documented that this species also roosts in tree hollows, particularly in large conifer snags (Cross and Clayton 1995, Chung-MacCoubrey 1996). Recently in California, (Pierson and Rainey unpubl. obs.) located a small colony in a hollow redwood tree in the Carmel Valley. Tree roosting would explain the observed association between fringed myotis and heavily forested environments in the northern part of its range (M. Brigham pers. comm., Cross et al. 1976, E. Pierson and W. Rainey pers. obs.).

This species is often captured at the entrances to night roosts in buildings, mines and caves (Barbour and Davis, 1969). Lactating females were mist netted entering a mine in the Castle Mountains in the Eastern Mojave Desert (P. Brown, pers. obs.). In a five year study on the upper Sacramento River, fringed myotis (although one of the least commonly encountered bats) were more readily detected at bridge night roosts than in netting surveys conducted over water (Pierson et al., 1996).

### **Population Status:**

Museum records suggest that the fringed myotis is widely distributed across California; it is always one of the rarest species in netting and night roost surveys in a number of localities, (Pierson et al. 1996). Historic records document only six maternity sites: two in Kern County (including the type locality at Old Fort Tejon), and one each in Marin, Napa, Tuolumne, and Tulare counties. Surveys by Brylski et al. (2002) since 1990 at four of these sites have shown that although the roost structures are still available, they are no longer occupied by fringed myotis. The limited data available suggest serious population declines. Not only have historic maternity colonies disappeared, but those remaining appear to contain significantly fewer animals (Pierson, 1998). For example, a Napa County roost documented by Dalquest (1947) to contain about 50 animals in July 1945 (of which 40 were collected at that time), in June 1987 had only 10-15 animals, and in August 1988 none were found. The building that housed the bats was near a new winery and had increased human activity in the vicinity. This species appears to be extremely sensitive to disturbance at roost sites and to human handling, more so than other species of *Myotis* (like the Yuma myotis). Another maternity colony of 40-50 bats in a mine in the Kern River Canyon is no longer occupied by fringed myotis, probably due to increased human entry (P. Brown, pers. obs.). The owners subsequently excluded a roost of over 200 adults located by P. Brown (pers. obs.) in 1991 in a house in Big Bear. Since no roost sites are known from the WMPA, the population status there is

difficult to assess. However, very few desert mines have been adequately surveyed. Since a large maternity colony was recently discovered in the mine in the Old Woman Mountains (Brown and Berry 2000), with increased survey effort, roosts may be discovered in the WMPA.

### **Threats Analysis:**

Within the WMPA, the threats to potential colonies of fringed myotis would be human entry or disturbance of roost sites in mines and buildings. While no roosting populations of fringed myotis have been identified in the WMPA, they may be at risk from closure of old mines for hazard abatement, and renewed mining in historic districts (Belwood and Waugh, 1991; Brown and Berry, 1991,1997; Altenbach and Pierson, 1995; Riddle, 1995; Tuttle and Taylor, 1994). Bats roosting in human-occupied buildings are often in danger of eviction. Potential conflicts are created between the goals of historic preservation, public access, and wildlife protection when fringed myotis occupy historic buildings, such as at Old Fort Tejon and two other historic buildings owned by the California Department of Parks and Recreation.

In the past, scientific collection may have contributed to the extirpation of the colony at Point Reyes National Seashore, and possibly the colony at Old Fort Tejon. While museum records are valuable in documenting past distribution, historic collecting practices appear to have harmed some populations. This species appears to be slow to recolonize areas (Brylski et al. 2002). For example, 16 fringed myotis were collected from a maternity roost in a cave in Sequoia National Park in 1951. Although this species has been mist-netted in the vicinity of this cave, heavy recreational use and vandalism of gates have probably prevented bats from roosting there recently.

While not an issue in the WMPA in some forested settings, current timber harvest practices might threaten fringed myotis populations that rely heavily on tree cavities as roost sites (Brylski et al. 2002).

### **Biological Standards:**

The distribution and habitat requirements of the fringed myotis throughout California need to be investigated. In the WMPA, bat surveys of abandoned mines should be conducted, especially prior to any closure activities. Given the intolerance of the fringed myotis to human disturbance, surveys need to be conducted with caution to avoid impacting the bats. Restricting human access to caves and mines would make a significant difference for a number of bat species, including fringed myotis. Known roosts should be protected and the populations monitored.

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## **LONG-LEGGED MYOTIS**

*Myotis volans*

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**Management Status:** Federal: USFWS Species of Concern  
California: None

### **General Distribution:**

The long-legged (or hairy-winged) myotis occurs throughout the western third of the United States, north to British Columbia and south to central Mexico (Grinnell, 1918; Hall, 1981; Warner and Czaplewski, 1984). This species is found in a variety of habitats throughout California, from the coast to high elevation in the Sierra Nevada and White Mountains. Although no records exist for the low desert areas of southeastern California, they occur in the mountains of the Mojave Desert, central San Diego County, the Coast Range, and the transverse ranges between the Los Angeles basin and the Central Valley (Brylski et al. 2002).

### **Distribution in the West Mojave Planning Area:**

The long-legged myotis typically occurs at higher elevations than those found in the WMPA, although females have been captured in the late summer at Lower Covington Flat (5000 feet elevation [1500 m]) and Quail Springs (3600 feet elevation [1080 m]) in Joshua Tree National Park (1950 MVZ records). Other Mojave Desert records for this species are from the Providence, New York and Kingston Mountains. In early April 1997, a dead long-legged myotis from Inyokern was given to the Maturango Museum. From April to early May, pregnant females have been found roosting in the historic building at Coso Hot Springs on NAWA China Lake and have been captured in mist nets around the edge of Owens Lake (P.Brown pers. obs.). They depart the area by summer prior to parturition, presumably for higher elevations in the Sierra Nevada Mountains. In the fall, both males and females have been captured at Haiwee Springs on NAWA China Lake.

### **Natural History:**

The long-legged myotis is a relatively large member of this genus, with a forearm of about 1.6 inches (37-41 mm). Also known as the hairy-winged myotis, it is distinguished by the presence of fur on the underside of the wing membrane, extending from the body to a line between the elbow and the knee, and relatively short, rounded ears (Warner and Czaplewski, 1984; Hoffmeister, 1986).

As with other North American vespertilionids, this species mates in the fall and/or winter. The females store sperm over winter, ovulate in the spring, and give birth to a single young in the late spring or early summer. In some areas, maternity colonies may contain several hundred females (Barbour and Davis, 1969). Considerable variation has been noted in time of birth across the species' range, with pregnant females being found from mid-April until mid-August (Warner and Czaplewski, 1984; Dalquest and Ramage, 1946) and lactating captured in mid-August in northern California (Brylski et al. 2002; Rainey and Pierson, 1996).

Although long-legged myotis consume mostly moths (Lepidoptera), they have been documented eating a variety of soft-bodied invertebrates and small beetles (Warner and Czaplewski, 1984). In southern Oregon, they appear to feed on spruce budworm moths, a forest pest (M. Perkins, pers. comm.).

### **Habitat Requirements:**

The long-legged myotis appears to be the most forest-dependent of any of the California *Myotis* species (Brylski et al. 2002). Although occurring from sea level to almost 10000 feet (3200 m), this species is usually found between 6000 and 9000 feet (2000-3000 m) in coniferous montane forests (S. Cross, pers. comm.; Jones, 1965; Jones and Suttkus, 1972). In California, Pierson and Rainey (cited in Brylski et al. 2002) have captured long-legged myotis in the high desert (e.g., Providence Mountains), redwood forest along the central coast, giant sequoia forest in the Sierra Nevada, mixed conifer forest in the upper Sacramento River drainage, and lower elevations in the Sierra Nevada. In recent surveys in the White Mountains, Szewczak et al. (1998) found it to be the most abundant species in summer net captures at 8000 feet (2700 m). P. Brown (pers. obs.) has netted pregnant *M. volans* around Owens Lake in April and May, but not during the summer months. Since museum specimens document them at higher elevations (up to 10000 feet) above Lone Pine in the eastern Sierra Nevada in the summer, this species probably migrates altitudinally.

Long-legged myotis roost in abandoned buildings, mines, rock crevices and trees (Barbour and Davis, 1969; Warner and Czaplewski, 1984). P. Brown (Brown and Berry 1999) has discovered maternity colonies in mines in the Hualapai Mountains in Arizona, and in the Stillwater and Humboldt Mountains in central Nevada (Brown and Berry 2002). Recent telemetry studies suggest that this species may roost primarily in trees, particularly large diameter conifer snags (Pierson and Rainey, 1996), or live trees with lightning scars. Colonies have been found in live and dead ponderosa pine in New Mexico (Chung-MacCoubrey, 1996), in ponderosa snags in South Dakota (Cryan, 1996) and in large snags and hollow cedar trees in the Central Oregon Cascades (Ormsbee, 1996).

Observations of long-legged myotis indicate that they forage along the forest edge, primarily above the canopy, in openings in the forest and 10-15 ft (3-5.4 m) over water (Barbour and Davis, 1969; Fenton and Bell, 1979; Saunders and Barclay, 1992). In California, a single individual radio-tagged in the Upper Sacramento River drainage appeared to feed above the canopy and along the river and tributary stream corridors (Rainey and Pierson, 1996).

### **Population Status:**

The relatively few museum specimens for the long-legged myotis in California document reproductive females at only five localities, all pre-dating 1955 (Brylski et al. 2002). These include a maternity colony numbering approximately 500 females in June 1945 at Old Fort Tejon in Kern County, that is now gone (Dalquest and Ramage, 1946). In July 1954, D. Constantine (pers. comm.) collected 40 long-legged myotis (including 16 mature females) from a colony of over 100 in Sonoma County. Returning to this site in September 1968, he found approximately 25 bats in another structure. The original building in which the bats were found has been renovated, and it is unknown whether this

species currently occurs in this area (Brylski et al. 2002). In the late 1800s, Miller (1897) collected 72 specimens in Nicasio, Marin County. Extensive netting at nearby Point Reyes National Seashore in recent years has yielded only a single male long-legged myotis (G. Fellers pers. comm.). Although, individual reproductive females have been captured recently at a number of localities in California, no maternity roosts for this species have been located in the past 40 years. P. Brown (pers. obs.) found a group of pregnant females in a building at Coso Hot Springs in Inyo County in April of 1980 and early May 1984, but the animals departed prior to parturition. This transient site is the only known roost for *Myotis volans* in the WMPA and has not been visited recently.

### **Threats Analysis:**

Historic museum collecting provides information on the distribution of maternity colonies, but it may have contributed to their abandonment. Since the majority of the current records for the long-legged myotis are from forested areas in California, one of the greatest threats is from timber harvest practices, which favor selective removal of large diameter trees without adequate snag retention/snag recruitment guidelines (Brylski et al. 2002). The aerial spraying of pesticides may pose a serious risk to the long-legged myotis and other forest species. Henny et al. (1982) showed that the carcasses of this and four other bat species showed post-spraying residues of DDT metabolites following a single DDT spray application for the Douglas fir tussock moth (*Orgyia pseudotsugata*) in northeastern United States in 1974. The residues were still detectable in tissue three years later. Although the long-term impact on bat populations (e.g., survivorship or reproductive success) were not assessed in this study, other research has correlated bat population declines to application of pesticides (e.g., Geluso et al., 1976; Clark et al., 1978). Short-term neurotoxic insecticides could be lethal or impair maneuverability, leading to reduced foraging efficiency and increased vulnerability to predators. Biological controls like the lepidopteran-specific agent *Bacillus thuringiensis*, may result in significant, short-term reduction in the prey base for lepidopteran specialists like the long-legged myotis (Sample et al., 1993).

Within the WMPA, the only known transient roost for the long-legged myotis is in a decaying historic building at Coso Hot Springs on NAWA China Lake. Since other buildings and mines in this area may also shelter colonies, degradation or destruction of buildings or mine closure without surveys at various seasons could impact this species.

### **Biological Standards:**

The distribution and habitat requirements of the long-legged myotis throughout California needs to be investigated, especially the location of winter refugia and maternity colonies. In the northern WMPA, bat surveys of abandoned mines and historic buildings should be conducted, especially prior to any closure activities or renovations. Additionally, if these bats are mist-netted in an area, radio-tracking studies are needed to identify roost sites and foraging areas.

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## **MOHAVE GROUND SQUIRREL**

*Spermophilus mohavensis*

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**Management Status:** Federal: None  
California: Threatened (CDFG, 1998)

### **General Distribution:**

The Mohave ground squirrel occupies portions of Inyo, Kern, Los Angeles and San Bernardino counties in the western Mojave Desert. The species ranges from near Palmdale on the southwest to Lucerne Valley on the southeast, Olancho on the northwest and the Avawatz Mountains on the northeast (Gustafson, 1993).

