Species Accounts - Mammals

Riparian brush rabbit

Sylvilagus bachmani riparius

State: Endangered 1994
Federal: Endangered 2000

General Habitat:

Riparian brush rabbits are only found in native riparian areas with large clumps of dense shrubs, low growing vines, and some tall shrubs and scrubby trees in the San Joaquin Valley. Grasses are the most important food, and riparian brush rabbits rarely venture more than one to two yards from dense cover. Its range is quite narrow. It is found in the 261-acre Caswell Memorial State Park in southern San Joaquin County, and near a railroad right of way in the Paradise Cut area south of Stockton.

Description:

The riparian brush rabbit is one of eight subspecies of the brush rabbit, an animal generally widespread in California. The riparian brush rabbit can be distinguished from other brush rabbit subspecies by its isolated location and its skull characteristics. This subspecies is slightly larger, has larger eyes and ears, is more grayish and yellowish in coloration, and has a very conspicuous tail. The animals are most active in the early morning and evening hours. The breeding season is typically from January to May, with peak activity between mid-January and mid-April. Gestation is about 27 days, and females may breed again shortly after giving birth. About three to four litters per female may be produced during the breeding season, with three to four young per litter.

Status:

Flooding, wildfires, predation, and disease remain the greatest threats to the riparian brush rabbit. The last documented estimate of population size was 200 to 300 individuals in 1993. During the mid-1970s, the population had dipped to an extreme low of 15 to 20 individuals due to severe flooding. The floods of 1996 may also have caused extensive mortality. Initial attempts to live-capture rabbits during a study that began in 1997 were of limited success, indicating an extremely low estimated population. In 1997, USFWS proposed endangered status

for the species

In 1998, USFWS finalized the *Recovery Plan for Upland Species of the San Joaquin Valley, California*. The Recovery Plan addresses the research, management, and recovery needs for the riparian brush rabbit, including restoring habitat and establishing additional populations within the historic range. In 2000, the riparian brush rabbit was listed as a federal endangered species. A brush rabbit working group has met periodically since 1997 to help guide conservation efforts for the subspecies. In 1998 live capture success was very low but improved slightly in 1999; a new population was discovered in the Paradise Cut area of San Joaquin County on Union Pacific Rail Road right of way lands. An agreement developed between the DFG and the rail road company allowed the rabbits within the right of way to be live captured and removed to a captive breeding facility, consisting of three large fenced and secured enclosed pens built in 2001-2002 on Department of Water Resources land in San Joaquin County.

Captive breeding facilities were stocked with wild caught rabbits in equal sex ratios. Genetic studies are ongoing to ensure the suitability of rabbits from different wild populations for captive breeding and translocation purposes. An additional wild population of rabbits was discovered on private land near the city of Stockton in 2003. Releases of radio-tagged rabbits began in 2002. To date, well over 100 rabbits have been produced in the three captive breeding pens and over 70 have been released to the wild to establish a new wild population on the San Joaquin River National Wildlife Refuge. Successful breeding within the new population has already been documented, and further releases are scheduled for 2003. Due to the ever accelerating nature of captive breeding a species such as a rabbit, the foregoing numbers must be considered a bare minimum of the total potential of the project. Mortality of the released rabbits is deemed moderate due to natural predation.

The goal of the recovery strategy is to continue to breed and release captive reared rabbits and establish at least three new wild populations in suitable habitat on secure public lands. Each such newly established population may ultimately consist of several hundred to thousands of individual riparian brush rabbits. With suitable areas provided, the populations are expected to reach the carrying capacity of the available habitats, which could lead to the ultimate recovery of the species. Augmentation of the Caswell Memorial State Park population with captive reared rabbits to near the carrying capacity of the available habitat is also proposed. The search continues for additional wild populations to protect and secure, as well as to serve as a source of breeders for the captive breeding facility.

The status in 2003 of the riparian brush rabbit: *Stable to Increasing*.

San Joaquin antelope squirrel

Ammospermophilus nelsoni

State: Threatened 1980
Federal:

General Habitat:

Habitats of antelope squirrels consist of grasslands with moderate shrub cover which includes such species as salt bush, ephedra, bladder pod, goldenbush, snakeweed, and others. Populations now exist primarily in marginal habitats of the low foothills and mountains of the western edge of the valley. Currently, populations of significant size exist only in western Kern County at Elk Hills and on portions of the Carrizo and Elkhorn plains.

Description:

The San Joaquin antelope squirrel is one of five species of antelope squirrels. The species is omnivorous with a diet consisting primarily of grass and forb seeds and insects. Antelope squirrels use burrows that they or other animals have dug. The general active period during spring and summer months coincides with air temperatures of 68°to 86°F.

Status:

Historically, San Joaquin antelope squirrels ranged from western Merced County to the southern end of western San Joaquin Valley. They occupied the valley floor in Kern County and along the eastern edge northward to Tipton, Tulare County. Conversion of native habitat to intensive forms of agricultural development is the greatest threat to the population. Recovery options for this species are addressed in the USFWS 1998 *Recovery Plan for Upland Species of the San Joaquin Valley, California*.

Researchers have gathered data on the interrelationships between antelope squirrels and the State and federally listed giant kangaroo rat. Translocation of giant kangaroo rats from one locality to another has been successful on the Carrizo Plain National Monument during 1989-92 and may have application to recovery efforts for antelope squirrels since the habitat requirements of the two species are quite similar. A study on the Lokern Area Preserve in Kern County, initiated in 1997, is addressing the issue of grazing as a management tool for several species including the antelope squirrel. San Joaquin antelope squirrels have steadily increased in number since 1998, due in large part to the below-average rainfall experienced since 1999. Numbers of antelope squirrels are now high across the Lokern Study Area. In 1999 and 2000, more squirrels were caught on the grazed plots compared to the ungrazed plots, but the lack of grass in both controls and treatments in recent years has masked any benefit we found from grazing. Rainfall levels that are higher than the average are needed in coming years in order to return the ungrazed sites to dense grass cover. Once the control plots are grassy, it should be possible to quantify the effect of cattle grazing on populations of San Joaquin antelope squirrels.

The DFG is involved in several conservation efforts for the San Joaquin antelope squirrel, including the

Metropolitan Bakersfield HCP, the California Department of Corrections Electric Fence HCP, the Coles Levee area 2081 Agreement, and the Arco Western Energy HCP.

The status in 2003 of the San Joaquin antelope squirrel is Stable to Declining.

Mohave ground squirrel

Spermophilus mohavensis

State: Threatened 1971
Federal: None

General Habitat:

The Mohave ground squirrel occurs only in California It is resident in the various desert scrub communities and Joshua Tree Woodland of the western Mojave Desert in southwestern Inyo, eastern Kern, northwestern San Bernardino, and extreme northeastern Los Angeles counties. The Mohave ground squirrel inhabits flat to moderate terrain and is not generally found in steep contours although juveniles apparently traverse steep terrain during dispersal. The species has been found most frequently in sandy, alluvial soils, but is also found in gravelly and occasionally rocky soils. Habitat features center on availability of food resources and soils with appropriate composition for burrow construction.

