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MAMMALS OF THE CALIFORNIA DESERT

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INTRODUCTION

The desert lands of southern California (Figure 1) support a rich variety of wildlife, of which mammals comprise an important element. Of the 19 living orders of mammals known in the world today, nine are represented in the California desert[15]. Ninety-seven mammal species are known to live in this area. The southwestern United States has a larger number of mammal subspecies than any other continental area of comparable size (Hall 1981). This high degree of subspeciation, which leads to the development of new species, seems to be due to the great variation in topography, elevation, temperature, soils, and isolation caused by natural barriers. The order Rodentia may be considered the most successful of the mammalian taxa in the desert; it is represented by 48 species occupying a wide variety of habitats. Bats comprise the second largest contingent of species. Of the 97 mammal species, 48 are found throughout the desert; the remaining 49 occur peripherally, with many restricted to the bordering mountain ranges or the Colorado River Valley. Four of the 97 are non-native, having been introduced into the California desert. These are the Virginia opossum, Rocky Mountain mule deer, horse, and burro. Table 1 lists the desert mammals and their range occurrence as well as their current status of endangerment as determined by the U.S. Fish and Wildlife Service (USFWS 1989, 1990) and the California Department of Fish and Game (Calif. Dept. Fish & Game 1991a,b, 1992).

Table 1 also lists those subspecies which are on one or more lists of concern.

Four mammals in the California desert have been formally listed as either Endangered or Threatened. The Amargosa vole (*Microtus californicus scirpensis*), whose population is restricted to small, isolated patches of habitat, is listed as Endangered by both U.S. Fish and Wildlife Service (USFWS 1990) and the State of California (Calif. Dept. Fish and Game 1991a,b;1992). The peninsular bighorn (mountain) sheep (*Ovis canadensis cremnobates*), the California bighorn (mountain) sheep (*Ovis canadensis californiana*), and the Mohave ground squirrel (*Spermophilus mohavensis*) are listed as Threatened by the State of California. The State also considers 19 others as Species of Special Concern; U.S. Fish and Wildlife Service considers 19 as Category 2 candidate species (i.e., species that may be considered).

The Mohave ground squirrel is the only mammal endemic to the California desert. However, the Panamint chipmunk (*Tamias panamintinus*) is almost entirely restricted to the California desert as just a small portion of its range extends into Nevada.

Development and use of the desert have altered the natural landscape at an increasingly rapid rate in recent years. Impacts resulting from these disturbances range from those with relatively little obvious effect on the landscape (e.g., transmission lines), to those that substantially change (e.g., urbanization) or convert native plant communities to other assemblages of plants (e.g., agricultural development). Responses of mammals to these changes vary depending upon their distribution and habitat requirements. For some species with limited distributions or specific habitat requirements, such as the Amargosa vole, habitat quality and quantity have declined to such a degree that their continued existence is seriously threatened.

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15. The "California Desert", a term in common use, is defined as those parts of the Great Basin, Mojave and Sonoran Deserts which lie within the political boundaries of California (see also chapters on Geology and Bioclimatology).

This chapter discusses the variety of mammals found in the deserts of California; general biological information on the seven orders of mammals which are native to the desert; specific information on representative species and those thought to be declining or whose survival is in question; adaptations of mammals to the hot, dry conditions and cyclical patterns of food abundance and scarcity of water; and the various ways that humans have affected the deserts of California and how mammals have responded to these changes.

MAMMALS OF THE CALIFORNIA DESERT

ORDER MARSUPIALIA (Marsupials)

Marsupials are among the most primitive of living mammals. Only the egg-laying monotremes of the order Monotremata (consisting of the duck-billed platypus and two genera o echidna, or spiny anteaters, all in the Family Tachyglossidae), are considered to be more primitive Marsupial young are born prematurely and complete their development in the fur-lined pouch of th mother. All other living mammals are placental mammals; the young receive nourishment through th placenta of the mother's body and undergo considerable development before they are born.

The Virginia opossum (*Didelphis virginiana*), in the Family Didelphidae, is the only marsupi found in the United States. It is quite common in the eastern United States and was introduced int the west in the early 1900s. It is now well established in Pacific coastal areas (Hall 1981). In th California desert, it is found in agricultural areas in the Coachella Valley and along the desert western border, where its occurrence is probably incidental.

ORDER INSECTIVORA (Insectivores - Shrews and Moles)

Insectivores comprise the most primitive living order of placental mammals. They a generally small in size, primarily insectivorous, and usually live in moist places. Of the seven speci of insectivores found in the deserts of California, six species are shrews (Family Soricidae); t seventh is a mole (Family Talpidae). The desert shrew (*Notiosorex crawfordi*) is the o widely-distributed member of this group in the California desert. Other species of the genus *Sorex*, the Family Soricidae, occur peripherally in foothills of the surrounding mountain ranges.

ORDER CHIROPTERA (Bats)

Bats form the second largest group, as measured by species numbers, of mamm inhabiting the desert. Twenty species are known to use the desert at some time during the ye Because these mammals are able to fly, they can migrate to and from the desert on a seasc basis. As such, our list (Table 1) probably does not include all bats which actually use the des At least three families of bats are represented in the desert:

Family	Number of Species
Phyllostomidae (leaf-nosed bats)	1
Vespertilionidae (evening bats)	16
Molossidae (free-tailed bats)	3

The diets of these bats are restricted to arthropods, but specific foods taken may vary considerably among species. The pallid bat (*Antrozous pallidus*) preys on large terrestrial arthropods, whereas other species take small flying insects (Vaughan 1972). Bats utilize a variety of roosting places, including man-made structures such as attics or mine tunnels, crevices in rocks, spaces beneath rocks, caves, bark, and cavities in trees and foliage (Vaughan 1972). Little is known about many of the bats in the California desert; of the species which have been studied, several are sensitive to disturbance and their numbers are known to be declining (Brown 1979).

ORDER LAGOMORPHA (Rabbits and Jackrabbits)

Four lagomorphs occur in the California desert, including one hare, or black-tailed jackrabbit (*Lepus californicus*), and three species of cottontails and rabbits (*Sylvilagus* spp.) in the Family Leporidae. These animals are generally crepuscular, that is, they are active primarily in the early morning and late evening. During the day, they can usually be found resting in a "form", or hollow, under the shade of a bush. The black-tailed jackrabbit is a familiar sight throughout the desert and is one of the best known hares of western North America. The desert cottontail (*Sylvilagus audubonii*) is also widely distributed. The brush rabbit (*S. bachmani*) is found primarily in coastal brush or foothill chaparral habitats and only peripherally along the western border of the desert. Nuttall's cottontail (*S. nuttallii*) is generally found in the Great Basin sagebrush habitat in the northern part of the California desert.