The species is one of two members of the subgenus *Xerospermophilus*, which also includes the round-tailed ground squirrel (*Spermophilus tereticaudus*) of the eastern Mojave and Sonoran deserts (Hall, 1981; Nowak, 1991). The ranges of the two species are in contact along a broad front, although they do not overlap (Best, 1995). There is some evidence that the species hybridizes near Helendale (Wessman, 1977), but the area in question is ecologically disturbed, which may have resulted in the breakdown of behavioral isolating mechanisms (Hafner and Yates, 1983). Analysis of chromosomal and genetic data supports the separation of *S. mohavensis* and *S. tereticaudus* as full species (Hafner and Yates, 1983).

### **Distribution in the West Mojave Planning Area:**

Virtually the entire range of the Mohave ground squirrel is within the WMPA. The following description is based on a review of all known locality records conducted by CDFG and adopted by the Mohave Ground Squirrel Working Group in 1992 (Gustafson, 1993). The species ranges from Palmdale on the southwest north to Olancho. The species occupies canyons in the eastern foothills of the Sierra Nevada up to 5600 ft. (1706 m). In the northwest, the species occupies the Coso Range and Argus Range. The northeast part of the range extends to the Avawatz Mountains and Soda Mountains. The Mojave River roughly marks the southeastern extent of its range, although the species historically occupied an area east of the Mojave River as far as Lucerne Valley. The southern edge of the distribution of the species is limited by the abrupt rise of the San Bernardino and San Gabriel Mountains. Although the species likely occupied the Antelope Valley historically, widespread conversion of native habitats has apparently resulted in the extirpation of the species from west of Palmdale and Lancaster. Recent trapping records and observations are lacking in the southern portion of the range, between Palmdale and Lucerne Valley, and persistence of the species in this highly developed area is in question (Gustafson, 1993).

### **Natural History:**

The Mohave ground squirrel is a medium-sized ground squirrel that measures 8.3-9.1 in. (210-230 mm) in total length, 2.2-2.8 in. (57-72 mm) in tail length, and 1.3-1.5 in. (32-38 mm) in hind foot length (Hall, 1981). There is little difference in size between the sexes. Dorsal coloration is uniformly light gray or brown, often with a wash of cinnamon or pink, while ventral coloration is creamy. The ears are small and the eyelids are white. *S. mohavensis* can be distinguished from *S. tereticaudus* by a shorter, flatter tail with a white ventral surface and brown rather than white cheeks. It is significantly larger than *S. tereticaudus* in most cranial measurements (Best, 1995).

Mohave ground squirrels feed on a variety of foods, but primarily on the leaves and seeds of forbs and shrubs. The diet varies greatly over the course of a season. Leaves of perennial shrubs make up a large part of the diet, and are consumed with greater frequency when annual plants are not available. If herbaceous annuals become available, Mohave ground squirrels forage on their leaves, flowers, seeds and/or pollen. Invertebrates are consumed regularly, but make up a relatively small proportion of the diet. Shrub species that were consumed most often at the Coso study area were winterfat (*Krascheninnikovia lanata*), spiny hopsage (*Grayia spinosa*) and saltbush (*Atriplex* sp.; Leitner and Leitner, 1998). However, it is not known if the results of this study can be extrapolated to the more southerly portions of the range of the species. Additional research concerning the food habits of Mohave ground squirrels in the southern portion of its range is clearly required.

The Mohave ground squirrel exhibits a strongly seasonal cycle of activity and torpor. The species typically emerges from hibernation in early- to mid-March (Leitner and Leitner, 1998). The timing of emergence appears to vary geographically, and individuals in the southern portion of the range may emerge as early as mid-January (Recht, unpublished data). Males typically emerge up to two weeks prior to females (Best, 1995). Once a sufficient amount of fat has been accumulated, individuals enter a period of aestivation and hibernation (Bartholomew and Hudson, 1961). Aestivation generally begins anytime between July and September, but during drought conditions, may begin as early as April or May (Leitner, et al., 1995).

The reproductive success of the Mohave ground squirrel is dependent on the amount of fall and winter rains. A positive correlation between fall and winter precipitation and recruitment of juveniles the following year has been demonstrated (Leitner and Leitner, 1998). Following low rainfall, annual herbaceous plants are not readily available, and the species may forego breeding entirely (Leitner and Leitner, 1998).

Adults of the species are solitary except during breeding, which occurs soon after emergence from hibernation. Gestation lasts 29-30 days, and litter size is between four and nine (Best, 1995). Juveniles emerge from natal burrows within four to six weeks. Mortality is high during the first year (Brylski, et al., 1994). Females will breed at one year of age if environmental conditions are appropriate, while males do not normally mate until two years of age (Leitner and Leitner, 1998).

Individuals may maintain several home burrows that are used at night, as well as accessory burrows that are used for temperature control and predator avoidance. The aestivation burrow is dug specifically for use during the summer and winter period of dormancy (Best, 1995). Burrows are often constructed beneath large shrubs (Leitner, et

al., 1995). Home ranges of adults vary between years and throughout a season, presumably as a result of variation in quantity and quality of food resources. Juveniles are gregarious and initially stay close to the natal burrow. Beginning in June, juveniles begin making exploratory movements away from the natal burrow, and some individuals eventually disperse (Brylski, et al., 1994). Recent radio-telemetry data suggest that females are more likely than males to remain in the vicinity of their natal burrows (Harris et al., 1997). During this study, the majority of radio-collared juvenile males moved greater than 0.6 mi. (1 km), up to a maximum of 3.9 mi. (6.2 km; Harris, et al., 1997). These distances are far greater than had been previously recorded.

### **Habitat Requirements:**

The Mohave ground squirrel occupies all major desert scrub habitats in the western Mojave Desert. It has been observed in habitats described by Holland (1986) as Mojave Creosote Scrub, dominated by creosote bush (*Larrea tridentata*) and burrobrush (*Ambrosia dumosa*), Desert Saltbush Scrub, dominated by various species of saltbush (*Atriplex*), Desert Sink Scrub, which is similar in composition to saltbush scrub, but is sparser and grows on poorly drained soils with high alkalinity, Desert Greasewood Scrub, with very sparse vegetation generally located on valley bottoms and dry lake beds, Shadscale Scrub, which is dominated by *Atriplex confertifolia* and/or *A. spinescens*, and Joshua tree woodland, which includes Joshua trees (*Yucca brevifolia*) widely scattered over a variety of shrub species (Gutafson, 1993). These habitat types are distributed throughout the range of the Mohave ground squirrel. In the northern portion of the range of the Mohave ground squirrel, it is found in a plant association described as Mojave Mixed Woody Scrub, typically occurring on hilly terrain and composed of a variety of shrub species (Holland, 1986).

The Mohave ground squirrel inhabits flat to moderate terrain and is not generally found in steep contours. However, juveniles can apparently traverse steep terrain during dispersal (Leinter, pers. comm.). The species has been found most frequently in sandy, alluvial soils, but is also found in gravelly, and occasionally rocky soils (Wessman, 1977; Zembal and Gall, 1980; Best, 1995). It is not known to occupy areas of desert pavement (Aardahl and Rousch, 1985).

Critical habitat features center on availability of food resources and soils with appropriate composition for burrow construction. The presence of shrubs that provide reliable forage during drought years may be critical for a population to persist in a particular area. In the Coso Range, spiny hopsage (*Grayia spinosa*), winterfat (*Krascheninnikovia lanata*) and saltbush (*Atriplex* sp.) were consumed extensively in the early spring before annuals were available, during the summer after annuals dried, and during drought years (Leitner and Leitner, 1998). However, critical forage plants in the southern portion of the range of the species may be different, and further investigation is warranted.

### **Population Status:**

Determining the status of the Mohave ground squirrel is difficult due to behavioral and demographic aspects of the species. The species is inactive throughout much of the year, and abundance as well as the period of surface activity varies from year to year.

Live-trapping studies must be scheduled carefully and even then cannot necessarily establish the absence of the species from a site (Gustafson, 1993). Further, Mohave ground squirrel populations are dependent on the amount of fall and winter precipitation (Leitner and Leitner, 1998). If poor conditions persist for several seasons, local extirpation can occur. Re-colonization of these areas can take place after conditions favoring reproduction resume. Therefore, suitable habitat can be unoccupied during some years but occupied during others (Gustafson, 1993).

The Mohave ground squirrel is not distributed continuously throughout its range (Gustafson, 1993). This was true prior to widespread conversion of habitats within its range. The dynamic nature of its distribution, both spatially and year-to-year, makes accurate estimates of overall population size impractical.

### **Threats Analysis:**

The primary cause of the decline of the Mohave ground squirrel is destruction of its habitat and conversion to urban, suburban, agricultural, military and other uses (Gustafson, 1993).

Urbanization has resulted in the loss of native habitats, particularly surrounding the cities of Palmdale/Lancaster and Victorville/Adelanto/Hesperia/Apple Valley. Urban development has accelerated in recent years in these and other areas, such as Mojave, California City and Ridgecrest. Urban development can result in the direct mortality of individuals and loss of habitat, but also in indirect effects such as fragmentation of the remaining habitat, increased on- and off-highway vehicle use, and increased abundance of domestic and feral cats. Local extirpations can result in the loss of genetic variability for the species as a whole, which can lead to a reduced ability to adapt to environmental change (Meffe, et al. 1997). Although Mohave ground squirrels have been observed at the edge of urbanization (e.g. Barstow), it is highly unlikely that the species can persist in urban settings.

Agricultural development has resulted in the loss of occupied and potential habitat in large areas, notably the western triangle of the Antelope Valley, Lucerne Valley and the Mohave River Basin. Agriculture affects the species through conversion of habitat, exposure to pesticides and herbicides and increases in California ground squirrel populations (Wessman, 1977).

Military operations, including weapons testing and troop training, have disturbed or destroyed habitat in certain areas, most notably on Fort Irwin. Energy development, including geothermal and solar energy development, has resulted in habitat loss for Mohave ground squirrels, and several such projects are under consideration.

Fragmentation of habitat resulting from the activities outlined above is another factor in the decline of the Mohave ground squirrel (Gustafson, 1993). Conversion of habitat results in the isolation of populations from one another, which leads to reduced gene flow. Small, isolated populations are subjected to the loss of genetic variation, which may ultimately lead to a reduction in fecundity, growth and survivorship (Meffe, et al. 1997). Small populations face a greater probability of extirpation, resulting from either environmental variation, fluctuations in abundance, or genetic factors such as inbreeding depression and genetic drift (Noss and Cooperrider, 1994). Moreover, if the habitat is

isolated from other blocks of habitat, natural re-colonization of the habitat can not take place.

Degradation of native habitats is another cause of the decline of the Mohave ground squirrel (Gustafson, 1993). Activities associated with increased human occupation include garbage dumping, off-highway vehicle use, and livestock grazing. Food resources available to Mohave ground squirrels occupying degraded habitat will be reduced, resulting in smaller litter size and lowered population levels. Off-highway vehicle use is prevalent in many areas within the range of the Mohave ground squirrel, in both designated and undesignated areas. Off-highway vehicles result in the mortality of individuals, collapsing of burrows, removal of shrubs used for cover, decrease in annual species used as forage, and changes in soil structure (Bury, et al., 1977). Grazing by cattle and sheep occurs throughout the range of the Mohave ground squirrel, and has been taking place for more than a century. Grazing by livestock may affect Mohave ground squirrels through changes in soil and vegetative structure, accelerated erosion, and collapsing of burrows. Persistent grazing pressure has resulted in the replacement of perennial grasses by annual grasses throughout much of the western Mojave Desert. At the Coso study area, overlap in the forage consumed by Mohave ground squirrels with that consumed by both sheep and cattle has been demonstrated (Leinter and Leitner, 1998). Competition for certain shrubs could be exacerbated during times of drought because alternative sources of food are not available. Shrub cover required by the Mohave ground squirrel for thermoregulation and protection from predators can be reduced by grazing pressure (Gustafson, 1993).

The effects of drought are another threat to the Mohave ground squirrel (Gustafson, 1993). Low rainfall leads to reduced productivity of annual plants. This, in turn, can cause Mohave ground squirrels to forego breeding, and can reduce the survivorship of adults. If drought events are prolonged, extirpation of Mohave ground squirrels from an area can result. In itself, drought events would not threaten the species, since it has adapted to these conditions. However, habitat fragmentation and degradation can prevent natural recolonization of habitat from which local populations have been extirpated.