Description:

The squirrel is cinnamon-gray in color with white underparts. Juveniles are cinnamon-colored and molt to grayer pelage as they mature. The species lives in underground burrows, in which it spends at least seven consecutive months (usually from July or August through February) at a low metabolic rate, living on body fat alone, to avoid the seasons of the year in which food is least available.

Status:

The Mohave ground squirrel is threatened by loss and degradation of its habitat due to agriculture, urban, suburban, and rural development, energy development, military activities, livestock grazing, and OHV use. Agriculture affects the species through conversion of habitat, exposure to pesticides, herbicides, and rodenticides. Agricultural development has resulted in the loss of occupied and potential habitat in the area between Antelope Valley, Lucerne Valley, and the Mojave River Basin. 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.

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. Impacts associated with urban and rural development include the direct mortality of individuals due to increased vehicle use and increased numbers of domestic and feral cats and dogs. Energy development, including geothermal and solar energy development, has resulted in habitat loss for Mohave ground squirrels, and several such projects are now under consideration. For

example, the BLM has identified sites for potential renewable energy resources, such as wind, solar, and photovoltaics, in the Mojave Desert.

The Mohave ground squirrel is not absent from all urban areas. In 2002, a Mohave ground squirrel was observed south of Highway 138, near Pinyon Hills, and a second observation occurred near an aerospace industrial complex located adjacent to Palmdale. In the first case, the site and adjacent areas are comprised of extensive tracts of undeveloped lands and those with relatively light rural development. At the second site, there are about five to six contiguous square miles of relatively undeveloped land, but the entire area is surrounded by urban and agricultural development. The ground squirrel has also been observed in residential backyards in Inyokern and may be seen foraging on the golf course at China Lake. One squirrel was recently trapped at the proposed Hyundai facility south of California City, where the consultant had identified habitat as being marginal. In these latter cases, the sightings are adjacent to extensive areas of undeveloped lands. Given these observations, the only certain areas of extirpation within the range of the species are those that have been physically developed. Such areas include, but are not limited to, paved roads and parking lots; residential, commercial, and industrial sites occupied by buildings, graded areas, and other areas where vegetation has been mechanically removed; solar facilities at Kramer Junction and Harper Lake; and large mined areas such as at U.S. Borax, Rand Mining Company facilities, and in portions of the Shadow Mountains east of Edwards AFB.

Four major, active military installations occur within the West Mojave and comprise a total of 4,165 square miles: the Naval Air Weapons Station at China Lake, the Fort Irwin National Training Center, Edwards Air Force Base, and Marine Corp Air Ground Combat Center near Twentynine Palms. A 250-square mile expansion of Fort Irwin has been proposed. Military maneuvers result in mortality to ground squirrels, damage to vegetation, soil compaction, a change soil texture, and creation of fugitive dust. The results are largely denuded habitat; altered vegetation composition, abundance, and distribution; and a change to finer grained soils. In studies of the desert tortoise, military activities had the greatest adverse impact in valley bottoms, areas that also provide habitat for the Mohave ground squirrel. Changes in soil texture, from a coarser to finer texture, has been documented in agricultural areas and areas of military maneuvers. Finer textured soils do not provide a suitable substrate for ground squirrel burrow construction.

Grazing by livestock may affect Mohave ground squirrels through changes in soil and vegetative structure, accelerated erosion, and collapsing of burrows. Sheep are generally grazed in the desert between late February and the middle of June, which coincides with Mohave ground squirrel emergence from hibernation in February and its entire activity period, particularly during very dry years when the squirrel may enter hibernation in June. These times are critical for both adult and juvenile squirrels to attain sufficient fat reserves to enter into and successfully emerge from hibernation. The severity of grazing impacts may range from marginal in lightly-used areas to extreme at cattle troughs and sheep bedding areas. Research conducted at the Coso study area demonstrated that forage consumed by Mohave ground squirrels is also consumed by both sheep and cattle. Competition for winterfat, hopsage, and saltbush, all important ground squirrel food plants, could be exacerbated during times of drought because alternative sources of food are not available. Although the Mohave ground squirrel is adapted to drought and arid conditions, prolonged drought reduces productivity of forage plants and reproduction in the ground squirrel. Shrub cover required by the Mohave ground squirrel for thermoregulation and protection from predators can be reduced by grazing pressure.

Persistent grazing pressure has resulted in the replacement of native perennial grasses by non-native annual grasses throughout much of the western Mojave Desert. Human development in the desert has also resulted in the proliferation of non-native grasses, such as red brome, cheatgrass, and Mediterranean grass. Grazing, OHV use, and other types of ground disturbance facilitate the spread of these grasses, which are adapted to disturbance and outcompete the native species that constitute food plants of the Mohave ground squirrel. The increase in grass cover between desert shrubs has been linked to increased fire frequency and fire intensity in the desert. Fires cause direct mortality when ground squirrels are burned or inhale lethal amounts of smoke, which can occur both in and out of burrows. Fire changes the composition of vegetation by facilitating the

establishment of non-native grasses and removing forage plants. Fires also fragment habitat by creating patches of unsuitable habitat.

Habitat fragmentation results in the isolation of populations and potential loss of genetic variation. Small isolated populations may experience a reduced ability to adapt to environmental change, and a decrease in reproductive success, growth, and survivorship. Such populations face a greater probability of extirpation. During extended droughts, for example, lower quality habitat may not be capable of supporting the species, and result in local extirpation. Recolonization of these areas may occur when conditions favoring reproduction resume.

In 2003, the BLM released the draft environmental documents for the West Mojave Plan (Plan). If adopted by the BLM, the Plan amends the California Desert Conservation Plan of 1980. It presents a strategy to conserve and protect the Mohave ground squirrel, desert tortoise, and nearly 100 other sensitive plant and animal species, while providing a streamlined program for complying with the requirements of the California and federal Endangered Species Acts. Seven alternative conservation strategies, representing different approaches to achieving biological goals and objectives for the covered species, are provided. These strategies are intended to mitigate for the future incidental take of the proposed "covered species" from urban development and land management activities. Goals of the Plan include protecting Mohave ground squirrel habitat throughout its range and ensuring long-term viability of the species. The entire known range of the Mohave ground squirrel occurs within the West Mojave; all but a small part of that, which is located northeast of Searles Dry Lake, occurs within the planning area, west and north of the Mojave River.

The preferred alternative for the West Mojave Plan proposes ecosystem-scale conservation with the establishment of four very large Desert Wildlife Management Areas (DWMA) and additional lands for the Mohave Ground Squirrel Conservation Area. The desert tortoise and Mohave ground squirrel are "umbrella species", a term used to describe protection of many other species under the "umbrella" of conservation for important wide-ranging species. A conservation area would be established for the long-term survival and protection of the Mohave ground squirrel. This Conservation Area would include portions of the Fremont-Kramer and Superior-Cronese Tortoise DWMAs, and additional, essential habitats located west and north of the two tortoise DWMAs.