ORDER RODENTIA (Rodents)

In terms of number of species, rodents comprise the largest mammalian order in the world as well as in the California desert. Half of the mammal species present are rodents; they are easily the most numerous mammals in the desert. Forty-eight species represent six families (see Table 1):

Family	Number of Species
Sciuridae (squirrels and chipmunks)	10
Geomyidae (pocket gopher)	1
Heteromyidae (pocket mice, kangaroo mice, and kangaroo rats)	17
Cricetidae (rats, mice, and muskrats)	18
Muridae (Old World mice and rats)	1
Erethizontidae (New World porcupines)	1

Because of their abundance and successful establishment in virtually all habitats, rodents provide a stable food supply for numerous carnivorous mammals, birds, and snakes. Many rodents are fossorial, that is, they are underground burrowers, while others reside in rock piles or tree canopies. For example, the woodrat, or "pack rat" (*Neotoma lepida*), lives in a two-chambered nest built of cactus joints, sticks, and a variety of other materials. The upper chamber is not used as a living space, but dead air trapped within it serves as insulation against the extremes of desert heat and cold. Families with more than one species are discussed below.

Family Sciuridae (Squirrels and Relatives)

The Mohave ground squirrel (*Spermophilus mohavensis*) lives only in a small portion of the western Mojave Desert. Within these restricted boundaries it is widespread, living in a variety of habitat and soil types (Aardahl and Roush 1985). The California Department of Fish and Game (1991a,b;1992) has placed it on the California list of Threatened species, citing urban development of

prime habitat areas and apparent population declines as the primary reasons for listing. Agricultura development, overgrazing, highway construction, and offroad vehicle use are other factors contributin to loss and degradation of habitat. There is no active habitat management where this specie occurs, and the species is virtually ignored in Federal land use decisions (Calif. Dept. Fish and Gam 1991a). Recent studies have found range extensions into new areas, and further losses, c regression, in other areas of the historical range of the Mojave ground squirrel (Aardahl and Rous 1985; Wessman 1977). Loss of range in some areas may be due in part to range expansions of th round-tailed ground squirrel (*Spermophilus tereticaudis*) and the California ground squirrel (S *beecheyi*) (Calif. Dept. of Fish and Game 1978). Hybridization with round-tailed ground squirrels ma also cause range regression (Hafner and Yates 1983).

Of the two subspecies of the Panamint chipmunk (*Tamias panamintinus*) in the Californ desert, the range of the more widely-distributed subspecies, the Panamint chipmunk (*T. p. panamintinus*), coincides with that of pinyon-juniper woodland but extends to higher elevations limber pine (*Pinus flexilis*) and bristlecone pine (*P. longaeva)* forests as well (Johnson et al 1948 This subspecies has a discontinuous range in eastern California and western Nevada (Hall ar Kelson 1959). In California, it lives on the eastern side of the southern Sierra Nevada, in the dese ranges of southern Mono and Inyo Counties nand in northwestern San Bernardino County.

The second subspecies, the Kingston Mountain chipmunk (*Tamias panamintinus acrus*), endemic to the Kingston Range of northeastern San Bernardino County. Unlike the Panami chipmunk, the Kingston Mountain chipmunk is restricted to pinyon-juniper woodland. Approximate 40 mi^2 (100 km^2) in the Kingston Range is suitable habitat for this subspecies; the population effectively isolated by the surrounding desert vegetation (Johnson 1943). The status of the Kingst Mountain chipmunk is of concern because of its small, isolated range.

Family Heteromyidae (Heteromyids)

The yellow-eared pocket mouse (*Perognathus xanthonotus*) generally inhabits areas chaparral, sagebrush, and bunchgrass vegetation (Burt and Grossenheider 1964). It has also be found in association with Joshua trees and their understories of California buckwheat, cheesebu and other shrubs (Berry et al 1975; Wessman 1974). These pocket mice are limited to a small p of the desert slopes of the southern Sierra Nevada in eastern Kern County, including Freem Canyon, Walker Pass, and Kelso Valley (Hall and Kelson 1959). According to Ingles (1965), yellow-eared pocket mouse is also found in the Tehachapi Mountains, but he may possibly h considered the southern Sierra Nevada as a part of the Tehachapi Mountains. Wessman (1974) Berry et al (1975) have shown that the range of this species extends into several additional cany in this general vicinity, including Indian Wells, Horse Canyon, and Sage Canyon. Although yellow-eared pocket mouse is fairly common at a few sites, it does not appear to be abunc throughout its entire range. Its relative scarcity and limited distribution make it extremely suscept to extirpation if its habitat is sufficiently disturbed.

The pallid, or pale, kangaroo mouse (*Microdipodops pallidus*) lives only in fine, windbl sand deposits in sagebrush habitats (Hall and Kelson 1959). Its distribution is limited to a s portion of California and Nevada; records for the California desert are from Deep Springs, Eu Valley and Fish Lake Valley in extreme southeastern Mono and northeastern Inyo Counties (Flet 1977). Interest and concern for this small, heteromyid rodent stem from its narrow ha preferences and restricted geographic range. Most mammalogists consider kangaroo mice in ger to be relatively rare.

Family Cricetidae (Cricetids)

The California vole (*Microtus californicus*), a wide-ranging species occurring throughout much of California, is represented in the desert by two or three subspecies, the Mohave vole (*M. c. mohavensis*), the Amargosa vole (*M. c. scirpensis*), and possibly the Owens Valley vole (*M. c. vallicola*) which is a Federal Candidate 2 and state species of special concern. It has been recorded as occurring at the north end of the Panamint Mountains and in the Olancha area (Hall 1981).

The Mohave vole is restricted to wetland habitats dominated by cattails and bulrush along portions of the Mojave River and at Harper Dry Lake marsh in San Bernardino County (T. Rado, pers. obs.). Some populations which once occurred at the few locations along the Mojave River may no longer exist due to land use patterns in this area.

In 1973, the U.S. Fish and Wildlife Service (USFWS 1973) listed the Amargosa vole as extinct. Studies since then established that this animal continues to exist in limited numbers in tule marshes along the Amargosa River from Tecopa Hot Springs south into the northern part of Amargosa Canyon in Inyo County, a habitat type which is restricted in area and very fragile (J. Brown, per. comm.; Gould and Bleich 1977; Bleich 1979, 1980; Rado and Rowlands 1984). The type locality near Shoshone where the Amargosa vole was first discovered has apparently not supported voles since 1917 (USFWS 1973) and it is considered extirpated from that area. Much of the area inhabited by the Amargosa vole occurs on privately-owned lands (V. Bleich, pers. comm; Calif. Fish and Game 1990a). Only a small amount of the 400-500 acres (160-200 hectares) of potential Amargosa vole habitat appears to be constantly inhabited (Rado and Rowlands 1984). Reasons for this occupation pattern may include periodic inundation of low-lying marsh habitat by runoff from rainfall. Development of, or damage to, the small amount of continuously occupied habitat could result in extirpation of this subspecies. This places the Amargosa vole in a very precarious situation. It has, however, been afforded protection under both the Califonia and Federal endangered species laws.

ORDER CARNIVORA (Carnivores)

The order Carnivora is represented in the California desert by 12 species occurring in five families:

Family	Number of Species
Canidae (coyotes, wolves, foxes, dogs)	3
Ursidae (bears)	1
Procyonidae (raccoons, ringtails)	2
Mustelidae (mustelids)	4
Felidae (cats and allies)	2

The black bear (*Ursus americanus*) is found in the peripheral mountain ranges which form the western border of the California desert, but may wander into adjacent desert areas. The families Canidae and Felidae are discussed below.