### **Biological Standards:**

Given the temporal and spatial variation in Mohave ground squirrel abundance, protection of large areas of native habitat is likely needed to ensure long-term survival. The size and location of preserve areas should be based on biological, demographic and genetic considerations. Mohave ground squirrel abundance is known to fluctuate widely in response to rainfall patterns. Moreover, during extended droughts, lower quality habitat may not be capable of supporting the species, and local extirpation can occur. However, these areas can be re-colonized by dispersing individuals when conditions favoring reproduction return. Therefore, core preserve areas must be large enough to support sufficient numbers of individuals to account for natural fluctuations in abundance. Further, it is critical that core reserves are situated in high quality habitats in which the species can persist during drought conditions. These "drought refugia" provide sources from which populations may expand under better conditions.

To determine appropriate preserve area size and localities, accurate data regarding demographics and habitat requirements are necessary. The most comprehensive research concerning population dynamics, food habits and habitat requirements of the Mohave ground squirrel has been gathered at a long-term study site in the Coso Range of Inyo County (Leitner and Leitner, 1998). A major result of this study is that certain shrub species appear to be important in providing forage during years when annual forb growth is low. These shrub species may be critical to the persistence of populations through years of drought. However, data gathered at Coso is primarily from a habitat (Mojave Mixed Woody Scrub) that is somewhat atypical of the bulk of the range of the species. Research into food habits and critical habitat features in creosote bush scrub and saltbush scrub habitats more typical of the southern part of the range is necessary to identify critical habitat features. A minimum preserve size of 60,000 acres of suitable habitat has been calculated (Gustafson, 1993).

Smaller preserve areas are not preferable due to consequences that arise from small population size. In general, small, isolated populations are at higher risk of local extirpation resulting from demographic and environmental stochastic events as well as from the genetic consequences of small population size, including loss of genetic variability, genetic drift and inbreeding depression. Smaller areas are also more susceptible edge effects and disturbance from surrounding non-compatible land use (Meffe, et al., 1997).

Connectivity between preserve areas is critical to ensure that populations inhabiting reserves are not isolated and that gene flow between populations is maintained. The width of such corridors between preserves should be based on demographic considerations including home range size and average dispersal distances.

As with all rare species, it is important to preserve naturally occurring genetic variability to the greatest degree possible (Meffe, et al., 1997). Data regarding genetic variation between populations of Mohave ground squirrels are currently lacking. Areas that show genetic differentiation from other populations, if there are such, should be prioritized for protection in order to preserve genetic variability of the species as a whole. Research investigating genetic hierarchies among populations of the Mohave ground squirrel is necessary to address this concern.

Human activities within preserve areas and corridors need to be assessed, managed and monitored. Certain activities are incompatible with maintaining optimal habitat for Mohave ground squirrels and should be eliminated. Other activities may be compatible at lower levels. Grazing by domestic livestock in Mohave ground squirrel habitat may reduce the availability of annual herbaceous plants and perennial forage species that are important to Mohave ground squirrels. Therefore, grazing in designated Mohave ground squirrel preserve areas should be carefully controlled or eliminated. Off-highway vehicle activity can negatively affect the frequency of shrubs critical to Mohave ground squirrel foraging and burrowing and have other direct and indirect effects. Such activities should be controlled or eliminated in Mohave ground squirrel preserve areas.

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## **MOJAVE RIVER VOLE**

*Microtus californicus mohavensis*

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**Management Status:** Federal: USFWS Species of Concern; BLM Sensitive  
California: Species of Special Concern (CDFG, 1998)

### **General Distribution:**

The Mojave River vole, also referred to as the Mojave River meadow mouse, is one of 17 named subspecies of the California vole, *Microtus californicus* (Hall, 1981). In California, the species ranges throughout the Coast Ranges, the Cascade Range, the Sierra Nevada with the exception of high elevations, the Central Valley, the Transverse Ranges and south into portions of Baja California. The subspecies *mohavensis* occupies moist habitats along the Mojave River. The Owens Valley vole (*M. c. vallicola*) occupies a disjunct range in the Owens Valley and is also considered a California Species of Special Concern. The Amargosa vole (*M. c. scirpensis*) occupies a small, disjunct range along the Amargosa River in the vicinity of Shoshone and Tecopa, and is listed as Endangered under both the State and Federal Endangered Species Acts.

### **Distribution in the West Mojave Planning Area:**

The range of *M. c. mohavensis* is entirely within the West Mojave Management Plan area. The species is restricted to moist habitats along the Mojave River between Victorville and Helendale. Appropriate habitat may also exist upstream of Victorville towards Hesperia (Williams, 1986). The Mojave River vole may intergrade with the Southern California vole (*M. c. sanctidiegi*) near the headwaters of the Mojave River (Kellogg, 1918; Zeiner, et al., 1990). California voles have been captured at other locations in the western Mojave Desert, including Harper Lake (NDDDB), Edwards Air Force Base near Piute Ponds and Rogers Dry Lake (Mitchell, et al., 1993), and China Lake Naval Air Weapons Station, (Kohfield, pers. comm). However, without phylogenetic analysis, it is premature to assign these specimens to a particular subspecies.

### **Natural History:**

The Mojave River vole is a large microtine, measuring 190-214 mm (7.5-8.4 inches) in total length (Kellogg, 1918). The pelage is brown overlaid with longer black hairs above, grayish below. The feet are paler than the rest of the body. The tail is distinctly bicolored; black above, brown below, and averages one-third of the length of the head and body. The eyes are small and the ears are inconspicuous and fur-covered. *M. c. mohavensis* differs from *M. c. sanctidiegi* by darker pelage, smaller ears, and a shortened terminal loop on the third molar (Kellogg, 1918). *M. californicus* can be distinguished from all other members of the genus by the shape of the incisive foramen (Ingles, 1965). However, no other microtines are sympatric with the Mojave river vole.

Mojave River voles construct runways in grassy habitats by clipping vegetation. These runways often lead to shallow burrows in friable soil. Little specific information regarding the natural history of *M. c. mohavensis* is available, and much of the following is taken from accounts of other subspecies. California voles are active diurnally and nocturnally year-round. They forage primarily on the stems and leaves of grasses and forbs, but will switch to grass seeds during the drier parts of the year (Batzli and Pitelka, 1971). Peaks in reproductive activity correspond to times when food and cover are abundant. The gestation period averages 21 days, and litter size ranges between 1 and 11 (Gill, 1979). California voles are a prey species for a variety of predators including diurnal and nocturnal raptors, mammalian carnivores and snakes.

### **Habitat Requirements:**

The Mojave River vole is found in moist habitats including meadows, freshwater marshes and irrigated pastures in the vicinity of the Mojave River. Suitable habitat is associated with ponds and irrigation canals along with the Mojave River proper. Alfalfa fields may also provide habitat (Williams, 1986), although this has not been confirmed. Elevations of known localities range between 750-823 meters (2325-2700 feet).

The closely related Amargosa vole (*M. c. scirpensis*) has been found in marshy areas that are subjected to annual flooding as well as riparian-associated habitats that can provide refuge during annual flooding. They also utilize adjoining upland habitat during unusually high water levels (Thelander et al., 1994).

### **Population Status:**

The current population status of the Mojave River vole is unknown. The amount of freshwater marsh and meadow habitat along the Mojave River has decreased as the result of agricultural and urban development. The rapid development of the Victorville/Apple Valley/Hesperia area has taken place in the historic core area of the subspecies. The Mojave Narrows Regional Park is the only protected land in this core area. To make a better determination of its current population status, updated information regarding the amount of potential and occupied habitat is needed.

### **Threats Analysis:**

The primary threats to the Mojave River vole are the destruction and fragmentation of habitat resulting from agriculture and urbanization. Urbanization adjacent to the Mojave River restricts the availability of upland habitat that may be critical during flood events. Agricultural development affects this subspecies by removing and modifying native habitats. Channelization of surface water and pumping of ground-water may continue to be a significant threat along the Mojave River. Introduction and spread of salt cedar (*Tamarix* sp.) displaces native plants and alters the composition and structure of native plant communities. Competition from introduced house mice (*Mus musculus*) has been identified as a threat to the closely related Amargosa vole (CDFG, 1992). Concentrated off-highway-vehicle use and other surface-disturbing activities also threaten *M. c. mohavensis* by removing vegetation required for foraging and cover. The restricted range of this subspecies makes it susceptible to natural stochastic events such as flooding and drought, and the genetic and demographic consequences of small populations.

Virtually all of the potential habitat along the Mojave River, with the exception of the Mojave Narrows Regional Park, is in private ownership.

### **Biological Standards:**

More detailed data regarding the current distribution, habitat associations and taxonomic relationships of the Mojave River vole is necessary to formulate specific protective measures. However, due to its extremely restricted range, acquisition and conservation of existing, occupied habitat is imperative. Preservation of habitat in the vicinity of known populations in Victorville, Oro Grande and Helendale is essential. All appropriate habitat, especially the meadows and marshes located between Hesperia and Barstow should be identified, mapped and surveyed to determine presence of the species. The taxonomic relationship between *M. c. mohavensis* and other subspecies, including *M. c. sanctidiégi* and *M. c. kernensis* should be determined. Reproductive isolating measures have developed between other subspecies of *M. californicus* that prevent interbreeding (Gill, 1979), and the degree to which the Mojave River vole is reproductively isolated should be determined. The taxonomic relationships of California voles inhabiting Harper Lake, Edwards Air Force Base and China Lake Naval Weapons Station should be analyzed.

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## **PALLID BAT**

*Antrozous pallidus*

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**Management Status :** Federal: USFWS Species of Concern  
California: Species of Special Concern (CDFG, 1998)

### **General Distribution:**

The following draws heavily from Brylski et al. 2002. Pallid bats are known from Cuba, Mexico and Baja California, through the southwestern and western United States, into southern British Columbia. They occur as far east as Kansas, Oklahoma, and Texas, and throughout much of the United States west of the Rocky Mountains (Hall 1981, Martin and Schmidly 1982). In California, the species occurs throughout the state, in a variety of habitats including low desert, oak woodland and coastal redwood forests, extending up to 3,000-m elevation in the Sierra Nevada. The subspecies *Antrozous pallidus pallidus* occurs in the West Mojave planning Area.

### **Distribution in the West Mojave Planning Area:**

Pallid bats are distributed throughout the WMPA in areas of mountains and rocky outcrops. Colonies in mines and historic buildings have been in the Coxcomb Mountains just east of Joshua Tree National Park. Individuals have been mist-netted or their vocalizations recorded in other scattered locations (Brown pers. obs).

### **Natural History:**

This section draws heavily from Brylski et al. 2002.

The pallid bat is a large (forearm = 45-60 mm), long-eared vespertilionid bat. It can be readily distinguished from all other California bat species by a combination of large size, large eyes, large ears, light tan coloration, a pig-like snout, and a distinctive skunk-like odor. Although color varies from very light, almost blonde, in desert populations, to tan along the coast and farther north, the overall impression is of a light colored bat. No other species has fur this light. Compared to other long-eared species, it lacks the nose-leaf found in *Macrotus californicus* or the bilateral nose lumps found in *Corynorhinus townsendii*. *Myotis evotis* is much smaller and has dark, rather than pale colored, ears. *Euderma maculatum*, which also has light ears, can be distinguished by its unique pelage coloration -- black with three large, white dorsal spots.

Pallid bats are colonial, with a typical colony containing 30-70 animals, although colonies of several hundred have been found. Colonies form in the spring (March-May), and stay together until October (Barbour and Davis 1969). These colonies can be bachelor groups, but usually consist of adult females and their young. Pallid bats mate in the fall or winter, and typical of Northern Hemisphere vespertilionids, the females do not actually become pregnant until the spring. They give birth to one or two young in early summer (Orr 1954). Young are born in an altricial state, and are dependent on their mothers for at least 6 weeks. They begin to respond to low frequency vocal communications at about 6 days of age, and have hearing equivalent to that of an adult by

12 days of age (Brown 1976, Brown et al. 1978). The young accompany their mothers when first learning to fly and forage (Brown and Grinnell 1980). Although they are weaned at 6-8 weeks, the young are not self-sufficient until the fall when colonies disperse. Recapture data from the upper Sacramento River drainage suggest that females in that part of California do not reproduce until they are two years old (Rainey and Pierson 1996). Lewis (1993) showed that reproductive success was positively correlated with temperature for a pallid bat population in Oregon. Pallid bats are not known to migrate, and are presumed to spend the winter hibernating close to their summer roosts. No wintering aggregations have been found, although hibernating individuals have been detected close to or in the same structures as the summer roosts (Barbour and Davis 1967, C. Scott pers. comm.). Brown and Berry (2002) have observed a pallid bat in a mine near Fallon, Nevada in winter. The bat was cool, but its eyes were open.