The West Mojave Plan would adopt provisions of the Los Angeles County Significant Ecological Area ordinance. Los Angeles County has identified a Significant Ecological Area (SEA) for northeastern Los Angeles County that should prove beneficial to protection of the Mohave ground squirrel. Within SEAs, the County performs a heightened environmental review for new projects, and has proposed zoning the area for a minimum lot size of 10 acres. The West Mojave Plan would focus on ground squirrel habitat on eastern side of the Sierra Nevada. This narrow band of habitat provides an important linkage corridor from north to south along Highways 178, 14, and 395. Projects in this area would also receive special review to ensure that habitat is not fragmented. Impact avoidance measure applicable to the desert tortoise would also be applied to the Mohave ground squirrel. These measures include restrictions on commercial activities, construction activities, and hunting and shooting.

The ultimate preserve design for the Mohave ground squirrel will need to conserve a substantial portion of its known range to allow for natural fluctuations in local and regional populations in response to climatic factors, rainfall. The size and location of preserve areas should be based on biological, demographic, and genetic considerations and 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.

In contributing to the conservation strategy for the squirrel, the DFG expressed concern that no strategy would be successful without the participation of the military bases in the western Mojave Desert. Because the Mohave ground squirrel is not federally listed, the military departments are not required to develop policies to conserve

the species. The DFG and USFWS concurred that those wildlands on military bases not needed for current missions should be managed for the greatest biodiversity of wildlife species and that those local areas on bases be managed for listed species such as the desert tortoise and Mohave ground squirrel. Special protective measures would need to be implemented if the Fort Irwin National Training Center expands into the Superior Valley region, as has been proposed. In December 2000, legislation authorizing expansion of Fort Irwin into critical habitat for the desert tortoise in the Superior Valley region was passed and signed into law by President Clinton. The proposed expansion is currently undergoing extensive environmental review; the release date of the documents is not known at this time (late 2004).

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. These points were underscored in a recent study conducted by the USGS. USGS scientists reviewed existing Mohave ground squirrel trapping records to facilitate future habitat modeling and population trend predictions. The scientists found that the trapping records could not be used to develop models because of differences in sampling methodology and types of data reported. The researchers found, however, that trapping success declined significantly between 1980 and 2000 across most of the range of the species, raising concerns that Mohave ground squirrel numbers are decreasing across its geographic range. The exception was in the Coso geothermal region where numbers of animals increased between 1984 and 1998. Population numbers did not correlate with winter rainfall. Due to the lack of quantitative data, additional research is needed to accurately determine the status and trend of the Mohave ground squirrel.

Morro Bay kangaroo rat

Dipodomys heermannii morroensis

State:	Endangered	1971
	Fully Protected	
Federal:	Endangered	1970

General Habitat:

The Morro Bay kangaroo rat primarily inhabits low, sparse coastal dune scrub vegetation associated with stabilized sand dunes in the Morro Bay area. Its habitat is highly localized in the vicinity of Los Osos in San Luis Obispo County. Plant species in its habitat include bush lupine, dune lupine, mock heather, coyote bush, California sagebrush, croton, buckwheat, phlox, and deerweed. Plant roots provide support for burrows.

Description:

This kangaroo rat, like all species of kangaroo rats, has long hind legs, small front legs and feet, brown upper parts, and a white belly. It is smaller and darker than any other subspecies of Heermann's kangaroo rat. The average adult weight is approximately 2.3 ounces, and the average length is about 11 inches. The lack of a complete hip stripe also distinguishes this animal from other kangaroo rats.

Status:

The Morro Bay kangaroo rat is threatened by loss and degradation of its habitat due to development, invasion of non-native plant species, disruption of natural disturbance patterns, and OHV use. The kangaroo rat is also threatened by predation by cats. The historic known distribution of this species was approximately 200 acres. If it still exists, it is believed to occur only on one small, privately-owned parcel of native vegetation. The most recent observations of the kangaroo rat date from the mid-1980s. A revised Draft Recovery Plan for the Morro Bay kangaroo rat was released in 2000 by the USFWS. The recovery plan was revised to allow captive breeding of the species if individuals are found.

The Morro Bay kangaroo rat is geographically isolated from other subspecies of the Heermann's kangaroo rat. A mitochondrial DNA study of museum specimens conducted at San Francisco State University suggests recent origin of the Morro Bay kangaroo rat and that the historic population underwent at least one genetic bottleneck. Researchers also found that historical populations of the Morro Bay kangaroo rat exhibited low genetic diversity even prior to a population bottleneck that endangered the subspecies. A genetic bottleneck refers to a drastic reduction in the size of the original population, usually due to a catastrophic event, which reduces the gene pool of the species.

In 2002, San Luis Obispo County received a grant from the USFWS under the Service's Habitat Conservation

Planning Assistance and Land Acquisition Section 6 grant program. This grant will help initiate the development of an HCP which will cover 43,500 acres in the Estero area, the central coastal part of the county. Development of an HCP in this area will provide for a conservation strategy for covered species to address recovery needs and to allow for more flexible planning and implementation. This HCP will benefit several listed species including the Morro shoulderband snail and the Morro Bay kangaroo rat. Additional federal funding has been granted to conduct a two year field survey for the Morro Bay kangaroo rat and to estimate the genetic relatedness between the Morro Bay and Lompoc kangaroo rats. The Lompoc kangaroo rat has been used as a surrogate for the Morro Bay kangaroo rat to develop captive breeding protocols.

The DFG considered the Morro Bay kangaroo rat to be *Possibly Extirpated*.

Giant kangaroo rat *Dipodomys ingens*

State:	Endangered	1980
Federal:	Endangered	1987

General Habitat:

Giant kangaroo rats require annual grassland and shrub land habitats with sparse vegetative cover and soils that are well drained, fine sandy loams with slope generally less than 10 percent. Areas of low annual precipitation and infrequent flooding are preferred by this species for establishment of permanent colonies. The historical range extended from Merced County south to Kern County and west to eastern San Luis Obispo and northern Santa Barbara counties.

Description:

Giant kangaroo rats are small mammals with elongated hind limbs for hopping and external cheek pouches for carrying food to their burrows. The giant kangaroo rat is the largest of all kangaroo rats and weighs from 4.6 to 6.4 ounces. The total length is 12 to 13 inches, including a tail that is six to eight inches. Giant kangaroo rats subsist almost entirely on the seeds of annual plants such as brome grasses and filaree. The animals harvest, stack, and dry caches of grasses and forbs near the entrance of their burrows. Giant kangaroo rats inhabit a territory, known as a precinct that averages 20 feet in diameter where a shallow burrow system, about 12 inches deep, is constructed. Each kangaroo rat maintains and defends an individual territory in a colony that may consist of from two to thousands of precincts.

Status:

The historical range of the giant kangaroo rat extended from Merced County south to Kern County and west to eastern San Luis Obispo and northern Santa Barbara counties. Populations were most numerous in areas with sparse vegetative cover and low annual precipitation. Today very little undisturbed suitable habitat remains. The loss of original habitat to agricultural conversion may be as much as 98 percent. Five relatively small areas totaling 12-square miles remain that support population densities typical of those existing prior to 1950.