Family Canidae (Coyotes, Wolves, Foxes, Dogs)

Members of the family Canidae are generally found throughout the desert area. The coyo (*Canis latrans*), once found primarily in western states, is now widespread throughout the nati except in the southeastern United States and can be found south into Central America and northwe into Alaska (Hall 1981). The gray fox (*Urocyon cinereoargenteus*) is found throughout most of t United States, excepting the Great Basin, Rocky Mountains, and Washington State, and rang southward into South America.

The kit fox (*Vulpes macrotis*) is represented in the California desert by the desert kit f (*Vulpes macrotus arsipus*) which is restricted to favored habitats over a large geographic range. foxes are often found on relatively flat plains which support rather open plant assemblages with sc that are conducive to burrowing. The burrows of the kit fox have a very distinctive appearance a are often located in loose, friable soils. Mortality as the result of cave-ins caused by a variety factors is thought to be substantial (O'Farrell and Gilbertson 1979). The kit fox is not a wary anir and therefore it is easily trapped or shot.

Family Felidae (Cats and Allies)

The mountain lion (*Felis concolor*), although found in many areas of the desert, is relati uncommon. One subspecies, the Yuma mountain lion, or Yuma puma (*Felis concolor browni*), i Federal Category 2 candidate for possible future Federal listing as Threatened or Endangered as as being listed by the State as a species of special concern (see Table 1). It is restricted to Colorado River and adjacent parts of the desert.

The bobcat (*Felis rufus*) is widely distributed and relatively common over a broad rang habitats. Demand for bobcat pelts by the fur industry has caused considerable concern over condition of bobcat populations in North America.

ORDER ARTIODACTYLA (Even-toed Hoofed Mammals)

According to Ingles (1965), this order of hoofed mammals may be divided into two n groups: 1) the hippopotamus, peccary, pig, and other piglike forms; and 2) those that cud-chewers, or ruminants, which include deer, sheep, pronghorn, true antelopes, goats, giraffes, others. There are two living families of this order in the California desert: Cervidae (mule deer), Bovidae (bighorn, or mountain, sheep). A third family, the Antilocapridae (pronghorn), has extirpated from the California desert. However, in recent years a small number of pronghorn been reintroduced into the western Mojave.

Family Cervidae (Elk, Moose, Caribou and Deer)

Four subspecies of mule deer (*Odocoileus hemionus*) live in many desert mountain r and some of the lowlands (Wallmo 1981). The Rocky Mountain mule deer (*O. h. hemionus*), inhabits the Providence and New York Mountains of San Bernardino County, is not native, bu introduced from northeastern California stock. Other subspecies are the desert mule deer (*crooki*) found along the Colorado River; the California mule deer (*O. h. californicus*), found eastern Sierra Nevada, Coso, Inyo, and San Bernardino Mountains; and the southern mule de *h. fuliginatus*) found in the San Jacinto and Santa Rosa Mountains and in the mountains c Diego County.

Family Bovidae (Sheep, Goats and Bison)

Three subspecies of bighorn sheep (*Ovis canadensis*) are found in or adjacent to the California desert. The peninsular bighorn sheep (*O. c. cremnobates*) is found in the San Jacinto and Santa Rosa Mountains and the mountains of eastern San Diego County; it is classified as Threatened by the California Department of Fish and Game (1991a,b) and has a total population of about 685 (Mansfield 1990). The second subspecies, the California (or Sierra) bighorn sheep (*O. c. californiana*), is found in several mountain ranges (e.g., Tehachapi Mountains) immediately to the west of the desert; its total population is about 275 (Mansfield 1990). The desert bighorn sheep (*O. c. nelsoni*), is most abundant of the three subspecies. It is found in many mountain ranges throughout the desert.

Historical information on population levels and distribution of bighorn sheep in the California desert indicates that populations in nearly all areas have declined substantially in the last 50 years despite over 100 years of full legal protection. Studies done by the California Department of Fish and Game (Weaver 1972; Weaver and Hall 1971a, 1971b, 1972; Weaver and Mensch 1969, 1970a, 1970b, 1970c, 1971a, 1971b; Weaver, Mensch, and Fait 1968; Weaver, Mensch and Thomas 1969; Weaver, Mensch, Zimmerman, and Hall 1972) showed that desert bighorn sheep have been extirpated from 16 (19%) mountain ranges in the desert, were transient in 24 (29%), declining in 17 (20%), holding in 18 (22%) and viable in only 8 (10%). At least six areas now receiving only transient use were known to support permanent populations in the past. Since these studies were completed, several small populations with only 5, 10 or 12 individuals may no longer exist.

Disease, recreational use, urbanization, livestock grazing, and the exploration for and extraction of oil, gas, and minerals are all factors which reduce the suitability of bighorn sheep habitat. A serious problem since the introduction of domestic livestock has been the susceptibility of bighorn sheep to bacterial and viral diseases. Since 1984, the Department of Fish and Game has conducted bighorn sheep inventories and disease surveys to better understand the geographical distribution and health condition of the desert bighorn populations (Clarke and Weaver 1990). The Bureau of Land Management (BLM) has contributed funds to the Desert Bighorn Institute to conduct research on diseases of the bighorn (BLM 1987).

Prolonged droughts in many areas resulted in the loss of historic water sources (Weaver 1975). The BLM has instituted a program of constructing a number of watering units to enhance water availability for the bighorn (BLM 1987). Feral burros occur in about 40% of the total range of the bighorn sheep in the California desert and compete with them for forage, water and space. The Bureau is attempting to manage burro populations at lower numbers in California and has removed a large number of these animals (BLM 1987). The competition between bighorn sheep and the non-native burro may have been a principal cause of bighorn declines in many areas (Weaver 1975).

In an effort to relocate and reintroduce the animals, the California Department of Fish and Game initiated an active program in 1971, concentrating primarily on the desert bighorn (*O. c. nelsoni*). Relocations were made from larger seed herds in the eastern San Bernardino County mountains to other desert ranges where the bighorn had declined or disappeared. In 1972, the estimated population of bighorn sheep statewide was about 2,400; in 1978, population estimates of total bighorn in the state were from 3,250 to 3,750 (Monson and Sumner 1980); by 1990 the estimated population had increased to about 4,000 (Mansfield 1990). With the increase in numbers, considerable controversy arose as to whether hunting of the bighorn should be allowed by the California Fish and Game Department. In 1987, for the first time in over 100 years, the Department of Fish and Game was allowed by the State Legislature to permit hunting of bighorn under controlled conditions. Incentives to the Department are high prices for permits and auctions or drawings which can produce considerable sums of money that may be used to fund research and improve sheep habitat (Mansfield 1990).

As Weaver (1973, 1975) has noted, bighorn sheep will survive only as long as sufficient food space, water and solitude are available to meet their basic requirements. To preserve the bighorn sheep, the land on which they depend must be adequate and carefully managed, and the disease must be controlled, or their numbers will continue to decline and the more marginal habitats wi cease to support bighorn sheep populations.