Pallid bats forage primarily on large (20-70 mm) arthropods, caught on the ground or gleaned off vegetation. Prey items include flightless arthropods, such as scorpions (Vejoridae), ground crickets (Gryllacrididae), solpugids (Solpugidae), and darkling ground beetles (Tenebrionidae); largely ground-roving forms, including scarab beetles (Scarabaeidae), predacious ground beetles (Carabidae), carrion beetles (Silphidae), and short-horned grasshoppers (Acrididae); and vegetation dwelling insects, including cicadas (Cicadidae), katydids (Tettigoniidae), praying mantids (Mantidae), long-horned beetles (Cerambycidae) and sphingid moths (Sphingidae) (Hatt 1923, Borell 1942, Barbour and Davis 1969, Hermanson and O'Shea 1983). Between foraging bouts, pallid bats congregate in night roosts in mines, buildings and under bridges where they leave characteristic sign; including remains of scorpions, katydids, sphinx moths, Jerusalem crickets, and/or long-horned beetles which in association with bat guano indicate the presence of pallid bats. It is possible, however, to find pallid bat guano deposits that do not have culled insect parts.

Radio tracking (P. Brown pers. obs.) and the known behavior of favored prey items suggest pallid bats fly close to and land on the ground to capture prey. Light-tagging studies have also documented animals feeding on the wing, 10-20 ft (3-6 m) off the ground (pers. obs.). Although pallid bats use echolocation to assess habitat, they apparently locate prey primarily by listening (Bell 1982). The auditory sensitivity of pallid bats extends into the lower frequency range associated with insect sounds (Brown et al. 1978). Pallid bats have also been reported as visitors to fruits and flowers (Barbour and Davis 1969, Howell 1980). Although they are presumably feeding on insects associated with these plants, they also appear to serve as pollinators of some desert plants (Herrera et al. 1993).

### **Habitat Requirements:**

This section draws heavily from Brylski et al. 2002.

Although pallid bats are frequently associated with desert areas and the Sonoran Life zone (Barbour and Davis 1967, Hermanson and O'Shea 1983), Orr (1954), who studied this species extensively in California, described the species as occurring in a number of habitats, including coniferous forests, nonconiferous woodlands, brushy terrain, rocky canyons, open farm land, and desert. Pallid bats are primarily a crevice roosting species, and select daytime roosting sites where they can retreat from view. Common roost sites are rock crevices, old buildings, bridges, caves, mines, and hollow trees (Barbour and

Davis 1969; Hermanson and O'Shea 1983). Recent radio tracking studies in the Mojave desert at Camp Cady near Mojave have demonstrated that the bats roost not only in crevices in granite boulders, but also between rocks in loosely-cemented conglomerate and in mud solution tubes in badlands formations (Brown et al. 1997). Other radio-telemetry efforts in the west, including California, suggest that pallid bats are far more dependent on tree roosts than was previously realized. They have been located in tree cavities in oak, Ponderosa pine, coast redwood and giant Sequoia (Rainey et al. 1992, Cross and Clayton 1995, Pierson and Heady 1996). On Santa Cruz Island, however, radio-tagged animals selected rock crevices and buildings, despite abundant oak woodland (Brown pers. obs.). They are also one of the species most predictably associated with bridges. They sometimes roost in expansion joints by day, but more commonly are found night roosting, particularly under concrete girder structures (Lewis 1994, Pierson et al. 1996). They are also often associated with buildings, ranging from collapsing barns and historically significant sites (e.g., some of the missions) to some relatively recent structures.

Roost temperature may be a limiting factor in roost selection. Cliff roosting pallid bats in Arizona selected crevices that remained warm and stable (ca. 30° C) in the summer, and tracked ambient temperature fluctuations in spring and fall (Vaughan and O'Shea 1976). Pallid bats are intolerant of roost temperatures above 40° C (Licht and Leitner 1967), and often occupy roosts that offer a varied temperature regime. In attic settings, the animals emerge from crevices to roost on open rafters when roof temperatures become excessive. Pallid bats are very sensitive to disturbance at the roost. When disturbed, they generally retreat into crevices, and with repeated disturbance, may abandon the roost. Their response time is slow, however, making them vulnerable to shooting and other forms of vandalism, and their loyalty to a chosen roost (particularly buildings, mines, bridges) is generally high.

### **Population Status:**

Draws heavily from Brylski et al. 2002. In several areas of California, bat biologists have noted a definite decline in pallid bat populations in recent years. For example, in 1980, four substantial pallid bat roosts were known in Napa County, and two in southern Sonoma County. Only one of these is still occupied, and when last checked, had many fewer animals than in 1980. This decline may be due to the conversion of oak woodlands to vineyards in the Napa Valley. This species, although it will coexist with humans in rural settings, appears to be intolerant of suburban and urban development. P. Brown (pers. obs.) noted precipitous declines in populations in coastal southern California in the 1970s. At that time, only one of 12 roost sites documented by Krutzsch (1948) in the 1940s were still occupied (P. Brown pers. obs.). Destruction of buildings, eradication of bats roosting in public buildings in response to public health concerns and urban expansion likely account for observed declines in Los Angeles, Orange, and San Diego counties. The population status of desert pallid bats is not well documented since they do not congregate in accessible roosts to the extent of the coastal populations. Except for a few colonies in mines, most bats appear to roost in rock crevices, making population estimates and trends difficult to assess.

### **Threats Analysis:**

Potential threats to the pallid bat include loss or disturbance to roosts and destruction of foraging habitat. In the desert, many rock crevice roosts may be difficult to identify, and impacts may be unintentional such as the blasting of rocks for renewed mining, highway construction, and other developments. When the bats occupy mines and buildings, human entry can cause the bats to abandon the roost, even if non-volant young are present. A pallid bat maternity roost in a mine on the east side of the Coxcomb Mountains was deserted after vandals inserted firecrackers into roost crevices.

Roosts in abandoned mines are also at risk due to closure for hazard abatement or renewed mining in historic districts. Closure can directly entomb bats if conducted during the day. Even if bats are excluded from a mine prior to closing (Brown and Berry 1997), they may not have a suitable alternate roost in the vicinity, and the local population may be extinguished. Installing gates in mine entrances that permit bat access but prohibit human entry is the best method to protect the bats and the people. No known pallid bat roost is currently threatened in the WMPA, but renewed activity is always a potential issue to bats roosting in mines. The best mitigation is to remove the bats from the mine at a non-critical period as determined by prior surveys of the site at all seasons. If an alternate roost exists off-site, it should be gated to provide secure future habitat.

In many parts of their range, pallid bats roosting in buildings are excluded by renovations or by the desire of property owners to be rid of them. Because their roosting sites are often highly visible (e.g., open rafters) and the animals display considerable roost loyalty, they are often targeted by pest control operators and vandals. In the name of human safety, public health personnel encourage the removal of bats in buildings. In the urban/suburban areas of the WMPA, pallid bats may roost in structures. Urban expansion has played a role in the elimination of many bat species from areas in Los Angeles, San Bernardino and Riverside counties. In addition to the removal of rock roosting habitat as roads and houses are constructed, the increase in population and recreational visitation to many desert cities does have a direct relation to the amount of people entering abandoned mines in the vicinity. Pallid bats feed on specific ground-dwelling arthropods, which may be affected by development activities. More research on the habitat requirements of prey species is necessary.

### **Biological Standards:**

Mines in the WMPA should be surveyed for *Antrozous*. Any roosts discovered should be fitted with bat gates following a baseline population assessment at different seasons. Researchers using night vision equipment should conduct counts of bats exiting the mine at dusk. Periodic monitoring is necessary to determine if the gate has been breached and if bats are using the mine. An inappropriate gate may discourage bat use, and modifications may be necessary. Sometimes a suitable mine within the range of *Antrozous* may not be used because of human disturbance (i.e. Lead Mountain), and gating the mine can encourage bat use.

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## **POCKETED FREE-TAILED BAT**

*Nyctinomops femorosaccus*

**Author:** Patricia Brown, Brown-Berry Biological Consulting, 134 Wilkes Crest, Bishop, California 93514

**Management Status:** Federal: USFWS Species of Concern  
California: Species of Special Concern (CDFG, 1998)

### **General Distribution:**

Pocketed free-tailed bats have an uneven distribution in the southwestern United States and into mainland Mexico and Baja California with records for southwestern Texas, southern New Mexico, south central Arizona, and southern California (Barbour and Davis, 1969; Hall, 1981; Kumirai and Jones, 1990).

Historic records in California were from Palm Springs in Riverside County (Merriam, 1889), and Anza Borrego (Neil, 1940) and Suncrest in San Diego County (Kruttsch, 1944a; 1945). More recent observations suggest that this species occurs in isolated locations in the southern third of the state (Pierson and Rainey, 1996). Breeding populations, based on captures of reproductive females or juveniles, occur in San Diego County at Anza Borrego State Park and east of San Diego (K. Miner, pers. comm.). Like western mastiff bats, both pocketed free-tailed and big free-tailed bats emit lower frequency echolocation signals that are audible to some people. Based on acoustic data, Brown (pers. obs.) has located additional populations in Painted Canyon (near Mecca) and Lake Mathews (both in Riverside County), on the eastern edge of Camp Pendleton (San Diego County) and in the Cargo Muchacho Mountains (Imperial County).

### **Distribution in the West Mojave Planning Area:**

In the WMPA, the only specimen of pocketed free-tailed bats was a male captured by J. Cornelly at Barker Dam in Joshua Tree National Park in May 1977. Like other free-tailed bats, this species is a strong, fast flier and could have come from roosting populations near Mecca. They could be expected to occur sporadically at lower elevation sites in the WMPA in the vicinity of cliffs and granite boulders.

### **Natural History:**

Pocketed free-tailed bats, like all molossids, have a free tail that extends beyond the edge of the interfemoral membrane. It is slightly larger than a Mexican free-tailed bat, differing from that species by having its ears joined at the midline (Constantine, 1958). A shallow fold of skin or "pocket" on the uropatagium, near the knee, is usually difficult to locate, and should not be relied upon as a distinguishing field characteristic.

The limited data on this species is summarized by Brylski et al. (2002). Like other free-tailed bats, mating occurs in the early spring, with females giving birth to a single young between June and July (Kumirai and Jones, 1990). Lactating females have been captured between July and August and volant juveniles have been taken in early August. With only a limited number of records for pocketed free-tailed bats from California, it is difficult to document seasonal patterns. Kruttsch (1948) documented their occurrence from March through August. This species is present all year in southern Arizona (Gould,

1961; Hoffmeister, 1986), and along the Lower Colorado River (P. Brown, pers. obs.). Recent records from late November suggests the species overwinters in San Diego County (Pierson and Rainey, 1996; K. Miner, pers. comm.).

Research on the diet of pocketed free-tailed bats suggests that they feed primarily on large moths (Sphingidae), but will also consume crickets, grasshoppers, flying ants, froghoppers, and leafhoppers (Easterla and Whitaker, 1972). In another study in Arizona, Ross (1967) found that the stomach of one bat contained only Macrolepidoptera (probably hawk moths), while another from the same locality had consumed 85% Microlepidoptera and 15% Coleoptera.

When emerging from their roosts in the evening, this species frequently makes audible “chattering” communication signals (Krutzsch, 1944b, 1948; Pierson and Rainey, 1996; K. Miner pers. comm.; P. Brown, pers. obs.). During the warm season, they will exit after dark (Gould, 1961; P. Brown, pers. obs.), while in California in November they leave while it is light (K. Miner, pers. comm.).

### **Habitat Requirements:**

Pocketed free-tailed bats are found at lower elevations in a variety of plant associations (Barbour and Davis, 1969; Schmidly, 1991; Easterla, 1973), and in proximity to roosting habitat in granite boulders, cliffs or rocky canyons. In California, it is associated primarily with creosote bush and chaparral habitats of Lower and Upper Sonoran life zones (Krutzsch, 1948). This crevice-dwelling species has occasionally been found in caves (Dalquest and Hall, 1947), and in buildings under roof tiles (Gould, 1961). All roosts in California have been in crevices in cliff faces or granite boulders located at least 10-ft (3.5 m) above the ground (Pierson and Rainey, 1996; K. Miner, pers. comm.; P. Brown, pers. obs.). At one site the, pocketed free-tailed bats shared a larger crevice with western mastiff bats, although they appeared to be roosting separately.