In 1997, several population assessment studies confirmed that the giant kangaroo rat population had dramatically declined along with that of many other kangaroo rats in the southern San Joaquin Valley. At other locales such as the Elkhorn Plain in eastern San Luis Obispo County the declines were not as severe. In 1998 and 1999 giant kangaroo rat numbers began to increase at the Elkhorn Plain study area. Genetics studies, initiated in 1993, continue on this and other kangaroo rat species, and are yielding valuable information that can be applied to

recovery strategies for all endangered kangaroo rats.

In 1997, an additional research effort began at the Lokern Area in western Kern County to further investigate the role of livestock grazing on species and habitats on the floor of the San Joaquin Valley. However, few giant kangaroo rats have been caught on plots in the Lokern Study Area since the beginning of the study. Researchers did, however, capture the most individuals in any year of the study in 2002 when they caught three in each of two treatment plots (out of four). In addition, a colony of about 20 individuals was seen near one of these treatment plots. Although numbers have remained fairly low throughout the study, giant kangaroo rats have only been caught in plots grazed by cattle, never in any of the four ungrazed plots. In a separate study initiated by BLM in 1993 at a location about 3 km north of the Lokern Study Site, researchers have captured giant kangaroo rats twice a year since 1993. Population numbers were as high as 110 individuals caught in a six-night census when the study began, decreased to 0 for both sessions in 1998 (dense grass year), and has steadily increased back up to about 45-70 individuals caught in 2002/2003. Trends in population size seem correlated with the amount of grass cover: the less grass, the greater the number of giant kangaroo rats caught.

The conversion of native habitat to agricultural uses remains the greatest threat to the species. Ongoing studies, initiated in 1987 at the Elkhorn Plain, an area that is now included in the Carrizo Plain National Monument, which was established in 2000, indicate a healthy population that is reproducing well during years with adequate rainfall. Researchers from the Endangered Species Recovery Program conduct giant kangaroo rat population censuses twice a year at the Elkhorn Plain study area.

The recovery options for the giant kangaroo rat are addressed, along with those for 33 other species of plants and animals, in the USFWS 1998 *Recovery Plan for Upland Species of the San Joaquin Valley, California*. The DFG is involved in several conservation efforts for the giant kangaroo rat. Some of the efforts include the Metropolitan Bakersfield HCP, the California Department of Corrections Electric Fence HCP, the Coles Levee area 2081 Agreement, and the Arco Western Energy HCP. Despite these conservation efforts, habitat loss remains the primary obstacle to recovery with only populations on established preserve lands secure for the foreseeable future.

The status in 2003 of the giant kangaroo rat: *Stable to Declining*.

Stephen's kangaroo rat *Dipodomys stephensi*

State: Threatened 1971
Federal: Endangered 1988

General Habitat:

The Stephen's kangaroo rat inhabits annual grassland with sparse perennial vegetation in the San Jacinto Valley and adjacent areas of western Riverside and northwestern San Diego County. Occupied habitats consist of sparse, slightly disturbed coastal sage scrub, dominated by California sagebrush or California buckwheat, or annual grassland. The populations with the highest densities have been found in areas where the herbaceous layer still contains California native annuals, and where perennial plant cover is less than 30 percent. Stephens' kangaroo rat occurs on level or low rolling terrain with slopes of less that 30 percent where gravel is a common component of the soil. It is not found on extremely hard or sandy soils. In general, the highest abundances of Stephens' kangaroo rats occur on gentle slopes less than 15 percent.

Description:

Stephens' kangaroo rat physically resembles all other kangaroo rat species in having long hind legs, small front legs and feet, brown upper parts, a white belly, and a long, tufted tail. There are five toes on the hind foot and the tail is 1.45 times the length of the head and body. Stephens' kangaroo rat is distinguished from the sympatric agile kangaroo rat (*Dipodomys ogilis*) by a lateral white tail band that is one half or less (rather than one half or more) times the width of the dorsal tail stripe, dusky (rather than dark) soles on the hind feet, a comparatively grizzled appearance to the dorsal tail stripe due to many white hairs, a darker tail tuft due to few white hairs, a smaller ear, and a relatively broad head. The average adult Stephens' kangaroo rat is 11 to 12 inches in length and weighs 23 ounces.

Status:

Stephens' kangaroo rat is threatened by destruction, fragmentation, and degradation of its habitat through human and human-induced activities. Adverse impacts to kangaroo rat habitat result from clearing of land for urban and suburban development and for agriculture, water projects, military activities, wildland or prescribed fires, OHVs, livestock use, and invasion of non-native plant species. The Stephens' kangaroo rat is restricted to Riverside County and adjacent northern-central San Diego County.

The USFWS released its draft recovery plan for the kangaroo rat in mid-1997. The document proposes that USFWS consider the kangaroo rat for reclassification to threatened status when four reserves totaling at least 15,000 acres of habitat occupied by the kangaroo rat in western Riverside County and one habitat reserve in San Diego County are "permanently protected, funded, and managed." The USFWS would consider delisting the kangaroo rat when at least five habitat reserves in western Riverside County, totaling at least 16,500 acres of occupied habitat and two additional reserves in San Diego County are "permanently protected, funded, and

managed."

Stephens' kangaroo rat populations at several reserves in Riverside County are being monitored through burrow counts and live-trapping. The kangaroo rat is the sole species addressed in the 1996 *Habitat Conservation Plan for the Stephens' Kangaroo Rat in Western Riverside County* (SKR HCP), prepared by the Riverside County Habitat Conservation Agency. The HCP provides Take Authorization for the species within its boundaries. The West Riverside Multiple Species Habitat Conservation Plan (MSHCP) provides Take Authorization for the kangaroo rat outside the boundaries of the Stephen's Kangaroo Rat HCP, but within the MSHCP boundaries. The core reserves established by the NCCP will be managed as part of the MSHCP Conservation Area consistent with the NCCP. Under the MSHCP, species conservation objectives include maintaining occupied habitat within the NCCP boundary; maintaining occupied habitat within the MSHCP Plan Area but outside of the HCP boundary; and maintaining a specified population density.

Approximately 22,400 acres of occupied sites and suitable habitat will be conserved in the MSHCP Conservation Area, 3,200 acres more than acreage conserved under the SKR HCP. The Conservation Area will conserve adequate representations of the older and younger populations with three of the core reserves containing the older populations and at least four of the core reserves containing the younger populations. In general, the largest and key populations of the Stephens' kangaroo rats are centered within the larger core reserves in western Riverside County: 1) the San Jacinto Wildlife Area/Lake Perris-Badlands-Potrero Valley complex; 2) the Lake Mathews/Estelle Mountain-Steele Peak-Kabian Park-Sedco Hills complex; and 3) the Lake Skinner/Domenigoni Valley-Sage-Wilson Valley-Vail Lake-Aguanga-Anza Valley complex. Other important locations in the MSHCP Plan Area not in the existing Stephens' kangaroo rat reserve include the Potrero Valley, Anza and Cahuilla valleys, and the Sage/Aguanga area.