Family Antilocapridae (Pronghorn)

The pronghorn (*Antilocapra americana*), or pronghorn antelope, is the only livin representative of the family Antilocapridae and the only hoofed animal that sheds its horns annuall from a bony core. Unlike the true antelopes, which occur in the Old World, the pronghorn is nativ to North America and once lived throughout the western United States in great numbers, in th thousands or perhaps even millions, although little is known of their abundance prior to the Europea settlement of the west. During the mid- to late-1800s, populations of pronghorn were great decimated or extirpated by hunting and other human activities. Conservation efforts began as ear as 1913 (Einarsen 1948) and continue through the efforts of state Departments of Fish and Gam and others. As a result, pronghorn are increasing in numbers in some western states, such a Colorado, South Dakota, Montana, and Wyoming, ranging from a few hundred in some states thousands in Idaho, Montana, and Wyoming. Hunting under permit is allowed in most states whe the pronghorn now occur. In California, by the 1950s pronghorn had all but disappeared from th state except for the northeastern part. However, with more effective wildlife management, thes numbers have since increased to about 7,000 (Loft 1989). In the California desert, remnant herds pronghorn existed in many of the desert valleys until the 1940s and perhaps into the early 1950s (Weaver, pers. comm.) by which time these herds were extirpated. Market hunting, agricultural a urban development, and poaching are primarily responsible for the loss of the pronghorn (Dasma 1964).

The Tejon Ranch and the California Department of Fish and Game recently released a sm group of pronghorns on the property of the Tejon Ranch, in the western Antelope Valley a Tehachapi Mountains. This introduction appears to be successful as they are surviving a reproducing (D. Geivet pers. comm.). Pronghorn do not migrate but tend to drift from place to plac A few of them have been sighted in the State Poppy Preserve east of the Tejon Ranch.

ADAPTATIONS OF MAMMALS TO DESERT LIFE

Desert-dwelling mammals have evolved a wide variety of ecological, behavioral, a morphological adaptations which enable them to meet the challenge of survival in an inhospital environment. The extreme conditions of high temperatures, intense solar radiation, scarcity of wa and unpredictable food sources make severe demands on animals. During summer months, temperatures may reach 110° Fahrenheit (43° Centigrade) or higher and the surface temperature the soil may rise above 160°F (71°C). Every homeothermic (warm-blooded) animal has a relativ narrow range of body temperatures within which it can function. When the environmer temperature exceeds body temperature, the animal must transfer heat from its body against thermal gradient to the hotter surroundings. If it cannot, body temperatures can rise above tolerable level (Bartholomew and Dawson 1968). An animal's body produces so much metabolic h that internal temperatures can be held within the required range only if the animal can dissipate heat load, usually by evaporative cooling. Deserts are generally areas where water is a r commodity. Hence, regulation of body temperature via evaporation of water presents a diffi problem, requiring a balance between temperature control and electrolytes. Desert mammals h developed a number of solutions for coping with this situation.

One adaptation to the desert environment is simply to leave the area when conditions are at their harshest. Migration is a tactic employed by a number of mammalian species. Many bat species are found in the desert only at times of year when conditions are most favorable. Large ungulates, such as mule deer and bighorn sheep, undertake altitudinal migrations in response to fluctuating supplies of food and water as well as temperature changes. Generally, in winter both of these latter species descend to lower elevations in order to find food. They then retreat during summer months to the higher elevations where food and water are more abundant and temperatures are cooler. An exception to this pattern is exhibited by the desert mule deer (*O. h. crooki*) found in Sonoran desert habitats along the Colorado River in California. Although the range of this subspecies does not include very high mountains, desert mule deer are usually found at relatively higher elevations in the winter months. In the summer months, they descend to lower elevations where the summer rainfall patterns of the Colorado Desert make water and forage available in the lower-elevation washes.

Most desert mammals circumvent the extremes of their environment by being active only at night. Many are also fossorial, spending inactive periods in underground burrows characterized by moderate temperatures and high humidities which provide an optimal environment for thermoregulation and maintenance of positive water balance (Schmidt-Neilson and Schmidt-Neilson 1950). Many carnivores, including the kit fox and coyote, also live in burrows and are generally nocturnal, procuring food at night when most burrowing rodents are active. Large mammals, such as ungulates, cannot escape the heat by burrowing, but their mobility allows them to seek shade and water at other locations. In addition, their size often provides them with the thermal inertia necessary to safely store excess heat acquired during the day with only a slight rise in body temperature. They then lose excess heat at night (Bartholomew and Dawson 1968).

In addition to nocturnal and fossorial behaviors, desert mammals have physiological and dietary adaptations that result in an extremely efficient water economy. Water losses via defecation, urination, respiration, and evaporation are reduced to a level balanced by the oxidative water produced by the animal's own metabolism, combined with moisture obtained from food and limited drinking water. Many species require few special physiological adaptations by combining nocturnal and fossorial behavior with a diet of succulent vegetation and by drinking water when it is available. However, others such as the kangaroo rat, rarely, if ever, drink water or consume succulent vegetation; instead, they subsist on dry seeds stored in their burrow. The high humidity and cooler temperatures of the burrow reduce the need for the animal to cool by evaporation during hot days. Metabolic water, produced from the oxidation of carbohydrates, provides the necessary water. In addition, the kangaroo rat has an amazingly efficient kidney, permitting concentration of urea in its urine as high as 24%, as compared to 6% in humans (Schmidt-Neilson and Schmidt-Neilson 1953).

Seasonal and daily torpor have been observed in several genera of desert rodents. The Mohave ground squirrel, a diurnal species, remains in its burrow from August to March. During this period, both food and water are scarce, and dormancy allows these animals to avoid the most severe desert conditions (Bartholomew and Hudson 1961). The little pocket mouse(*Perognathus longimembrus*), a common desert inhabitant, apparently also enters a period of seasonal dormancy from October through February (Chew and Butterworth 1964). Daily periods of torpor occur among a number of nocturnal heteromyid rodents and one genus of cricetid rodents. These daily periods of torpor appear to be an adaptation to long-term food shortages, rather than a predictable seasonal scarcity of food (Bartholomew and Dawson 1968; MacMillen 1972).

MAN'S IMPACT ON DESERT MAMMALS

Increased human use of the California desert has reduced the number of mammalian spe living there and threatens the continued existence of many. Impacts may be divided into two gro 1) those directly eliminating animals and their habitat, and 2) those indirectly eliminating animal reducing or degrading resources required for their continued existence. These categories are mutually exclusive.

Highways and unprotected aqueducts can be the cause of direct mortality of animals inadvertently gain access to them. Open pit mines, agricultural development, power plant sites, utility corridors can substantially alter large expanses of habitat. Indiscriminate offroad vehicle can affect mammals by direct mortality as well as habitat degradation. More subtle impacts in activities which may not directly eliminate animals or their habitat, but alter the habitat so that it longer suitable for a particular species. Such changes may have negative effects on some spe yet may be beneficial to others.