### **Population Status:**

Pocketed free-tailed bats have a limited distribution in southern California, and have never been common. More information is needed on roosting and foraging ecology and seasonal movements before the population status can be accurately determined. As acoustic monitoring methods are refined, more distribution data can be gathered. A few breeding colonies have been identified and these need to be monitored for population trends. In the WMPA, no colonies have been identified.

### **Threats Analysis:**

Any construction activities (e.g., quarry operations, highway projects, water impoundments) that impact cliffs or boulders could potentially affect pocketed free-tailed bat roosts. Recreational climbing may also disturb roosting bats. In the WMPA, rock climbing is an important activity in Joshua Tree National Park. Although no information is available regarding what proportion of the crevices used by climbers offer suitable roosting sites for bats, hands or temporary climbing aids inserted into a roost crevice could cause abandonment of a site.

Pesticides sprayed in agricultural areas in the past have impacted bat populations (Clark, 1981; Clark et al., 1978, 1983). Even non-chemical methods, such as the lepidopteran-

attacking *Bacillus thuringensis*, can reduce the prey base for pocketed free-tailed bat populations which rely heavily on moths (Sample et al., 1993). Since pocketed free-tailed bats forage over a large area, pesticide applications outside of the WMPA could impact bats roosting within the WMPA. Since at least one known roost at Mecca is near an agricultural area, the spraying of pesticides could affect the prey base and inadvertently poison this species.

### **Biological Standards:**

Roost sites, particularly maternity colonies, need to be identified and protected from impacts. The effects of recreational climbing, in the vicinity of roost sites needs to be assessed. This would be of particular importance in areas such as Joshua Tree National Park.

Acoustic cues could be used to determine spatial and temporal distribution, and to define foraging habitat. Like other molossids, however, this species has a variable vocal repertoire, and more documentation of call characteristics in different circumstances is necessary before a protocol can be established for distinguishing between this and other free-tailed species.

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Pocketed free-tailed bats are found at lower elevations in a variety of plant associations (Barbour and Davis, 1969; Schmidly, 1991; Easterla, 1973), and in proximity to roosting habitat in granite boulders, cliffs or rocky canyons. In California, it is associated primarily with creosote bush and chaparral habitats of Lower and Upper Sonoran life zones (Krutzsch, 1948). This crevice-dwelling species has occasionally been found in caves (Dalquest and Hall, 1947), and in buildings under roof tiles (Gould, 1961). All roosts in California have been in crevices in cliff faces or granite boulders located at least 10-ft (3.5 m) above the ground (Pierson and Rainey, 1996; K. Miner, pers. comm.; P. Brown, pers. obs.). At one site the, pocketed free-tailed bats shared a larger crevice with western mastiff bats, although they appeared to be roosting separately.

### **Population Status:**

Pocketed free-tailed bats have a limited distribution in southern California, and have never been common. More information is needed on roosting and foraging ecology and seasonal movements before the population status can be accurately determined. As acoustic monitoring methods are refined, more distribution data can be gathered. A few breeding colonies have been identified and these need to be monitored for population trends. In the WMPA, no colonies have been identified.

### **Threats Analysis:**

Any construction activities (e.g., quarry operations, highway projects, water impoundments) that impact cliffs or boulders could potentially affect pocketed free-tailed bat roosts. Recreational climbing may also disturb roosting bats. In the WMPA, rock climbing is an important activity in Joshua Tree National Park. Although no information is available regarding what proportion of the crevices used by climbers offer suitable roosting sites for bats, hands or temporary climbing aids inserted into a roost crevice could cause abandonment of a site.

Pesticides sprayed in agricultural areas in the past have impacted bat populations (Clark, 1981; Clark et al., 1978, 1983). Even non-chemical methods, such as the lepidopteran-

attacking *Bacillus thuringensis*, can reduce the prey base for pocketed free-tailed bat populations which rely heavily on moths (Sample et al., 1993). Since pocketed free-tailed bats forage over a large area, pesticide applications outside of the WMPA could impact bats roosting within the WMPA. Since at least one known roost at Mecca is near an agricultural area, the spraying of pesticides could affect the prey base and inadvertently poison this species.

### **Biological Standards:**

Roost sites, particularly maternity colonies, need to be identified and protected from impacts. The effects of recreational climbing, in the vicinity of roost sites needs to be assessed. This would be of particular importance in areas such as Joshua Tree National Park.

Acoustic cues could be used to determine spatial and temporal distribution, and to define foraging habitat. Like other molossids, however, this species has a variable vocal repertoire, and more documentation of call characteristics in different circumstances is necessary before a protocol can be established for distinguishing between this and other free-tailed species.

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## **SPOTTED BAT**

*Euderma maculatum*

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**Management Status:** Federal: USFWS Species of Concern  
California: Species of Special Concern (CDFG, 1998)

### **General Distribution:**

Spotted bats occur throughout much of western North America) with their range extending as far north as southern British Columbia (Woodsworth et al., 1981), and as far south as Durango, Mexico (Watkins, 1977). The range map from Hall (1981) does not reflect more recent extensions, including records for western Colorado (Navo et al., 1992), Oregon (McMahon et al., 1981; Barss and Forbes, 1984), and the Klamath Mountains of northwest California (Pierson et al., 1996a; Pierson and Rainey, 1998 submitted). Within this overall range, appropriate roosting habitat determines the species' distribution (Brylski et al. 2002).

"Prior to 1990, the majority of California records (mostly single, dead or moribund animals) came from low elevation, xeric settings (e.g., Red Rock Canyon State Park in Kern County, Mecca in Riverside County, and several from the Indian Wells Valley in Kern County and Owens Valley, Inyo County) (Grinnell 1910, Hall 1939, Constantine et al. 1979, Bleich and Pauli 1988, Brown, pers. obs.)" (Brylski et al. 2002). More recent surveys (Pierson and Rainey, 1998) have detected the distinctive low frequency echolocation signals (audible to many humans) emitted by spotted bats at several sites in the mountains of Shasta and Siskiyou counties. Most of the widely distributed Sierra Nevada localities are around 3500-4000 feet in elevation (ca. 1200-1400 m), but one or more individuals have been heard at several sites up to 8500 ft (2880 m). Other recent auditory detections have been made at Mt. Palomar in San Diego County; and near Bishop, Inyo County. North of Bishop a roost site was discovered in the cliffs at Owen's Gorge (Mono County; P. Brown, pers. obs.).

### **Distribution in the West Mojave Planning Area:**

Within the WMPA, spotted bat specimens exist from Red Rock Canyon (Hall, 1939), China Lake, Inyokern and 29 Palms (Benson, 1954; Brown pers. obs.). The only areas where acoustic records of spotted bats have been reported recently at Red Rock Canyon, where cliff faces provide preferred roosting habitat (K. Miner pers. comm.).

### **Natural History:**

Spotted bat is "distinguished from all other North American species by its unique coloration (three dorsal white spots on a background of black fur), and very large, pinkish-red ears with a white patch at the base of each ear" (Brylski et al. 2002).

Brylski et al. (2002) has summarized available data on the life history of this species. Females roost singly, and give birth to a single young in June or early July (Findley and Jones, 1965; Watkins, 1977). "A pregnant female, captured on June 11, 1969, in a mist net in Big Bend National Park in western Texas gave birth to a single young, which

weighed 4 g (25% mother's weight; Easterla 1971). Lactating females have been caught as early as June 12 in Texas (Easterla 1973)" (Brylski et al. 2002) and as late as early September in Yosemite National Park (Pierson and Rainey, 1996b).

Spotted bats appear to feed primarily on noctuid moths (Ross, 1961; Easterla, 1965; Easterla and Whitaker, 1972). However, in one of these studies, the stomach contents of two individuals were 10-30 % by volume June beetles (Scarabaeidae; Easterla and Whitaker 1972). Solitary foraging bats sometimes maintain exclusive feeding areas (Wong and Fenton, 1982; Wai-Ping and Fenton, 1989; Leonard and Fenton, 1983), and at other times employ a "trapline" strategy (Woodsworth et al., 1981). Individual bats forage in large elliptical paths 15-45 feet (5-15 m) above the ground (Wai-Ping and Fenton, 1989; Navo et al., 1992). Telemetry studies suggest that spotted bats do not appear to night-roost and are active all night, traveling one way distances of 4-7 miles (6-10 km) between roosting and foraging areas each night (Wai-Ping and Fenton, 1989).

Seasonal patterns and movements for this species are not well known. No evidence exists for longitudinal migration. In the colder portions of their range, they have been found hibernating (Hardy, 1941), yet spotted bats are periodically active throughout the winter in southwestern Utah (Ruffner et al., 1979; Poché, 1981), and in the upper Sacramento River drainage of northern California (R. Miller pers. comm.). Sierra Nevada populations probably do not migrate long distances as evidenced by the presence of foraging animals in Yosemite Valley in both midsummer and early November (Pierson and Rainey, 1993). On the east side of the Sierra Nevada, it has been detected frequently at Owens Lake in the spring and fall, but rarely in the summer. The roost in Owen's Gorge is occupied from early spring through fall (P. Brown pers. obs.).

### **Habitat Requirements:**

Throughout their range, spotted bars are found in a variety of habitats from desert scrub to montane coniferous forest (Findley and Jones, 1965; Best, 1988) at elevations from 170 feet (57 m) below sea level (Grinnell 1910) to 9700 feet (3230 m) above sea level (Reynolds 1981). In California, spotted bats have been found in extremely arid areas, such as the Salton Sea (Grinnell, 1910) and Red Rock Canyon (Hall, 1939). Past and current records exist from the Great Basin desert sagebrush community around the Owens Valley (Bleich and Pauli, 1988; J. Szwczak, pers. comm., P. Brown pers. obs.). Numerous reports identify the species from areas dominated by Ponderosa pine (Handley, 1959; Findley and Jones, 1965; Watkins, 1977; Woodsworth et al., 1981), oak savannah (Bleich and Pauli, 1988), or mixed oak/conifer woodland (Pierson and Rainey, 1998). Spotted bats do not appear to roost in trees or forage within forests, although Pierson and Rainey (1998) have found spotted bats feeding over wet, montane meadows from 3600-8700 feet (1200 to 2,900 m) in the Sierra Nevada, in areas with nearby cliffs. Water is also present in the vicinity of all sites where resident populations have been identified (O'Farrell, 1981).

An important habitat component are substantial rock cliffs (Parker, 1952; Medeiros and Heckmann, 1971; Easterla, 1973; O'Farrell, 1981; Berna, 1990; Navo et al., 1992; Brylski et al. 2002), suggesting that the distribution of spotted bats may be limited by the availability of suitable roosting habitat. The species appears to roost in crevices in cliff faces of varied rock types (including granite, basalt, limestone, sandstone, and other sedimentary rock; Easterla, 1970; Easterla, 1973; Poché, 1975; Poché and Ruffner, 1975). In the Okanagan Valley in British Columbia (Leonard and Fenton, 1983; Taylor and Wai-

Ping, 1987), radio-tracking studies suggest that individual spotted bats roost singly in high cliffs, and exhibit high roost fidelity.

Although the preponderance of the records of spotted bats are from cliffs, they have also been discovered roosting in caves and mines. Four spotted bats were observed hibernating in February on the walls of a wet cave in Utah (Hardy, 1941), and others were found in natural caves in Nevada (Soulages, 1966), and Wyoming (WDFG, 1994). A spotted bat was also found in a wet "cave dug into the side of a hill" in San Bernardino County, California (Parker 1952) and in a mine in Sonora, Mexico (Vorhies, 1935).

### **Population Status:**

Although recent surveys by Pierson and Rainey (1996a) have extended the range and identified several new localities for spotted bats in California, they were detected at only one out of nine historic localities surveyed. Yosemite Valley was the only historic locality at which this species was found. At 70 other localities, with apparently suitable roosting habitat, spotted bats were not heard. The results of this survey suggest that spotted bats have a patchy distribution, and are still considered a relatively rare species. In 1996-1997 surveys for spotted bats at the historic locality of Red Rock Canyon, Karen Miner (pers. comm.) heard their echolocation signals on several occasions. "The recent reappearance of *E. maculatum* at this locality may be related to restoration of a flowing creek following tamarisk removal" (Brylski et al. 2002).