Preserve configuration and connectivity within and between populations are essential to the long-term conservation of the species. Research has shown that the Stephen's kangaroo rat is more sedentary than other species of kangaroo rat and that genetic exchange between populations of the species is restricted in fragmented habitat. Maintaining connectors between core areas is, therefore, critical to maintaining genetic exchange in the species. Because the kangaroo rat is relatively sedentary, these connectors should include functional habitat that can be permanently colonized. The preserve design envisioned under the MSHCP would include the three large core reserves in western Riverside County. Culverts under Highway 79 and Highway 60 in the first area allow kangaroo rat movement to habitat bisected by these highways. Culverts could be installed under Highway 74, a potential barrier to movement in the Lake Matthews habitat complex.

The Stephens' kangaroo rat populations in the southeastern portion of the Plan Area probably have the best existing habitat connections, within contiguous habitat linking Lake Skinner-Domenigoni Valley, Sage, Wilson Valley, Lewis Valley, Vail Lake, Aguanga, Tule Valley and Anza Valley. Potential obstacles to movement between these areas are Sage Road, Highway 79 (between Temecula and Aguanga), and Highway 371. However, the rural character of this region will be preserved and it is expected that existing habitat connection function also will be preserved. Two core reserves that are, and probably will remain, functionally isolated from other reserves are the Motte-Rimrock Reserve and Sycamore Canyon-March Air Reserve Base. Existing land uses and high economic values in these areas preclude connecting these reserves to other large reserve areas.

In northern San Diego County, Stephens' kangaroo rat occurs at Camp Pendleton, Fallbrook Naval Weapons Annex, Lake Henshaw, Santa Maria Valley (Ramona), and Guejito Ranch. Occurrences in grasslands adjacent to Guajome Lake and Pilgrim Creek and Ramona that the species could be more widespread in grasslands of San Diego County than was previously thought, but suitable habitat is mostly north and east of the MHCP plan area. Available habitat in San Diego County has been greatly reduced and fragmented through urban and agricultural development. Periodic disturbances that reduce shrub cover and increase cover by annual plants may improve habitat for this species. Only about 31% of the remaining grasslands in the MHCP area are expected to be conserved, and much if this occurs on clay soils unsuitable for burrow construction and in isolated areas that are too small to support viable populations of kangaroo rat. Nevertheless, Stephens' kangaroo rat could potentially

colonize grasslands or agricultural fields in Oceanside, in the vicinity of occupied habitat on Camp Pendleton and Fallbrook Navel Weapons Annex. The 2003 wildfires burned large areas of San Diego County, including approximately 19,000 acres (25%) of habitat suitable for the Stephens' kangaroo rat. Because Stephens' kangaroo rats prefer low, sparse vegetation, compared to denser grassland or coastal sage scrub, the long-term effects of fire may be beneficial to the species.

Recent mitochondrial DNA (mtDNA) analysis found that the different geographic regions within the species' range (northern, central and southern) differ genetically, with the central area having the greatest diversity of genetic lineages. The data indicate that genetic flow has been restricted among the different geographic regions of the species' range. A notable finding was that genetic diversity of sample sites in the southern part of species' range (Fallbrook, Camp Pendleton, Lancaster Valley, and Guejito) was much lower than the northern and central sample sites. This low diversity may indicate a possible population bottleneck that occurred during a recent range expansion in the southern region. The genetic characteristics of the Anza and Cahuilla valleys population are unknown.

Other conservation efforts involving this species include the Lake Mathews MSHCP, Pacific Gateway Homes HCP, and Ridge at Cresta Verde HCP. A previously unknown population of the kangaroo rat was discovered in the Ramona Valley, San Diego County in October 1997. It is not known if this species still inhabits extreme southwestern San Bernardino County.

At the end of 2002, the DFG considered the trend and status for the Stephens' kangaroo rat to be *Unknown*.

Tipton kangaroo rat

Dipodomys nitratoides nitratoides

State: Endangered 1989
Federal: Endangered 1988

General Habitat:

Tipton kangaroo rats are limited to arid land communities of the valley floor in the Tulare Basin, in level to nearly level terrain at an elevation of 200 to 300 feet. Woody shrubs such as spiny saltbush, iodine bush, and mesquite are sparsely scattered over the terrain with scant to moderate ground cover of grasses and forbs. Soils are typically fine-textured and alkaline.

Description:

The Tipton kangaroo rat is one of three subspecies of the San Joaquin kangaroo rat (*Dipodomys nitratoides*). Tipton kangaroo rats are visually similar to other kangaroo rats; they have a tawny yellow head and back with a white belly and a white stripe on the elongated hind legs that continue down the sides of the otherwise black tail. Other characteristics include: a large head, compared to other rodents, with large eyes and small rounded ears; small forelegs with strong claws; and a long, tufted tail. Adult Tipton kangaroo rats weigh about one to 1.3 ounces.

Status:

This subspecies originally occupied a range that included the Tulare Lake Basin in portions of Fresno, Kings, Tulare, and Kern counties. This geographic range encompassed about 1.7 million acres. An estimate of historic population based on today's density data and the estimated extent of former range is about 17.2 million individuals. Currently, approximately 190,200 individuals, or about 1 percent, remain. The conversion of native habitat to agricultural, residential, and commercial developments and flooding remain the principal threats to this species.

The recovery options for the Tipton kangaroo rat are addressed in the USFWS *Recovery Plan for Upland Species of the San Joaquin Valley, California*, completed in 1998. Proposed actions include establishment of habitat preserves and captive breeding and translocation of populations. Severe declines, beginning in 1994, affected all kangaroo rat populations, including Tipton, in the southern San Joaquin Valley. In 1998 and 1999 populations slowly returned to previous population levels of the early 1990s. As of 2003, the population levels of Tipton kangaroo rats are largely unknown but presumed to be still fairly low and vulnerable to further declines. Dense vegetation due to above average rainfall has had a negative impact on this and other kangaroo rat species. During wet years, kangaroo rat species may suffer from diseases precipitated by low food stores and seeds that are moldy.

The closely related short-nosed kangaroo rat (*D. n. brevinasus*) occurs at the Lokern grazing study area. Findings by researchers regarding the affects of cattle grazing on the short-nosed kangaroo rat may have application to the Tipton kangaroo rat. Short-nosed kangaroo rats have steadily increased in number since 1998, due in large part to the below-average rainfall experienced since 1999. Numbers of the species are now high across most of the Lokern Study Area. In 1999 and 2000 more short-nosed kangaroo rats were caught on the grazed plots compared to the ungrazed plots, but the lack of grass in both controls and treatments in recent years has masked any benefit we found from grazing. Higher than average level of rainfall is needed in future years to return the control sites to high grass cover. Once the control plots are grassy, researchers should be able to quantify the effect of cattle grazing on populations of short-nosed kangaroo rats.

The DFG is involved in several conservation efforts for Tipton kangaroo rat including the Kern County Valley Floor and Waste Facilities HCPs, Kern Water Bank HCP, Metropolitan Bakersfield HCP, and the PG&E San Joaquin Valley HCP. Despite these conservation efforts, the species is in severe decline; extinction could occur if current levels of habitat loss continue into the future.

The status in 2003 of the Tipton kangaroo rat: *Declining*.