Although the greatest numbers of cattle and sheep lived in the western United States (the first part of this century when the sheep industry was at its peak, forage demand by livest still at a very high level because of the large number of livestock on the range (Wagner Limited livestock grazing can be compatible with many mammals. However, grazing demonstrated by numerous studies, can cause shifts in plant species composition and vege structure (Weaver and Clements 1938; Ellison 1960; Wagner 1978). As vegetation compositio structure are altered by grazing, wildlife may be affected by even subtle changes, even though condition still remains favorable for livestock (Wagner 1978). Consequently, a change in m species composition can be expected as a result of vegetative changes due to grazing. These in plant species composition and habitat structure may be beneficial for species such black-tailed jackrabbit (*Lepus californicus*) and Merriam's kangaroo rat (*Dipodomys merriami*), occupy more open habitats. Other species, such as cottontails and rabbits, western harves (*Reithrodontomys megalotis*), and pocket mice (*Perognathus* and *Chaetodipus* spp.), require a overstory of vegetation and therefore their numbers decrease in response to increasing pressure (Phillips 1936; Stoddard and Smith 1955; Reynolds 1958; Ellison 1960; Martin Dick-Peddie 1976).

Overdraft of ground water supplies through excessive pumping of well overdevelopment of natural surface water sources, and extended droughts can have severe i on mammals. Reduction in flow or loss of water directly affects mammals that require water diets. These reductions in water availability also indirectly affect wildlife by altera water-dependent habitats, such as marsh and riparian areas. Water sources and their ass riparian and marsh systems may dry up as the water table declines, forcing dependent speci as bighorn sheep to seek other water sources. If no alternative sources are available, extirp local wildlife populations may result. As water becomes less available, interspecific compet limited quantities of water may increase. Less mobile species requiring riparian habitats extirpated if their habitat is eliminated due to lack of water.

Introduction and maintenance of populations of exotic species, such as the bur detrimental to many native mammal species. Forage, cover, and water are critical resource are often limited in supply. Excessive demands on these resources can lead to reduc population size, reproductive rates, and even extirpation of some mammal species. Even if supply of forage is present, increased use by a greater number of animals will reduce the available to any one individual. Forage may be available, but it may take more time and e obtain. This may cause reductions in the reproductive rate and consequently in population Feral burros consume a broad variety of forage and are able to increase their numbers on a poor range (Wagner 1978), while at the same time using limited water and consumin preferred by wildlife, including bighorn sheep (Hansen and Martin 1973; Seegmiller 1977;

1978). Competitive effects are not necessarily confined to food and water. If one animal consumes vegetation required by another for cover or if one species is intolerant of another's presence, the impacts would be equally detrimental.

Highways and aqueducts, in addition to eliminating habitat, may impede or halt movement of large herbivores and fragment mammal populations. The average paved highway forms a barrier to small mammals; such highways are as difficult to cross as a river twice as wide (Oxley et al 1974). Bighorn sheep are found in relatively small populations in many mountain ranges; corridors of suitable habitat between mountain ranges allow populations to move to other ranges when conditions become less favorable, such as during an extended drought. Interstate highways are bordered by fences which restrict, if not eliminate, movement by large mammals and may cause injuries to migratory bighorn sheep and mule deer. Fragmentation of mammal populations may result in extirpation of some subpopulations or perhaps increase the process of speciation, resulting in different forms than existed previously.

SUMMARY

Despite the overwhelming demands of a harsh environment and human encroachment, a large and diverse mammalian fauna exists in the California desert. At least 97 mammal species are known to occur in this region, with the greatest number of species and individuals being rodents. Desert mammals range from the peninsular bighorn sheep, recognized by the State as a Threatened species, to the ubiquitous coyote seen throughout the desert. A number of mammals, such as the Amargosa vole, listed as Endangered by both State and Federal government, and the Kingston Mountain chipmunk, which currently has no protection, are of special concern because their distributions are restricted or their populations are at low levels. Mammals are found in a variety of desert habitats, ranging from sand dunes to white fir forests, where they have adapted in a number of ways to existence in an inhospitable environment. These adaptations include mobility through flight or size which enables the animal to move great distances in a short time. Many species that cannot migrate circumvent desert conditions by being active only at night, restricting activity to more moderate seasons and finding refuge in underground burrows. Still others have special physiological adaptations.

Desert mammals may be more sensitive to human interferences than species in more hospitable habitats due to the unpredictable and often scarce nature of the resources upon which they depend. They also face intense competition from a variety of greatly increasing land use demands. Impacts in the California desert which affect mammal populations include urban and agricultural development; mineral, oil and gas exploration and development; mining; construction of power plants, power lines, aqueducts and highways; overdraft of ground water supplies; offroad vehicle use; livestock grazing and competition with introduced species. All these factors exert pressure on wildlife by altering habitats or directly influencing populations. Their cumulative impacts may, in time, substantially change the composition of the mammalian fauna in the California desert.

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LITERATURE CITED

Aardahl, J.B. and P. Roush. 1985. Distribution, relative density, habitat preference and s activity levels of the Mohave ground squirrel (*Spermophilus mohavensis*) and antelope squirrel (*Ammospermophilus leucurus*) in the western Mojave Desert, California. Department of Interior, Bureau of Land Management, California Desert District, F California. Adm. Rep.

Bartholomew, G. and W. Dawson. 1968. Temperature regulation in desert mammals. p In: G. Brown (Editor), Desert Biology, Vol. 1. Academic Press, New York and Londo

Bartholomew, G. and J. Hudson. 1961. Desert ground squirrels. Scientific American 205:1(

Berry, K., E. Wessman and J. Aardahl. 1975. Unit resource analysis: El Paso planning u Department of Interior, Bureau of Land Management, California Desert Plan Riverside, California.

Bleich, V. 1979. *Microtus californicus scirpensis* not extinct. J. Mamm. 60(4):851-852.

Bleich, V. 1980. Amargosa vole study: progress report. California Department of Fish ar Non-game Wildlife Investigations Progress Report. January 1980.

Brown, P. 1979. Analysis of the literature and other existing data on 22 species of bats oc the California desert. U.S. Department of Interior, Bureau of Land Management, Desert Plan Program, Riverside, California. Contr. CA-960-CT-115.

Bureau of Land Management. 1987. Desert Bighorn. BLM Newsbeat, September 1987. Land Management, Sacramento, California.

Burt, W. and R. Grossenheider. 1964. A Field Guide to Mammals. Houghton-Mifflin Co., E

California Department of Fish and Game. 1978. At the Crossroads. California Departme and Game, Sacramento.

California Department of Fish and Game. 1991a. 1990 Annual Report on the Status of State Listed Threatened and Endangered Plants and Animals, March 1991. The Agency, California Department of Fish and Game, Sacramento. 207 p.

California Department of Fish and Game. 1991b. Special Animals, August 1991. Department of Fish and Game, Natural Diversity Data Base, Sacramento.

California Department of Fish and Game. 1992. State and Federal Endangered and Animals of California. Revised April 1992. The Resources Agency, California De Fish and Game, Sacramento.

Chew, R. and B. Butterworth. 1964. Ecology of rodents in Indian Cove, Joshua Tr Monument, California. J. Mamm. 45:203-225.

Clark, R. and D. Weaver. 1990. You guys are doing what...? Outdoor California California Department of Fish and Game, Sacramento.

Dasmann, R. 1964. Wildlife Biology. John Wiley and Sons, Inc., New York.

Dick-Peddie, W. 1976. Changes in grass cover and desert rodent fauna following habitat perturbation. J. Ariz. Acad. Sci. 11:23.

Einarsen, A.S. 1948. The Pronghorn Antelope and its management. The Wildlife Management Institute, Washington, D.C. 238 p.