### **Threats Analysis:**

Pierson and Rainey (1996a) discussed in detail a number of potential threats to the roosting and foraging habitat of spotted bats. In California, these include the creation of water reservoirs that inundate canyon walls, highway projects in canyon areas, grazing in meadows, pesticide spraying and recreational caving. In the WMPA, one of the potential threats is recreational climbing. There has been an extraordinary increase in recreational rock climbing in the west in recent years, and improving technical aids have made previously unclimbable areas accessible. Some climbers actively alter cliff habitat by dislodging unstable rock and clearing ledges (Brylski et al. 2002). Although no spotted bat roosts are currently identified in the WMPA, it is reasonable to assume that climbing activities in areas such as Joshua Tree National Park might impact roosting bats. Mining and quarry operations that impact cliff habitat might potentially remove roosting habitat, although quarries may in some circumstances create cliff habitat. "Additionally, the noise generated by active mining and quarry operations could disturb roosting bats" (Brylski et al. 2002). Although no true meadow habitats exist in the WMPA, riparian areas that are over-grazed or trampled by livestock and burros could affect foraging habitat for *Euderma* by altering the insect productivity (particularly of lepidopterans).

### **Biological Standards:**

Management priorities should be the identification, monitoring and protection of spotted bat populations. The monitoring of the distinctive echolocation signals will aid in locating roosting and foraging areas, and on the spatial and temporal distribution of populations. Individual roost fidelity should be studied using radio-telemetry to determine if single roost sites, or larger roosting areas need to be monitored and protected. The impact of certain human activities, particularly recreational climbing, in the vicinity of roost sites should be assessed.

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## **TEHACHAPI POCKET MOUSE**

*Perognathus alticola inexpectatus*

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**Management Status:** Federal: USFWS Species of Concern  
California: Species of Special Concern (CDFG, 1998)

### **General Distribution:**

The Tehachapi pocket mouse, also called the Tehachapi white-eared pocket mouse, is one of two subspecies of *P. alticola* currently recognized (Hall, 1981; Williams et al, 1993; Best, 1994). The specific epithet *alticolus* was constructed incorrectly by Rhoads (1894), and continues to be used by some authors. The correct Latin form is *alticola*, as used by Osgood (1900) and explained by Williams et al. (1993), and is the form followed herein.

*P. a. inexpectatus* occupies the Tehachapi Mountains from Tehachapi Pass southwest towards Gorman, as far west as Cuddy Valley near Mount Pinos, and east along the lower slopes of the San Gabriel Mountains to Elizabeth Lake (Williams et al., 1993). The other subspecies, *P. a. alticola*, is known only from outside of the WMPA in the vicinity of Little Bear Valley in the San Bernardino Mountains. It has not been observed for more than fifty years (Williams, 1986).

*P. a. inexpectatus* and *P. a. alticola* occupy geographically disjunct ranges, and it has been suggested that the two are specifically distinct (Sulentich, 1983). *P. alticola* is related to the Great Basin pocket mouse (*P. parvus*), and the yellow-eared pocket mouse (*P. xanthonotus*) based on similar karyotypes, although relatively great biochemical differences occur between *P. i. inexpectatus* and the other two taxa (Williams et al., 1993). The taxonomic relationships between these species still need to be resolved more clearly.

### **Distribution in the West Mojave Planning Area:**

The range of *P. a. inexpectatus* straddles the western boundary of the WMPA between Tehachapi Pass and Sacatara Creek. Much of the western range of the subspecies is outside of the WMPA. The southeastern portion of the range of *P. a. inexpectatus* straddles the border of the WMPA along the northern slopes of the San Gabriel Mountains as far east as Elizabeth Lake. Within the WMPA, the subspecies has been recorded from Tehachapi Pass, Oak Creek Canyon, Cameron Canyon and Elizabeth Lake. Appropriate habitat still remains in Cameron Canyon, but the subspecies was not found during trapping conducted in 1981 (CNDDDB). Appropriate habitat is present within the WMPA along the southeastern flank of the Tehachapi Mountains both north and south of the known localities, and along the northern slopes of the San Gabriel Mountains between Three Points and Elizabeth Lake.

### **Natural History:**

The Tehachapi pocket mouse is medium-sized for the genus, averaging 149 and 164 mm (5.9 and 6.5 in.) in total length for females and males, respectively (Best, 1994). Males are significantly larger than females for most external and cranial measurements (Best, 1993). Coloration is yellowish-brown heavily overlaid with black dorsally, and whitish ventrally. The ochraceous lateral line and dark facial markings are faint. The inside of the ears are whitish, the

patch at the base of the ear is white, and the ear pinna possesses a lobed antitragus. The tail is bicolored, measures slightly more than the head-body length, and is crested along the distal one-third. *P. a. inexpectatus* differs from *P. a. alticola* in larger size, darker ears and a square- rather than pentagonal-shaped interparietal bone. It is distinguished from the Great Basin pocket mouse (*P. parvus*) by its smaller size, more compressed interparietal bone and smaller baculum. The Tehachapi pocket mouse can be distinguished from the little pocket mouse (*P. longimembris*) and the San Joaquin pocket mouse (*P. inornatus*), with which it may be sympatric, by its larger size, less inflated auditory bullae, and relatively broader interorbital breadth.

Little information is available concerning the ecology of the Tehachapi pocket mouse. Other members of the species group are nocturnal granivores, foraging primarily on seeds of grasses, forbs and annuals, but also on leafy plant material and insects (Verts and Kirkland, 1988). Most other members of the genus exhibit seasonal hibernation (Verts and Kirkland, 1988), and it is expected that *P. a. inexpectatus* does as well. It has been suggested that *P. a. inexpectatus* exists in disjunct, allopatric subpopulations (Sulentich, 1983). Given these factors, the subspecies can be difficult to detect, particularly at certain times of the year.

### **Habitat Requirements:**

The Tehachapi pocket mouse occupies native and non-native grasslands, Joshua tree woodland, pinyon-juniper woodland, yellow pine woodland and oak savannah (Williams et al., 1993). It has been captured in open pine forests at higher elevations (Huey, 1926), and in chaparral and coastal sage communities at lower elevations (Best, 1994). It has also been detected in rangeland and fallow grain fields (Sulentich, 1983). It constructs burrows in loose, sandy soils (Zeiner et al., 1990). Elevations range between 1067 and 1829 meters (3500 and 6000 feet).

### **Population Status:**

Very few localities that support the Tehachapi pocket mouse are known. Several historic Tehachapi pocket mouse localities, including Cameron Canyon, were sampled in the early 1980's without success (CNDDDB). However, much of the range of the subspecies within the WMPA is on private land, and probably has not been sampled extensively. Potential habitat exists along the southeastern slopes of the Tehachapi Mountains, and additional trapping is necessary to determine the current distribution of the Tehachapi pocket mouse. Trapping in suitable habitats along the northern slopes of the San Gabriel Mountains between Three Points and Elizabeth Lake is necessary to determine if the subspecies persists in this portion of its range.

### **Threats Analysis:**

Much of the range of the Tehachapi pocket mouse within the WMPA is in private ownership. Livestock grazing is the predominate land-use throughout much of its range. It is unclear how grazing and its subsequent effects on plant diversity and abundance affect the Tehachapi pocket mouse. Many areas within the range of the Tehachapi pocket mouse are used for wind-generated electricity production or have the potential to support wind farms. Such areas are typically crossed by a network of roads, which could lead to increased erosion in steeper terrain. Mineral extraction is another potential threat to the Tehachapi pocket mouse. In general, surface disturbing activities such as mineral extraction are incompatible with persistence of the native small mammal assemblage. Conversion of native habitats to urban use has occurred in the

Elizabeth Lake area. If the subspecies persists in small, scattered populations, it is highly vulnerable to local extirpation resulting from natural or human-related events.

### **Biological Standards:**

Data concerning current distribution and habitat requirements of the Tehachapi pocket mouse are needed to evaluate the status of the subspecies. Trapping studies should be conducted in suitable habitats in the Tehachapi Mountains including Oak Creek Canyon, Bean Canyon, Tylerhorse Canyon and Cottonwood Creek. Suitable habitats along the northern slope of the San Gabriel Mountains between Three Points and Fairmont Reservoir should be sampled to determine if the subspecies occurs there. The extent of suitable habitat and linkages between subpopulations should be identified. In addition, the taxonomic relationship with *P. xanthonotus* needs to be clarified, and trapping in Lone Tree Canyon and the Middle Knob area might reveal a zone of contact between the taxa. Given the scarcity of known, extant populations, conservation efforts, particularly land acquisition, should focus on known locales. Additional information regarding the effects of wind farming, grazing and ORV use on the subspecies needs to be gathered in order to guide conservation efforts.

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## **TOWNSEND'S BIG-EARED BAT**

*Corynorhinus townsendii*

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**Management Status:** Federal: USFWS Species of Concern  
California: Species of Special Concern (CDFG, 1998)

### **General Distribution:**

Townsend's big-eared bats are distributed throughout the western United States, especially in areas with caves and mines (Jones 1965, Jones and Suttkus 1972, Findley and Negus 1953). In California, they are found from sea level along the coast to 6000 feet elevation in the Sierra Nevada Mountains (Dalquest 1947, Pearson et al. 1952, Pierson and Rainey 1996).

### **Distribution in the West Mojave Planning Area:**

Townsend's big-eared bats are found throughout the WMPA in the vicinity of mines and caves. Small numbers of bats have been found in mines at Joshua Tree National Park and in the lava tubes of Pisgah Crater (P. Brown pers. obs.).

### **Natural History:**

Townsend's big-eared bat is a medium-sized bat with buff brown fur distinguished by the combination of a two-pronged, horseshoe-shaped lumps on the rostrum, and large, rabbit-like ears (Barbour and Davis 1969, Kunz and Martin 1982). Although the large ears are obvious in alert bats, they are tightly curled like a ram's horn when animals are in torpor or hibernation (Brylski et al. 2002).

Pierson in Brylski et al. (1998) has summarized the natural history requirements of this species. Big-eared bats form maternity colonies in the spring varying in size from a dozen to several hundred animals. During this period, the females create densely packed clusters (100 bats in a one-foot diameter circle). The timing of the maternity season varies with latitude. In desert areas, colonies begin to form in mid-March (P. Brown pers. obs.), and not until June in interior northern California (G. Fellers pers. comm., E. Pierson unpubl data). The single pups are born between May and July and weigh an average of 2.4 g at birth, which is nearly 25% of the mother's postpartum mass (Kunz and Martin 1982, Easterla 1973, Pearson et al. 1952, Twente 1955, Brylski et al. 2002). Young bats are capable of flight at 2.5 to 3 weeks of age and are fully weaned at 6 weeks. Nursery colonies start to disperse in August about the time the young are weaned (Pearson et al 1952, Tipton 1983).

As in other temperate zone vespertilionids, Townsend's big-eared bats mate in the hibernaculum between October and February (Brylski et al. 2002). The females store sperm in the uterine lining until ovulation and fertilization in the spring. The length of gestation varies with climatic conditions, but generally is 56 to 100 days (Pearson et al. 1952). Females

become pregnant in their first year, and males reach sexual maturity in their second year (Brylski et al. 2002). Only 50% of juvenile bats survive their first year, whereas after that annual survivorship increases to 80% (Pearson et al. 1952). Band recoveries have documented longevity of 21 years, 2 months (Perkins 1995). This sedentary species does not undertake long migrations (Barbour and Davis 1969, Humphrey and Kunz 1976, Pearson et al. 1952). Banding studies (Pearson et al. 1952, P. Brown pers. obs.) have shown seasonal movements of 20 miles.

The diet of California populations of Townsend's big-eared bats has not been analyzed. Brylski et al. (2002) summarized that this species in other areas as a lepidopteran specialist, feeding primarily (>90% of the diet) on medium sized (6-12 mm) moths (Dalton et al. 1986, Ross 1967, Sample and Whitmore 1993, Whitaker et al. 1977, 1981). Shoemaker and Lacki (1993) determined that *P. t. virginianus* differentially selected noctuid moths, with geometrids, notodontids and sphingids also making up a significant portion of the diet. Representatives of the family Arctiidae constituted 37.5% of the available moth prey items, but were not consumed. Sample and Whitmore (1993) identified moth species, the majority of which were noctuids, from wing fragments collected at maternity caves

### **Habitat Requirements:**

Townsend's big-eared bats occur in a wide range of habitats from the low deserts to the cool, moist coastal redwood forests to mid-elevation mixed coniferous-deciduous woodlands. The determining factor in their distribution, however, tends to be the availability of cave-like roosting habitat, as summarized by Pierson in Brylski et al. 1998. Population concentrations occur in areas with substantial surface exposures of cavity forming rock (e.g., limestone, sandstone, gypsum or volcanic) and in old mining districts (Genter 1986, Graham 1966, Humphrey and Kunz 1976, Kunz and Martin 1982, Perkins et al. 1994, Pierson and Rainey 1996). In some areas, particularly along the Pacific coast, it has been found in old, mostly abandoned, buildings with darkened, enclosed cave-like attics and in other anthropogenic structures (e.g., water diversion tunnels and bridges; Barbour and Davis 1969, Dalquest 1947, Howell 1920b, Kunz and Martin 1982, Pearson et al. 1952, Perkins and Levesque 1987, Brown et al. 1994, Pierson and Rainey 1996a).