Fresno kangaroo rat *Dipodomys nitratoides exilis*

State: Endangered 1980
Federal: Endangered 1985

General Habitat:

The Fresno kangaroo rat occupies chenopod scrub and grassland in the San Joaquin Valley. The historic range of the Fresno kangaroo rat extended from north central Merced County, south through southwestern Madera and central Fresno counties. Typical plants within the species habitat include seep weed, iodine bush, saltbush, peppergrass, filaree, wild oats, and foxtail fescue.

Description:

The Fresno kangaroo rat is one of three subspecies of the San Joaquin kangaroo rat. The Fresno kangaroo rat is the smallest of the San Joaquin kangaroo rats with a total length of nine inches, including a five-inch tail. Adults weigh about one ounce. Their fur is dark yellowish-buff on the back and white on the stomach. A white stripe extends along the flanks and on the sides of the tufted tail.

Status:

The current population distribution and population size are unknown. The species is critically threatened by loss of habitat and fragmentation throughout its range. Surviving populations are isolated and are likely small. The species is also threatened by flooding and the use of rodenticides within its range.

Demographic studies, initiated in 1993, are continuing to locate any extant populations of Fresno kangaroo rats. Beginning in 1995 and continuing to 2003, fire management has been applied to the habitat supporting a small population of kangaroo rats on a small patch of habitat at the Lemoore Naval Air Station, Fresno County. Additional study and management is planned; discussions are ongoing between land managers and researchers concerning the future management of larger tracts of land that may constitute suitable habitats at Lemoore NAS and at other locations within the range of the species in the San Joaquin Valley. Populations of Fresno kangaroo rats are suspected on certain private lands, but access to conduct the necessary surveys has not been granted.

The recovery options for the Fresno kangaroo rat have been addressed in the USFWS *Recovery Plan for Upland Species of the San Joaquin Valley, California*, completed in 1998. The recovery plan calls for establishment of additional habitat preserves and the possible captive breeding and translocation of populations of this species onto those secure refuges. The Fresno kangaroo rat may well be one of the most severely endangered mammal species in the State and drastic measures may be needed to save it from extinction in the next decade. One option that could be a step toward recovery of the species would involve the rehabilitation of deteriorated

kangaroo rat habitat at the DFG Alkali Sink Ecological Reserve where the species was last reported in 1992. The ecological reserve once supported a moderate population of the species. With suitable habitat established, the area could be re-populated with captive-reared Fresno kangaroo rats. Similar recovery actions could be attempted at other locations within the range of this species.

The status in 2003 of the Fresno kangaroo rat: *Declining*.

Salt-marsh harvest mouse

Reithrodontomys raviventris

State:	Endangered	1971
	Fully Protected	
Federal:	Endangered	1970

General Habitat:

The salt-marsh harvest mouse is found only in California, inhabiting tidal and nontidal salt marshes of Suisun, San Pablo, and central and south San Francisco Bays. Its preferred habitat is dominated by pickleweed although this species can occur in the upper marsh zone dominated by other salt-tolerant plants.

Description:

The salt-marsh harvest mouse has rich brown fur on its back, underparts of cinnamon to buffy white, and a unicolored tail. It is very similar in appearance to the western harvest mouse, a closely-related species, which complicates identification of the salt-marsh form in field studies. The salt-marsh harvest mouse can tolerate quite salty food and water.

Status:

The salt-marsh harvest mouse is threatened by loss and degradation of its habitat through human and human-induced activities. Of the 193,800 acres of tidal marsh that bordered San Francisco Bay in 1850, only about 30,000 remain. Parts of the East Bay shoreline are eroding. About 600 acres of former salt marsh along Coyote Creek, Alviso Slough, and Guadalupe Slough have been converted to fresh- and brackish-water vegetation due to freshwater discharge from South Bay wastewater facilities. This area may no longer support the salt-marsh harvest mouse. Adverse impacts to harvest mouse habitat have also resulted from filling of marshes to allow development, invasion of non-native cordgrass and other non-native species, and pollution from urban run-off, industrial discharges, and sewage effluent. The salt-marsh harvest mouse is likely subject to predation by the non-native red fox and non-native feral cat.

The USFWS is preparing a recovery plan for tidal-marsh species in the San Francisco Bay, including the salt-marsh harvest mouse. Determining the distribution and abundance of the mouse is one of the management goals of the San Francisco Estuary Wetlands Regional Monitoring Program (WRMP) Plan, the first version of which was released in June 2002. The mission of the WRMP, which is a product of the San Francisco Estuary Institute and wetland managers representing a variety of agencies including the DFG, "is to provide the scientific understanding necessary to protect, create, restore, and enhance wetlands of the San Francisco Bay Region, through objective

and cost-effective monitoring, research, and communication." Although the initial focus of the WRMP is on the tidal bay lands of the San Francisco estuary, the geographic scope of the WRMP is the entire estuary plus the watersheds that drain to the estuary within the nine-county San Francisco Bay Area.

At the end of 2002, the DFG considered the population trend and status for the salt-marsh harvest mouse to be *Unknown*.

Amargosa vole *Microtus californicus scirpensis*

State:	Endangered	1980
Federal:	Endangered	1984

General Habitat:

Habitat for the Amargosa vole consists of a discontinuous, narrow band of small, permanent fresh-water marshes along the Amargosa River of Inyo County. Bulrush is the dominant overstory species. Associated wetland species include cattail, saltgrass, and willow. The vole may occur downstream in adjacent San Bernardino County. The flooding of potential or inhabited vole habitat during late summer thunder storms and extended periods of winter rainfall probably allow permanent vole occupation only in marshes on the margins of the river's floodplain.

Description:

This small mammal is pallid, neutral gray above, smoky gray below, has a tail which is brown above and grayish below, and has feet of brownish gray. The comparatively short tail, small rounded ears, short legs, and compact, almost-cylindrical body shape distinguish voles from other mouse-like rodents. It differs from most other subspecies of California vole by its brighter coloration. As with other voles in the genus *Microtus*, the Amargosa vole probably is active year round.

Status:

The Amargosa vole is threatened by loss and degradation of its habitat through human and human-induced activities. Adverse impacts to vole habitat include groundwater pumping and water diversion, OHV use, cattle grazing, invasion by tamarisk and other non-native plants, and severe or prolonged flooding. Construction of the Tidewater-Tonopah Railroad and the Old Spanish Trail in the early 1900s, and development of springs in Shoshone and Tecopa, are believed to have fragmented or eliminated habitat that existed at that time. The vole is also subject to predation by the domestic cat from nearby human-occupied areas. The alien house mouse, found in marshes inhabited by this vole, may compete with the vole for food.

The USFWS prepared a Recovery Plan for this species in 1997. The Recovery Plan indicated that protection of extant wetland habitat and the water sources need to perpetuate these wetlands are critical to the survival and

recovery of the Amargosa vole. Delisting criteria and species-specific management options were not proposed due to the lack of detailed biological information for the species.