Ellison, L. 1960. Influence of grazing on plant succession of rangelands. Bot. Rev. 26(1):1-78.

Fletcher, D. 1977. *Microdipodops pallidus*: Annotated Bibliography. U.S. Department of Interior, Bureau of Land Management, California Desert Plan Program, Riverside, California. Contr. CA-060-PH7-2239.

Gould, G. and V. Bleich. 1977. Amargosa vole study: progress report. California Department of Fish and Game. Non-game Wildlife Investigations Progress Report. May 1977.

Hafner, D.J., and T.L. Yates. 1983. Systematic status of the Mojave ground squirrel, *Spermophilus mohavensis* (Subgenus *Xerospermophilus*). J. Mamm. 64:397-404.

Hall, E. 1981. The Mammals of North America, 2nd Ed. John Wiley and Sons, New York.

Hall, E. and K. Kelson. 1959. The Mammals of North America. Ronald Press, New York.

Hansen, R. and P. Martin. 1973. Ungulate diets in the lower Grand Canyon. J. Range Mgmt. 26:380-381.

Ingles, L. 1965. Mammals of the Pacific States. Stanford University Press, Stanford, California.

Johnson, D. 1943. Systematic review of the chipmunks of California. Univ. Calif. Publ. Zool. 48:63-148.

Johnson, D., M. Bryant and A. Miller. 1948. Vertebrate animals of the Providence Mountains area of California. Univ. Calif. Publ. Zool. 48:221-376.

Jones, J.K., Jr., D.C. Carter, H.H. Genoways, R.S. Hoffman, D.W. Rice and C. Jones. 1986. Revised checklist of North American mammals north of Mexico, 1986. Occas. Pap. Mus., Texas Tech. Univ. No. 107:1-22.

Laudenslayer, W.F. Jr., and W.E. Grenfell, Jr. 1983. A list of amphibians, reptiles, birds and mammals of California. Outdoor California 44(1):5-14. Department of Fish and Game, Sacramento.

Loft, E.R. 1989. A success story for California. Outdoor California 50(4)1-4. California Department of Fish and Game, Sacramento.

MacMillen, R. 1972. Water economy of nocturnal desert rodents. p. 147-174. In: G.M.O. Maloiy (Editor). Comparative Physiology of Desert Animals. Symp. Zool. Soc. London. Academic Press, New York and London.

Mansfield, T. 1990. Once in a lifetime bighorn. Outdoor California 51(1)19-20. California Department of Fish and Game, Sacramento.

Martin, S.C. 1975. Ecology and management of southwestern semidesert grass - shrub ranges: The status of our knowledge. Research Paper RM-156, Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

Merriam, C. 1919. Is the jaguar entitled to a place in the California fauna? J. Mamm. 1:38

Monson, G. and L. Sumner, Editors. 1980. The desert bighorn - its life history, e management. University of Arizona Press, Tucson. 370 p.

O'Farrell, T. and L. Gilbertson. 1979. Ecological life history of the desert kit fox in th Desert of Southern California. USDI, Bureau of Land Management, California De Program, Riverside, CA. Report for Contract CA-060-CT8-55 and CA-060-CT7-2779.

Oxley, D., M. Fenton and G. Carmody. 1974. The effects of roads on populations mammals. J. Appl. Ecol. 11:51-59.

Phillips, P. 1936. The distribution of rodents in overgrazed and normal grasslands Oklahoma. Ecol. 17(4):673-679.

Rado, T. and P. Rowlands. 1984. A small mammal survey and plant inventory of wetlan in Amargosa Canyon and Grimshaw Lake Areas of Critical Environmental Conce Department of Interior, Bureau of Land Management, Report No. 20310.3(C-068.26)

Reynolds, H. 1958. The ecology of the Merriam kangaroo rat on the grazing lands of Arizona. Ecological Monographs 28(2):111-127.

Schmidt-Neilson, B. and K. Schmidt-Neilson. 1950. Evaporative water loss in desert roden natural habitats. Ecology 31:75-85.

Schmidt-Neilson, K. and B. Schmidt-Neilson. 1953. The desert rat. p. 189-191. In: Adaptations. W.H. Freeman and Co., San Francisco.

Seegmiller, R. 1977. Ecological relationships of feral burros and desert bighorn sheep Arizona. M.S. Thesis, Arizona State University, Tempe.

Seton, E. 1929. Lives of Game Animals. Doubleday and Co., Garden City, New York.

Stoddard, L. and A. Smith. 1955. Range Management. McGraw-Hill Book Co., New York.

U.S. Fish and Wildlife Service. 1973. Threatened wildlife of the United States. U.S. Wildlife Service, Washington, D.C. Resource Publication 114.

U.S. Fish and Wildlife Service. 1989. U.S. Department of the Interior, Fish and Wildlif Federal Register 50 CFR Part 17: Endangered and Threatened Wildlife and Plant Notice of Review. January 6, 1989.

U.S. Fish and Wildlife Service. 1990. Endangered and Threatened Wildlife and Plants 17.11 and 17.22, April 15, 1990. U.S. Government Printing Office, Washington, D.C

Vaughan, T. 1972. Mammalogy. W.B. Saunders Co., Philadelphia.

Wagner, R. 1978. Livestock grazing and the livestock industry. p. 121-145. In: H.I (Editor), Wildlife in America. Council of Environmental Quality, Washington, D.C.

Wallmo, O.C. (Editor). 1981. Mule and Black-tailed Deer of North America. Th Management Institute, Washington, D.C.

Weaver, J. and F. Clements. 1938. Plant Ecology. McGraw-Hill Book Co., New York.

Weaver, R. 1972. Desert bighorn sheep in Death Valley National Monument and adjacent areas. Wildl. Mgmt. Adm. Rep. 72-4. California Dept. of Fish and Game, Sacramento.

Weaver, R. 1973. California's bighorn management plan. Desert Bighorn Council Trans. Las Vegas, Nevada.

Weaver, R. 1975. Status of the bighorn sheep in California. p. 58-64. In: J. Trefethen (Editor), The Wild Sheep in Modern North America. Boone and Crockett Club in cooperation with Winchester Press, New York.

Weaver, R. and J. Hall. 1971a. Bighorn sheep in Joshua Tree National Monument and adjacent areas. Wildl. Mgmt. Adm. Rep. 71-7. California Department of Fish and Game.

Weaver, R., and J. Hall. 1971b. Bighorn sheep in southeastern San Bernardino County. Wildl. Mgmt. Adm. Rep. 71-8. California Department of Fish and Game.

Weaver, R., and J. Hall. 1972. Bighorn sheep in the Clark, Kingston and Nopah Mountain ranges (San Bernardino and Inyo Counties). Wildl. Mgmt. Adm. Rep. 72-3. California Dept. of Fish and Game.

Weaver, R. and J. Mensch. 1969. A report on desert bighorn sheep in eastern Imperial County. P.R. Project W-51-R-14. California Dept. of Fish and Game.

Weaver, R., and J. Mensch. 1970a. Bighorn sheep in northwestern San Bernardino County. Wildl. Mgmt. Adm. Rep. 70-3. California Dept. of Fish and Game, Sacramento.