Temperature as well as morphology defines roost requirements (Humphrey and Kunz 1976, Perkins et al. 1994, Pierson et al. 1991, Lacki et al. 1994, Pearson et al. 1952, Pierson and Rainey 1996). Temperatures in maternity roosts in California vary from 19 C in the cooler regions to over 30 C in the deserts (Pierson et al. 1991, P. Brown pers. obs.). Some colonies change roosts during the maternity season, using cooler roosts earlier in the year, warmer areas during parturition, and then again occupying cooler roosts after the young are volant (Pierson et al. 1991, P. Brown pers. obs., V. Dalton pers. comm.). Sometimes the areas used are within the same mine or cave, but they may also move between sites during the warm season. Interior dimensions are also important, with the majority of the roosts examined in California at least 100 feet long and the ceiling 4 feet high (Pierson et al. 1991). Maternity clusters are always situated on open surfaces, often in raises in the ceiling just inside the roost entrance where warm outside air is trapped (E. Pierson pers. comm., P. Brown pers. obs.)

In the winter, cooler temperatures are required for hibernation sites (Pearson et al. 1952, Barbour and Davis 1969), and the bats may move to caves or mines at higher elevations. Studies in the western U.S. have shown that Townsend's big-eared bats select winter roosts with stable, cold temperatures, and moderate air flow (Humphrey and Kunz 1976, Kunz and Martin 1982). Occasionally bats are found in buildings (Dalquest 1947, E. Pierson pers. obs.). Often mines with multiple entrances at different elevations are used since cooler outside air will be drawn through

the mine by the chimney-effect (Tuttle and Stevenson, 1978). Deep mine shafts in New Mexico sheltered large numbers of hibernating Townsend's big-eared bats (Altenbach and Milford 1991), and may also be important in California (P. Brown pers. obs.). Winter roosting behavior varies with latitude and elevation. In desert areas, mines contain from one to several dozen individuals (P. Brown pers. obs., Barbour and Davis 1969, Pierson et al. 1991, Pierson and Rainey 1996). Larger aggregations (75-460) are confined to areas which experience prolonged periods of freezing temperatures (Pierson and Rainey 1996)

The proximity of good foraging habitat appears to be a determining factor in roost selection. In a recent survey in the Panamint Mountains, mines with suitable temperatures were occupied by maternity colonies only if they were within 2 miles of a canyon with water (P. Brown, pers. obs.). Recent radio-tracking and light-tagging studies have found that Townsend's big-eared bats foraged in a variety of habitats in California. Brown et al. (1994) showed that this species on Santa Cruz Island bypassed the lush introduced vegetation near their day roost, and traveled up to 3 miles to feed in native oak and ironwood forest. "Radiotracking and light-tagging studies in northern California have found *C. townsendii* foraging within forested habitat (Rainey and Pierson 1996), within the canopy of oaks (E. Pierson and W. Rainey unpubl. data), and along heavily vegetated stream corridors, avoiding open, grazed pasture land (G. Fellers pers. comm.)" (Brylski et al. 2002).

In the WMPA, the majority of roosts for this species are in mines. A recent mist-netting and radio-telemetry study in the WMPA at Camp Cady, demonstrated that the Townsend's big-eared bat foraged in the Mojave River riparian corridor and roosted in mud caves of a badlands formation. Lava tubes in the Pissgah Crater flow have also been shown to shelter small numbers of this species (P. Brown pers. obs.).

### **Population Status:**

The following draws heavily from Brylski et al. (2002). Recent surveys conducted by Pierson and Rainey (1996a) for CDFG show marked population declines for this subspecies in many areas of California, and proposed that Townsend's big-eared bats should be recommended for threatened status in the state. As discussed by Pierson in Brylski (2002), there has been a 52% loss in the number of maternity colonies, a 45% decline in the number of available roosts, a 54% decline in the total number of animals, and a 33% decrease in the average size of remaining colonies for the species as a whole across the state over the past 40 years. The status of particular populations is correlated with amount of disturbance to or loss of suitable roosting sites. The populations that have shown the most marked declines are along the coast, in the Mother Lode country, and along the Colorado River.

### **Threats Analysis:**

This section draws heavily from Brylski et al. (2002).

A multi-state conservation assessment and strategy for Townsend's big-eared bats was coordinated by Pierson et al. (1999) with the consensus that a combination of restrictive roost requirements and intolerance of roost disturbance or destruction has been primarily responsible for population declines of Townsend's big-eared bats in most areas. The tendency for this species to roost in highly visible clusters on open surfaces, near roost entrances, makes them highly vulnerable to disturbance. Additionally, low reproductive potential and high roost fidelity increase the risks for the species. Although fire, winter storms, or general deterioration are sometimes responsible, in all but two of 38 documented cases, roost loss in California can be

directly linked to human activity (e.g., demolition, renewed mining, entrance closure, human-induced fire, renovation, or roost disturbance).

The intense recreational use of caves and mines in California provides the most likely explanation for why most otherwise suitable, historically significant roosts are currently unoccupied. Townsend's big-eared bats are so sensitive to human disturbance that simple entry into a maternity roost can cause a colony to abandon or move to an alternate roost (Pearson et al. 1952; Graham 1966; Stebbings 1966; Mohr 1972; Humphrey & Kunz 1976; Stihler and Hall 1993; P. Brown pers. obs.). Inappropriate behavior on the part of well-intentioned researchers and others (i.e., entry into maternity roosts or hibernacula, and capturing animals in roosts) can also contribute to population declines. Mark recapture studies are not without risk, since at least one wing band design causes serious injuries to Townsend's big-eared bats (Pierson and Fellers 1994). Scientific collecting likely resulted in the extirpation of a population at Prisoner's Harbor on Santa Cruz Island (Brown et al. 1994).

From the perspective of many bat species, old mines are cave habitat and are now sheltering many large colonies (Tuttle and Taylor 1994, Altenbach and Pierson 1995, Pierson and Rainey 1991, Brown et al. 1992 & 1993). Unfortunately, abandoned mines are at risk from closure for hazard abatement, renewed mining and reclamation. Liability and safety concerns have led to extensive mine closure programs in western states, particularly on public lands, often without consideration for the biological values of old mines. If closures are done at the wrong time of year, or without prior biological survey (Altenbach 1995, Navo 1995, Rainey 1995), they can result in the death of entire bat colonies. Even if the bats are properly excluded, replacement roosts in the area may no longer be available.

Although the industry originally created bat roosts, current mining procedures potentially threaten cave-dwelling bat species (Brown 1995a&b, Brown and Berry 1991&1997, Brown et al. 1993&1995). In the creation of open pits, old mine workings are frequently destroyed. Other aspects of modern mining, such as cyanide heap leach ponds, can threaten bats and other wildlife (Clark and Hothem 1991). While effective mitigation is possible (Pierson 1989, Pierson et al. 1991), there is currently no legal mandate requiring that existing populations be protected (Brown and Berry 1997, Brown et al 1993 and 1995). In the California desert, renewed mining is responsible for the loss of a large maternity colony of Townsend's big-eared bats in the Panamint Mountains (P. Brown pers. obs.). This species was also displaced in Viceroy's Castle Mountain Project. In the WMPA, the Rand mining operation has destroyed workings that sheltered some Townsend's big-eared bats, and the proposed Soledad Mountain project near Mojave will also remove potential roosting habitat (P. Brown, pers. obs.). At the end of a mine project, any remaining historic workings are often closed to relieve the claimant of future liability.

The loss of foraging habitat is also a contributing factor to declines in Townsend's big-eared bat populations in some areas, e.g., in urbanized regions, and along the Colorado River, where the native floodplain community has been subjected to extensive agricultural conversion. Although the mines near the Colorado River that were documented by Stager (pers. comm.) to contain large maternity colonies in the 1930's do not appear to have been destroyed or disturbed, this species is no longer found in the area (P. Brown pers. obs.). The adjacent floodplain vegetation has been removed over the past 50 years. In forested areas, spraying for lepidopteran species may alter the prey base for big-eared bats (Perkins and Schommer 1991). Although the effects of grazing have not been specifically addressed for this species, a radio-tracking study at Point Reyes National Seashore indicated that tagged bats avoided grazed pastureland (E. Pierson pers. obs.)

## **Biological Standards:**

This section draws from Brylski et al. (2002).

Management priorities in California should be to identify and protect key roost sites. In many cases adequate protection could be accomplished by excluding people. For caves and mines this generally means gating the roost entrance, using a design that excludes people and allows bats access (Dalton and Dalton 1995, Pierson et al. 1991, Pierson and Brown 1992). Key populations (based on both size and geographic distribution) should be monitored on a regular basis to document current population trends. Censuses should be conducted early in the maternity season (before young are volant) by counting animals upon emergence from the roost, using night vision equipment. Since this species is so sensitive to entry into the roosts, survey protocols need to be established so that population monitoring does not cause an impact (Navo 1995, Rainey 1995). More research needs to be conducted to evaluate the impacts of roost disturbance and displacement on the reproductive success of a colony. The composition and proximity of preferred foraging habitats requires further definition.

Regulatory agencies need to be informed of the importance of both caves and anthropogenic structures, such as mines, as roosting habitat for Townsend's big-eared bats and other species. Too often the biological significance of these habitat features is overlooked in environmental assessment processes especially where public safety is involved. In the WMPA, mine surveys for bats should be conducted at various seasons prior to any impacts such as renewed mining or closure for hazard abatement (Brown and Berry 1997). Whenever possible, mines should be gated and periodically monitored for bat occupancy. Riparian areas and water sources in the vicinity of roosts should be protected.

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## **WESTERN MASTIFF BAT**

*Eumops perotis*

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**Management Status:** Federal: None  
California: Species of Special Concern (CDFG, 1998)

### **General Distribution:**

The western mastiff bat has a disjunct distribution in the southwestern United States, Mexico and South America (Eger, 1977). The subspecies found in North America (*Eumops perotis californicus*) ranges from central Mexico north into parts of California, southern Nevada, southwestern Arizona, southern New Mexico and western Texas (Barbour and Davis, 1969; Bradley and O'Farrell, 1967; Eger, 1977; Hall, 1981).

Historical records for the western mastiff bat were primarily from southern California from the Colorado River to the coast (Cockrum 1960, Eger 1977). Most known roosts were concentrated in the Los Angeles Basin (Howell 1920a,b; Leitner, 1966; Vaughan, 1959) and San Diego County (Kruttsch, 1943; 1945; 1948; 1955). Historically, only three colonies were located north of the Los Angeles area: on the west side of the Central Valley in San Benito County (Dalquest, 1946), in Kern County near McKittrick (Kruttsch, 1955), and in the Kern River Canyon east of Bakersfield (Koford, 1948; Kruttsch, 1955). Single specimens had been taken from the San Francisco Bay area (Sanborn, 1932), western Sierra Nevada (Koford, 1948), Yosemite Valley and Hetch Hetchy Reservoir in Yosemite National Park (Vaughan, 1959, Natural History Museum, Yosemite National Park) and Butte County, near Oroville (A. Beck pers. comm.; Eger, 1977).

Recent surveys in California (Pierson and Rainey, 1996a) have shown that western mastiff bats are "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, eastern Trinity Alps" and in the Coast Range south of San Francisco (Brylski et al. 2002). Although there were no historic records east of the Sierra Nevada crest, recent acoustic detections at several localities suggest that this species occurs at times in Mojave Desert mountain ranges (e.g., Coso, Granite and Panamint Mountains) and Bishop (P. Brown pers. obs.). Audible echolocation signals of mastiff bats have been heard in the warm season as high as 7800 feet (2377 m) elevation in Yosemite National Park (Pierson and Rainey, 1995; 1996b), and at sea level at Niland on the Salton Sea (P. Brown pers. obs.).

### **Distribution in the West Mojave Planning Area:**

Signals have also been detected at various areas of Joshua Tree National Park and occasionally in the Panamint Mountains at Manly (P. Brown, pers. obs.). Although no roost sites have been identified in the WMPA, the detection of multiple signals near dusk on several occasions at Joshua Tree National Park signifies roosts in the vicinity (P. Brown pers. obs.).