An analysis of effect of habitat fragmentation and genetics of the Amargosa vole revealed a significant level of differentiation between populations from different marshes. Because the marshes occupied by the Amargosa vole are fragmented within the surrounding desert habitat, dispersal by the voles, and consequently genetic exchange between populations, is limited. The data obtained in this study suggested a relatively recent divergence of the Amargosa vole from closely related species, and that is is persisting along an independently evolving lineage. Such data can be used to guide conservation activities by identifying individual marshes that are critical to preserving the genetic diversity of the species.

The vole is a featured species in the planning effort for the Northern and Eastern Mojave Desert Management Plan developed by the BLM, with considerable contribution by the USFWS and NPS. The BLM's July 2002 proposed plan included the elements of the Recovery Plan, including preservation and management of its remaining habitat. The final plan was approved by the BLM in December 2002, as an amendment to the California Desert Conservation Plan of 1980. Although the planning team had considered an alternative plan that would have emphasized managing lands for recovery of the vole, desert tortoise, and other species, the team recommended a plan allowing less land devoted to such recovery. For the Amargosa vole, the final plan maintains the emphasis of the alternative in protecting the watershed of the Amargosa River. Both versions of the plan propose establishing an Amargosa River Area of Critical Environmental Concern (ACEC). The final plan identifies five areas along the river for potential implementation of a conservation strategy for the vole. Two of the areas are Areas of Critical Ecological Concern: the Grimshaw Lake Natural Area and the Amargosa Canyon Natural Area. The final plan proposes identifying potential segments of the Amargosa River for addition to the National Wild and Scenic River system. The BLM anticipates purchasing approximately 2,600 acres of privately-held land containing currently-suitable and/or potentially-restorable habitat for the vole.

The DFG considers the population trend and status for the Amargosa vole to be *Unknown*.

Sierra Nevada red fox

Vulpes vulpes necator

State: Threatened 1980
Federal: None

General Habitat:

The Sierra Nevada red fox is known to inhabit types of vegetation similar to those used by the marten and wolverine. Sightings of the subspecies have been reported from the 5,000 to 7,000 foot elevation range with extremes placed at 3,900 feet in Yosemite Valley and 11,900 feet at Lake South America in the southern Sierra Nevada. The range is described as the southern Cascade Range in northern California, southeastward to the northern Sierra Nevada, and then south along the Sierra Nevada crest to Tulare County. Preferred habitat for the Sierra Nevada red fox appears to be red fir and lodgepole pine forests in the sub-alpine, and in the alpine of the Sierra Nevada.

Description:

The Sierra Nevada red fox, California's only indigenous subspecies, is one of 10 recognized North American subspecies of *Vulpes.* The Sierra Nevada red fox is distinguished from members of the introduced lowland population of red foxes by its slightly smaller size and darker colored fur.

Status:

The Sierra Nevada red fox inhabits remote areas of the State where chance encounters with humans are uncommon. It occurs at low densities throughout Sierra Nevada and Cascade Range of California. Threats to the Sierra Nevada red fox are unknown.

The existence of the Sierra Nevada red fox in the Lassen Peak region has provided an opportunity to conduct research to assist in the recovery of this threatened species and to increase our information base on the ecology of the subspecies. Fox populations have been confirmed in two proposed wilderness areas: Wild Cattle Mountain on the southern boundary of Lassen Volcanic National Park and in Heart Lake on the southwestern boundary of the park below Brokeoff Mountain.

Since 1997, the University of California at Berkeley, Lassen Volcanic National Park, Lassen National Forest, and the DFG has been conducting research on the Sierra Nevada red fox in Lassen Volcanic National Park. Research has included home range size and composition, habitat use for foraging and reproduction, seasonal movements between federal and private lands, diet, local density and spatial interactions with other sympatric carnivores

such as coyotes (*Canis latrans*) and bobcats (*Lynx rufus*). Pilot studies were conducted in the summers of 1998 and 1999 and full-time research commenced in March 2000. In March 2000, researchers began a 30-month investigation of the basic ecology of the Sierra Nevada red fox in the Lassen Peak region. Radio-collared animals were tracked using ground and aerial telemetry, and non-collared animals were detected by systematic photostation surveys. Of particular interest were data on seasonal and elevational movements of red foxes and relationship to prey availability and the presence of other carnivore species in the Park.

As of July 2001, five red foxes (one male and four females) had been radio-collared and tracked by telemetry. Summer home ranges, primarily between June and October, averaged 2300 acres and had little overlap, suggesting territoriality. In winter, the foxes moved up to nine miles southward to lower elevations, returning to higher elevations once spring returned. The locations and characteristics of red fox rest sites and dens were recorded, and scats were collected for diet analysis. Photostations detected red foxes most often between 2100 and 0500 hrs.

The ongoing research is a spin-off of a study of the wolverine (*Gulo gulo*), initiated in 1990, using remote, automatic cameras for the first time in a large scale field investigation of a furbearer. That earlier study incidentally yielded the first documented photographs of the Sierra Nevada red fox in the Lassen Park area. Since then, additional remote-camera photographs of Sierra Nevada red foxes have been taken at that location in conjunction with the ongoing research of the subspecies. The techniques used in the wolverine study (i.e., baited stations with remote cameras) have shown promise for application to the study of several other carnivores including the Sierra Nevada red fox. Genetic samples taken from red foxes captured during this study are currently under analysis.

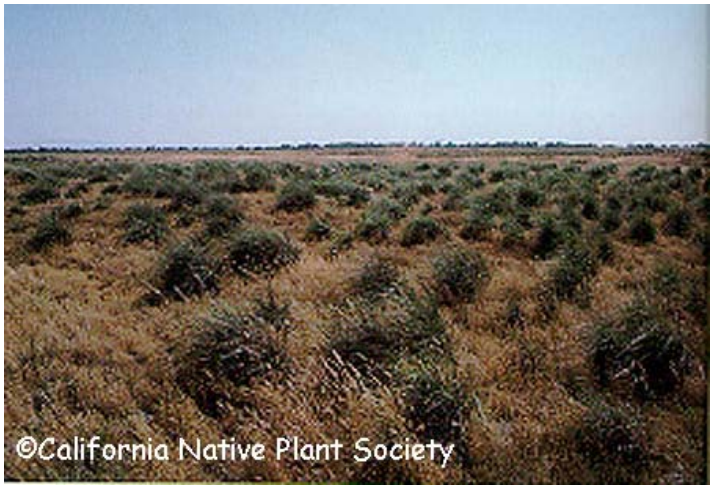
The current status of the Sierra Nevada red fox is unknown.

San Joaquin kit fox *Vulpes macrotis mutica*

State:	Threatened	1971
Federal:	Endangered	1967

General Habitat:

Kit foxes occur in the remaining native valley and foothill grasslands and chenopod scrub communities of the valley floor and surrounding foothills from southern Kern County north to Los Baños, Merced County. In addition, smaller, less dense populations are thought to exist further north and in the narrow corridor between Interstate 5 and the Interior Coast Range from Los Baños to Alameda and Contra Costa Counties. Portions of Monterey, Santa Clara, San Benito, San Luis Obispo, and Santa Barbara counties are also included in the range of the San Joaquin kit fox.