Weaver, R., and J. Mensch. 1970b. Bighorn sheep in southern Riverside County. Wildl. Mgmt. Rep. 70-5. California Dept. of Fish and Game, Sacramento.

Weaver, R., and J. Mensch. 1970c. Desert bighorn in northern Inyo and southern Mono Counties. Wildl. Mgmt. Adm. 70-7. California Dept. of Fish and Game, Sacramento.

Weaver, R., and J. Mensch. 1971a. Bighorn sheep in northeastern Riverside County. Wildl. Mgmt. Adm. Rep. 71-1. California Dept. of Fish and Game, Sacramento.

Weaver, R., and J. Mensch. 1971b. Bighorn sheep in southwestern San Bernardino County. Wildl. Mgmt. Adm. Rep. 71-2. California Dept. of Fish and Game, Sacramento.

Weaver, R., J. Mensch and W. Fait. 1968. A survey of the California desert bighorn in San Diego County. P.R. Project W-51-R-14. California Dept. of Fish and Game.

Weaver, R., J. Mensch and R. Thomas. 1969. A report on desert 'bighorn sheep in northeastern San Bernardino County. P.R. Project W-51-R-14. California Dept. of Fish and Game, Sacramento.

Weaver, R., J. Mensch, W. Zimmerman and J. Hall. 1972. Desert bighorn sheep in Death Valley National Monument and adjacent areas. Wildl. Mgmt. Adm. Rep. 72-4. California Dept. of Fish and Game.

Wessman, E. 1974. Unpublished field notes. U.S. Department of Interior, Bureau of Land Management, Desert Plan Staff, Riverside, California.

Wessman, E. 1977. The distribution and habitat preferences of the Mohave ground squirrel southeastern portion of its range. Wildl. Mgmt. Adm. Rep. 77-5. California Dept. of Fis Game, Sacramento.

Table 1. Mammals[1] known to occur within or adjacent to the California Desert.[2] (1/6)

ORDER FAMILY Genus, Species, Subspecies	Common Name	Range in the California Deserts[3]	Current Status[4]
ORDER MARSUPIALIA (Marsupials)			
DIDELPHIDAE (Possum Family)			
Didelphis virginiana	Virginia opossum	3	--
ORDER INSECTIVORA (Insectivores)			
SORICIDAE (Shrews)			
Sorex vagrans	Vagrant shrew	3A	--
Sorex monticolus	Dusky shrew	3A	--
Sorex ornatus	Ornate shrew	3	--
Sorex tenellus	Inyo shrew	3A	--
Sorex merriami	Merriam's shrew	3A	--
Notiosorex crawfordi	Desert shrew	2	--
TALPIDAE (Moles)			
Scapanus latimanus	Broad-footed mole	3	--
ORDER CHIROPTERA (Bats)			
PHYLLOSTOMIDAE (American Leaf-nosed Bats)			
Macrotus californicus	California leaf-nosed bat	2	C-2,CSC
VESPERTILIONIDAE (Vespertilionid Bats)			
Myotis lucifugus	Little brown myotis	3A	--
Myotis lucifugus occultus	Occult little brown bat	5	C-2,CSC
Myotis yumanensis	Yuma myotis	2	--
Myotis velifer	Cave myotis	5	C-2,CSC
Myotis velifer brevis	Southwestern cave bat	5	C-2,CSC
Myotis evotis	Long-eared myotis	2	--
Myotis thysanodes	Fringed myotis	2	--
Myotis volans	Long-legged myotis	2	--
Myotis californicus	California myotis	2	--
Myotis leibii	Small-footed myotis	2	--
Lasionycteris noctivagens	Silver-haired bat	6	--
Pipistrellus hesperus	Western pipistrelle	2	--
Eptesicus fuscus	Big brown bat	2	--
Lasiurus cinereus	Hoary bat	2	--
Lasiurus ega	Southern yellow bat	4	--

Table 1. Mammals[1] known to occur within or adjacent to the California Desert.[2] (2/6)

ORDER FAMILY Genus, Species, Subspecies	Common Name	Range in the California Deserts[3]	Current Status[4]
VESPERTILIONIDAE (Vespertilionid Bats) (continued)			
Euderma maculatum	Spotted bat	2	C-2,CS
Plecotus townsendii	Townsend's big-eared bat	2	C-2,CS
Plecotus townsendii townsendii	Pacific western big-eared bat	3	C-2,CS
Antrozous pallidus	Pallid bat	2	CSC
MOLOSSIDAE (Free-tailed Bats)			
Tadarida brasiliensis	Brazilian free-tailed bat	2	--
Tadarida femorosaccus	Pocketed free-tailed bat	4	CSC
Eumops perotis	Western mastiff bat	2	--
Eumops perotis californicus	California mastiff bat	2	C-2,CS
ORDER LAGOMORPHA (Hares, Rabbits and Pikas)			
LEPORIDAE (Rabbits and Hares)			
Sylvilagus bachmani	Brush rabbit	3	--
Sylvilagus nuttallii	Nuttall's cottontail	3A	--
Sylvilagus audubonii	Desert cottontail	2	--
Lepus californicus	Black-tailed hare	2	--
ORDER RODENTIA (Rodents)			
SCIURIDAE (Squirrels and Relatives)			
Tamias merriami	Merriam's chipmunk	3	--
Tamias panamintinus	Panamint chipmunk	6	--
Tamias panamintinus panamintinus	Panamint chipmunk	6,7(a)	--
Tamias panamintinus acrus	Kingston Mountain chipmunk	1	FSS
Tamias umbrinus	Unita chipmunk	3A	--
Ammospermophilus leucurus	White-tailed antelope squirrel	2	--
Spermophilus variegatus	Rock squirrel	5,6	--
Spermophilus beecheyi	California ground squirrel	3	--
Spermophilus mohavensis	Mohave ground squirrel	1	C-2,
Spermophilus tereticaudus	Round-tailed ground squirrel	2(b)	--
Spermophilus tereticaudus chlorus	Palm Springs ground squirrel	1	C-2,
Spermophilus lateralis	Golden-mantled ground squirrel	3B	--
Sciurus griseus	Western gray squirrel	3	--

Table 1. Mammals[1] known to occur within or adjacent to the California Desert.[2] (3/6)