## **Natural History:**

Western mastiff bats belong to the family Molossidae, which are distinguished by the presence of a “free-tail,” which extends beyond the edge of the interfemoral (i.e., tail) membrane. As the largest bat species found in California, it has a two-foot wingspan and large bonnet-like ears, which extend forward over the eyes and are connected at the midline (Barbour and Davis, 1969).

Unlike most other North American bat species that mate in the fall, free-tailed bats breed in the spring and give birth to a single young in the early to mid-summer. As summarized by Brylski et al. (2002), most western mastiff bats give birth by early July (Kruttsch, 1955), although parturition dates vary extensively (Barbour and Davis, 1969), and births are not synchronous, even within colonies (Cockrum, 1960, Brylski et al. 2002). Colonies generally contain fewer than 100 animals (Barbour and Davis, 1969; Howell, 1920a). Adult males and females may roost together at all times of year (Kruttsch, 1955), in contrast to other North American bat species.

Western mastiff bats emit an audible echolocation call and can be detected flying throughout the night. However, a mastiff bat was observed in mid-morning flying low over the Desert Studies Center at ZZZZX in the Mojave Desert, without emitting any audible calls (P. Brown pers. obs.) These strong, fast fliers cover an extensive foraging area in an evening, and . was heard in open desert, at least 15 miles (24 km) from the nearest possible roosting site (Vaughan, 1959). Often multiple animals are detected together, and this species may travel or forage in groups (E. Pierson, pers. comm.; P. Brown pers. obs.). Unlike Mexican free-tailed bats that undertake long seasonal migrations, western mastiff bats move relatively short distances seasonally. Although capable of lowering their body temperatures for short periods of time, they do not undergo prolonged hibernation, and may be periodically active throughout the winter. In Southern California, mastiff bats have been detected at all seasons, although they may change roost sites (Howell, 1920a; Kruttsch 1948 and 1955; Leitner, 1966; Barbour and Davis, 1969). Mastiff bats are also detected at all seasons foraging near the Lower Colorado River (P. Brown, pers. obs.).

In California, western mastiff bats appear to feed primarily on moths (Lepidoptera), but may also take beetles and crickets. In Arizona, Ross (1961, 1967) found that large Lepidoptera (up to 2.4 in [60 mm]) predominated, although a few small (about 0.32 in [8 mm]) hymenopterous insects were also consumed.

## **Habitat Requirements:**

Western mastiff bats are found in a variety of biotic environments from low desert scrub to chaparral, oak woodland and ponderosa pine. However, the abiotic components appear to determine their distribution. This crevice-dwelling species predominantly selects cliff faces (e.g., granite, sandstone, or columnar basalt) or exfoliating granite boulders (Dalquest, 1946; Kruttsch, 1955; Vaughan, 1959), but also utilizes cracks in buildings (Howell, 1920a; Barbour and Davis, 1969). All roosts located in California by Pierson and Rainey (1996a) were in crevices at least 10 feet above the ground. In the WMPA, mastiff bats have been heard in the vicinity of granite boulders (P. Brown, pers. obs.). They appear to forage over open areas (Vaughan, 1959; Pierson and Rainey, 1996a), and many individuals have been heard feeding over agricultural fields in the Imperial Valley (P. Brown pers. obs.).

## **Population Status:**

An absence of historical records makes it impossible to assess current trends for this species in many areas. The study of Pierson and Rainey (1996a) expanded the known range of western mastiff bats in California, although this was probably due to improved detection techniques (i.e., monitoring distinctive audible echolocation signals), rather than animals colonizing new areas. Vaughan (1959) referred to the audible calls of this species, but this characteristic had not been previously used as a survey tool. Where historic roost areas are not known, it is difficult to compare present and past distributions to arrive at population trends.

However, in recent surveys (Pierson and Rainey, 1996a; P. Brown pers. obs.), few mastiff bats were detected in the Los Angeles Basin in an area with many historic records, suggesting local population declines. The building that sheltered 200-300 mastiff bats in Azusa in the 1960s (Leitner, 1966) no longer exists, and there was no acoustic evidence that the species still occurs in Azusa, nor in adjacent communities or drainages leading into the San Bernardino Mountains. A church in Highland, which had 40-50 adults in 1969 (D. Constantine pers. comm.), sheltered only three bats in 1992. Since no historic or current roost sites have been located in the WMPA, population status is unknown.

### **Threats Analysis:**

Potential threats to the roosting and foraging habitat of western mastiff bats are discussed in detail in Pierson and Rainey (1996a). These include urban expansion, which can lead to both loss of roosting and foraging habitat, as has occurred in the Los Angeles basin. When colonies are within or in close proximity to human dwellings, they are vulnerable to disturbance, vandalism, and extermination by pest control operators and public health departments. These large, noisy bats are vulnerable to the hysteria, which often surrounds bat colonies. Two recent colonies in buildings in the Los Angeles area (e.g., Norco and Rancho Cucamonga) were eradicated in the name of public health (P. Brown pers. obs.).

Any construction activities (e.g., quarry operations, highway projects, water impoundments) that impact cliffs or boulders could affect western mastiff bat roosts. Recreational climbing may also disturb roosting bats. In the WMPA, rock climbing is an important activity in Joshua Tree National Park. Although no information is available regarding what proportion of the crevices used by climbers offer suitable roosting sites for bats, hands or temporary climbing aids inserted into a roost crevice could cause abandonment of a site.

Pesticides sprayed in agricultural areas in the past have impacted bat populations (Clark, 1981; Clark et al., 1978; 1983). Even non-chemical methods, such as the lepidopteran-attacking *Bacillus thuringensis*, can reduce the prey base for western mastiff bat populations which rely heavily on moths (Sample et al., 1993). Since mastiff bats forage over a large area, pesticide applications outside of the WMPA could impact bats roosting within the WMPA.

### **Biological Standards:**

Acoustic surveys throughout California, including the WMPA, need to be coordinated to locate roosting and foraging areas of western mastiff bats. When roosts are discovered,

they need to be protected from disturbance, and monitored to increase knowledge of temporal distribution and population dynamics. The impacts of some human activities, particularly rock climbing, in the vicinity of roost sites should be assessed (Brylski et al. 2002). This would be of particular importance in areas such as Joshua Tree National Park.

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## **YELLOW-EARED POCKET MOUSE**

*Perognathus xanthonotus*

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**Management Status:** Federal: BLM Sensitive  
California: None

### **General Distribution:**

The yellow-eared pocket mouse, also called the Walker Pass pocket mouse, inhabits the eastern slopes of the Piute Mountains and Sierra Nevada along the western fringe of the Mojave Desert. The species has been recorded between Kelso Valley on the south and Sand Canyon on the north (Hall, 1981; Williams et al., 1993; Laabs, et al. 1990).

*P. xanthonotus* is a member of the *parvus* species-group, which also includes the Great Basin pocket mouse (*P. parvus*) and the white-eared pocket mouse (*P. alticola*). The yellow-eared pocket mouse was first described from near Walker Pass (Grinnell, 1912), and has been treated as a separate species by many subsequent authors (Ingles, 1965; Hall, 1981; Verts & Kirkland, 1988; Nowak, 1991; Zeiner et al., 1990). However, based on morphological and karyological similarities, others have concluded that *P. xanthonotus* is not sufficiently differentiated from *P. parvus*, and have included it as a subspecies of the latter (Honacki et al., 1982; Sulentic, 1983; Williams et al., 1993). All members of the *parvus* species group share a diploid number of chromosomes of 54 although *P. xanthonotus* possesses a different number of autosomal arms than *P. parvus olivaceous*, its closest neighbor to the north (Patton and Rogers, 1993). It has been speculated that the ranges of these two forms overlap narrowly along the eastern front of the Sierra Nevada (Williams et al, 1993).

### **Distribution in the West Mojave Planning Area:**

Most of the range of the Yellow-eared pocket mouse is within the WMPA on the eastern slope of the Sierra Nevada and Piute Mountains. The species is known from Kelso Valley, Horse Canyon, Sage Canyon, Freeman Canyon, Indian Wells Canyon and Sand Canyon. Similar habitat, which may harbor the species, is present both north and south of this region, as well as in intervening canyons.

### **Natural History:**

The yellow-eared pocket mouse is a large-sized member of the genus, averaging approximately 165.3 mm (6.5 inches) in total length. The pelage is ochraceous buff slightly overlaid with black dorsally. The feet and underparts are white. The inside of the ear is whitish, and a conspicuous spot at the base of the ear is white. The ochraceous lateral line and dark facial markings are faint. The tail is faintly bicolored, ending in a small tuft, and slightly longer than the length of the head and body. *P. xanthonotus* can be distinguished from the little pocket mouse (*P. longimembris*) and the San Joaquin pocket mouse (*P. inornatus*), with which it may be sympatric, by lobes at the base of the ears,

larger overall size, relatively less inflated auditory bullae, and relatively broader interorbital breadth. *P. xanthonotus* is distinguished from the Tehachapi pocket mouse (*P. alticola inexpectatus*) by its lighter colored dorsal pelage, larger size and a relatively larger interparietal. *P. xanthonotus* differs from the Great Basin pocket mouse (*P. parvus olivaceous*) by its smaller size, and relatively smaller auditory bullae (Grinnell, 1912; Hall, 1981).

There is little information regarding the ecology of the yellow-eared pocket mouse, but it is expected to be similar to the closely related Great Basin pocket mouse, *P. parvus*. The Great Basin pocket mouse generally reproduces between March and September, normally producing a single litter each year. Reproduction may be curtailed in dry years. *P. parvus* generally forages on seeds and fruit of a variety of grasses, annuals, forbs and shrubs. Seeds are cached during the spring and summer to provide food during the winter months. Insects may also be part of the diet, at least seasonally (Ingles, 1965; Verts and Kirkland, 1988). The yellow-eared pocket mouse is uncommon compared to the other small mammals with which it occurs (Williams, 1986; Laabs et al, 1990). Other members of the species group hibernate during the winter, and it is presumed that this species does also (Zeiner et al., 1990). This restricted surface activity, which along with patchy distribution, makes the species difficult to detect during certain times of the year.

#### **Habitat Requirements:**

Little information is available regarding habitat requirements of the yellow-eared pocket mouse. The species has been found Joshua tree woodland, desert scrub, pinyon-juniper, mixed and montane chaparral, sagebrush and bunchgrass habitats (Grinnell, 1912; Williams et al., 1993). It occurs primarily in sandy soils with sparse to moderate shrub cover (Zeiner et al., 1990). Elevations of known localities range between 1030-1615 m (3380-5300 feet; Hall, 1981; CNDDDB; Zeiner et al., 1990).

#### **Population Status :**

The yellow-eared pocket mouse has been recorded from several canyons along the eastern slope of the Piute Mountains and Sierra Nevada, specifically Kelso Valley, Horse Canyon, Sage Canyon, Freeman Canyon, Indian Wells Canyon and Sand Canyon. Similar habitats are available in canyons both north and south of this range, as well as in intervening canyons. Additional trapping is necessary to determine the current distribution of the species. Some of these canyons remain relatively undisturbed, while others, including Sand Canyon, receive recreational use.

#### **Threats Analysis:**

Given the small range of the yellow-eared pocket mouse, any habitat disturbance of its known or suspected habitat could have significant deleterious effects. Cattle and sheep grazing may pose a potential threat due to the effects on plant assemblages or erosion of soils. Off-highway vehicle activity and mineral extraction are other potential threats, due to their effects on native vegetation. Most of the canyons supporting the species have roads and are therefore accessible. Wind-energy production also poses a potential threat, resulting from impacts associated with road networks. These activities

should be studied further to determine the extent to which they affect yellow-eared pocket mice and their habitat.

### **Biological Standards:**

Additional data concerning the current distribution and habitat requirements of the yellow-eared pocket mouse are necessary to evaluate the status of the species and to focus conservation measures. The species has been identified in only six localities (Kelso Valley, Horse Canyon, Sage Canyon, Freeman Canyon, Indian Wells Canyon and Sand Canyon), most of which are under BLM administration. Human activities in these canyons should be identified and their impacts on yellow-eared pocket mouse habitat assessed. Uses deemed detrimental to the species should be restricted. The presence of this species in the canyons to the north and the south of this core area, as well as in the intervening canyons (e.g. Dove Spring Canyon, Bird Spring Canyon, Grapevine Canyon) should be determined. The extent of suitable habitat and linkages between subpopulations in individual canyons should be identified. The taxonomic relationships of this pocket mouse with other members of the species complex need to be clarified.

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