ORDER FAMILY Genus, Species, Subspecies	Common Name	Range in the California Deserts[3]	Current Status[4]
GEOMYIDAE (Pocket Gophers)			
Thomomys bottae	Botta's pocket gopher	2(c)	--
Thomomys bottae amargosae	Amargosa southern pocket gopher	1	C-2,CSC
HETEROMYIDAE (Heteromyids)			
Perognathus longimembris	Little pocket mouse	2(d)	--
Perognathus longimembris brevinasus	Los Angeles pocket mouse	3	C-2,CSC
Perognathus inornatus	San Joaquin pocket mouse	3	--
Perognathus inornatus inornatus	San Joaquin pocket mouse	3	C-2,CSC
Perognathus parvus	Great Basin pocket mouse	6	--
Perognathus xanthonotus	Yellow-eared pocket mouse	3(e)	--
Chaetodipus formosus	Long-tailed pocket mouse	2	--
Chaetodipus baileyi	Bailey's pocket mouse	4	--
Chaetodipus penicillatus	Desert pocket mouse	2(b)	--
Chaetodipus fallax	San Diego pocket mouse	3B	--
Chaetodipus californicus	California pocket mouse	3	--
Chaetodipus spinatus	Spiny pocket mouse	4	--
Microdipodops pallidus	Pale kangaroo mouse	6	--
Dipodomys ordii	Ord's kangaroo rat	6	--
Dipodomys microps	Chisel-toothed kangaroo rat	6(b)	--
Dipodomys agilis	Pacific kangaroo rat	3(b)	--
Dipodomys panamintinus	Panamint kangaroo rat	7	--
Dipodomys panamintinus panamintinus	Panamint kangaroo rat	3(f)	FSS
Dipodomys panamintinus argusensis	Argus Mtns. kangaroo rat	1	FSS
Dipodomys deserti	Desert kangaroo rat	2	--
Dipodomys merriami	Merriam's kangaroo rat	2(g)	--
CRICETIDAE (Cricetids)			
Reithrodontomys megalotis	Western harvest mouse	2	--
Peromyscus eremicus	Cactus mouse	2	--
Peromyscus californicus	California mouse	3	--
Peromyscus maniculatus	Deer mouse	2	--
Peromyscus crinitus	Canyon mouse	2	--
Peromyscus boylii	Brush mouse	2	--
Peromyscus truei	Pinyon mouse	3,6	--
Onychomys leucogaster	Northern grasshopper mouse	6	--
Onychomys torridus	Southern grasshopper mouse	2	--

Table 1. Mammals[1] known to occur within or adjacent to the California Desert.[2] (4/6)

ORDER FAMILY Genus, Species, Subspecies	Common Name	Range in the California Deserts[3]	Current Status[4]
Sigmodon arizonae	Arizona cotton rat	5	--
Sigmodon arizonae plenus	Colorado River cotton rat	5	C-2,CSC
Sigmodon hispidus	Hispid cotton rat	5	--
Sigmodon hispidus eremicus	Yuma hispid cotton rat	5	C-2,CSC
Neotoma albigula	White-throated woodrat	4,5	--
Neotoma lepida	Desert woodrat	2	--
Neotoma fuscipes	Dusky-footed woodrat	3	--
Neotoma cinerea	Bushy-tailed woodrat	3A	--
Microtus californicus	California vole	1(d)	--
Microtus californicus mohavensis	Mohave vole	1	*
Microtus californicus scirpensis	Amargosa vole	1	FE,SE
Microtus californicus vallicola	Owens Valley vole	1	C-2,CSC
Lemmiscus curtatus	Sagebrush vole	6	--
Ondatra zibethicus	Muskrat	5	--
MURIDAE (Murids) *Mus musculus*	House mouse	2,8	--
ERETHIZONTIDAE (New World Porcupines) *Erethizon dorsatum*	Porcupine	3,6	--
ORDER CARNIVORA (Carnivores)			
CANIDAE (Coyotes, Wolves, Foxes and Dogs) *Canis latrans*	Coyote	2	--
Vulpes macrotis	Kit fox	2	--
Vulpes macrotis arsipus	Desert kit fox	1	--
Urocyon cinereoargenteus	Gray fox	2	--
URSIDAE (Bears) *Ursus americanus*	Black bear	3	--
PROCYONIDAE (Raccoons and Allies) *Bassariscus astutus*	Ringtail	2	--
Procyon lotor	Raccoon	2	--

Table 1. Mammals[1] known to occur within or adjacent to the California Desert.[2] (5/6)

ORDER FAMILY Genus, Species, Subspecies	Common Name	Range in the California Deserts[3]	Current Status[4]
MUSTELIDAE (Mustelids)			
Mustela frenata	Long-tailed weasel	3	--
Taxidea taxus	Badger	2	CSC
Spilogale gracilis	Western spotted skunk	2	--
Mephitis mephitis	Striped skunk	2	--
FELIDAE (Cats and Allies)			
Felis concolor	Mountain lion	2	--
Felis concolor browni	Yuma puma (mountain lion)	5	C-2,CSC
Felis rufus	Bobcat	2	--
ORDER PERISSODACTYLA (Introduced Perissodactyls)			
EQUIDAE			
Equus caballus	Horse	2	--
Equus assinus	Burro	2	--
ORDER ARTIODACTYLA (Artiodactyls)			
CERVIDAE (Cervids)			
Odocoileus hemionus	Mule deer	2	--
Odocoileus hemionus hemionus	Rocky Mountain mule deer	8	--
Odocoileus hemionus crooki	Desert mule deer	5	--
Odocoileus hemionus californicus	California mule deer	3A	--
Odocoileus hemionus fuliginatus	Southern mule deer	3B	--
BOVIDAE (Bovids)			
Ovis canadensis	Bighorn sheep	2	--
Ovis canadensis californiana	California bighorn sheep	3A	FSS,C-2,ST
Ovis canadensis cremnobates	Peninsular bighorn sheep	3B	FSS,C-2,ST
Ovis canadensis nelsoni	Desert bighorn sheep	1	*

Table 1. Mammals[1] known to occur within or adjacent to the California Desert.[2] (6/6)

ORDER FAMILY Genus, Species, Subspecies	Common Name	Range in the California Deserts[3]	Current Status[4]
ANTILOCAPRIDAE (Pronghorn) *Artilocapra americana*	Pronghorn	9	--

[1]Subspecies listed are only those on one or more list of species of concern whose populations small or fragmented, or are discussed in the text.

[2]Nomenclature from Laudenslayer and Grenfell (1983) and Jones et al (1986). Range informa from Hall and Kelson (1959) and Hall (1981). Information on bats from Brown (1979). Status f U.S. Fish and Wildlife (1989, 1990); Calif. Dept. of Fish and Game (1991a); Special Animals f Calif. Dept. Fish and Game (1991b); and Calif. Dept. of Fish and Game 1992).

[3]Key to the Range Code of Mammals listed in Table 1:

1. Restricted to California desert
2. Widespread range includes California desert
3. Peripheral along western border of California desert

3A. Peripheral along northwestern border of California desert
3B. Peripheral along southwestern border of California desert

4. Peripheral along California/Mexican border
5 Peripheral along California/Arizona border
6. Peripheral along California/Nevada border
7. Large portion of range is within the California desert
8. Introduced
9. Reintroduced

a. 1 subspecies restricted to California desert; 30% of species' total range in California deserts
b. 1 subspecies restricted to California desert
c. Several subspecies are restricted to California desert
d. 3 subspecies restricted to California desert
e. Restricted to Tehachapi Mountains; range extends into California desert
f. 2 subspecies restricted to California desert; one other subspecies has about 80% of its range in the California desert
g. 1 subspecies has about 80% of its range in the California desert

[4]Current Status Codes:

C-2 = Category 2 candidate species for possible future Federal listing as Threatened or Endang
FE = Federally listed as Endangered
FSS = Federal (BLM and USFS) Sensitive Species
SE = California listed as Endangered
ST = California listed as Threatened
CSC = California Department of Fish and Game Species of Special Concern
* = Taxa which fall into one or more of several categories: rare or endangered under C guidelines; biologically rare, restricted or declining; occurs elsewhere but threatened with extirpati California; or habitat rapidly declining.