Description:

The kit fox *(Vulpes macrotis)* is the smallest canid species in North America. San Joaquin kit foxes have an average body length of 20 inches, an average tail length of 12 inches and stand about nine to 12 inches at the shoulder. These slender-built mammals are characterized by relatively long legs and large, conspicuous ears. Adult males weigh about five pounds, and adult females weigh about 4.6 pounds.

Status:

Currently, kit foxes occur in the remaining native valley and foothill grasslands and chenopod scrub communities of the valley floor and surrounding foothills from southern Kern County north to Los Baños, Merced County. Distribution is spotty within this broad range. In addition, smaller, less dense populations are thought to exist further north and in the narrow corridor between Interstate 5 and the Interior Coast Range from Los Baños to Contra Costa County. Portions of Monterey, Santa Clara, San Benito, San Luis Obispo, and Santa Barbara counties are also included in the range of the San Joaquin kit fox. Studies and information from various sources indicate that a density of one kit fox per square mile in suitable habitat is a reasonable figure to use to estimate

populations based on known acreage of habitat, although densities can range from less than one to over six foxes per square mile.

Loss of native habitat to various kinds of agriculture (e.g., cotton fields and vineyards), and residential and commercial developments remain the principal threats to this species. Several research projects funded by the DFG and studies by cooperators, begun in the mid-1990s and continuing to the present, are yielding more information about the habitat needs and biology of the kit fox. The recovery actions recommended for the kit fox are contained in the USFWS *Recovery Plan for Upland Species of the San Joaquin Valley, California*, which was completed in 1998. The kit fox is described as a keystone species (i.e., a species essential to the health of the natural community), and efforts to save habitat for this species will result in benefits to other endangered plant and animal populations.

Long-term ecological studies at the Elk Hills Naval Petroleum Reserve in western Kern County terminated several years ago following the sale of the Reserve to private interests in the late 1990's. However, the landmark research that was conducted over a period of more than a decade is currently being published in a number of journal articles and will make valuable contributions to our understanding of the biology, ecology, and management of the species and its recovery. Considerable research activity has been initiated or continued for the kit fox in recent years. One study, started in 1997, examines the special case of the kit fox in the urban environment. Kit foxes have been captured, radio-collared and their movements monitored within the city of Bakersfield, Kern County. This field phases of this investigation of the demography and ecology of San Joaquin kit foxes in urban environments will continue through June 2004, and then data analyses and report and manuscript preparation will be conducted. Preliminary results have indicated that urban kit fox populations exhibit favorable demographic patterns, and that conservation of these populations could contribute to overall recovery efforts. The DFG has contributed funding, derived from federal sources, and support for this project.

Other studies on the San Joaquin kit fox include:

- An investigation of the effects of two-lane highways on San Joaquin kit foxes was initiated in 2001 and data collection will continue through June 2004. Results from this investigation will be used to develop strategies to mitigate road effects on kit foxes. Kit foxes are impacted by highways through direct road killing mortalities as well as indirectly through habitat loss and fragmentation effects.

- A study of the effects of livestock grazing and agricultural burning, as well as other farmland and ranchland activities on competitive interactions between San Joaquin kit foxes and coyotes was initiated in January 2003 and data collection will continue through June 2004. Results from this investigation will assist in developing habitat management strategies that may benefit kit foxes on these private lands.

- Research on the use of artificial den structures by San Joaquin kit foxes was initiated in May 2001 and data collection will continue through June 2004. Results from this investigation will be used to develop strategies to mitigate den loss and also to enhance den availability in areas where natural dens are a limiting factor for kit foxes. Escape dens help kit foxes avoid predation by coyotes and may provide secure sites for pup rearing.

- An investigation of strategies to facilitate survival of kit foxes crossing agricultural lands was initiated in 2001. This project is on-going, and represents a new approach to kit fox conservation in that it involves the establishment of a Safe Harbor Agreement with Paramount Farms. The DFG has contributed funding, derived from federal sources, for this effort.

- An investigation was completed in January 2003 on the efficacy of using search dogs and fecal DNA analyses as a non-invasive strategy for collecting demographic and ecological data on San Joaquin kit foxes. A doctoral dissertation and several manuscripts are being prepared that report the results of this effort. The technique proved to be useful where specially trained searchers were employed. Research confirmed Numerous locations throughout the historic range of San Joaquin kit foxes confirmed that

populations still exist in western Kern County and the Carrizo Plain National Monument and along the west side of the San Joaquin Valley north to Santa Nella. Despite the extensive search effort, no kit fox sign was found along the west side from Santa Nella to Contra Costa County, or in Valley floor locations north of Kern County. One kit fox was observed in eastern Merced County.

Various other studies have been conducted with San Joaquin kit foxes to examine social ecology and range-wide genetic exchange, kit fox-red fox interactions, and kit fox use of agricultural lands. Several manuscripts for scientific journal publications and technical reports for these past and ongoing studies have been produced.

Protection for the kit fox is addressed in several conservation plans. Some examples of these plans include the Kern County Valley Floor and Waste Facilities HCPs, Kern Water Bank HCP, Metropolitan Bakersfield HCP, and the PG&E San Joaquin Valley HCP. Despite these efforts, and other conservation efforts, San Joaquin kit foxes continue to decline throughout their range and are close to extinction in the northern most part of the range in Contra Costa and Alameda counties.

The status in 2003 of the San Joaquin kit fox: *Declining*.

Island fox *Urocyon littoralis*

State	Threatened	1971
Federal	Endangered	2004

General Habitat:

The island fox occurs on the six largest California Channel Islands, as follows: San Miguel, Santa Rosa, Santa Cruz, Santa Catalina, San Nicolas, and San Clemente. The fox appears to use most habitat types found on these islands.

Description:

This small fox has pepper-and-salt upper pelage with underfur that is rufous or buffy in color, with a dorsal median black stripe ending in the black tip of the tail. Faces are marked by distinctive black, white, and rufous-colored patterns. At 12 to 13 inches in height and 3 to 4 pounds, the island fox is about the size of a housecat. The island fox feed largely on insects, mice, and wild-growing fruits. They can live as long as 10 years, generally mate for life and give birth to litters of 2-5 pups in mid-April.

Status:

The island fox is endemic to the Channel Islands and is distributed as six genetically distinct subspecies, one on each of the six largest Channel Islands: San Miguel, Santa Rosa, Santa Cruz, San Nicolas, Santa Catalina, and San Clemente. On March 5, 2004 the Channel Island Fox of Santa Cruz, Santa Rosa, San Miguel, and Santa Catalina Islands were federally listed as endangered species. Fox populations on at least four of the six islands have experienced recent catastrophic declines – as much as 95% over 1994 population levels. The total island fox population is currently estimated at about 1300 individuals. This precipitous decline resulted in the island fox being listed as critically endangered by the International Union for Conservation of Nature (IUCN). Many experts fear the island fox could become extinct without implementation of recovery activities and intensive management. The NPS released a recovery strategy for foxes on the northern Channel Islands in 2003. The island fox is threatened primarily by golden eagle predation. Loss and degradation of its habitat, a result of overgrazing by non-native animals, disease, and low natural recruitment also threaten this species.

Golden eagle predation is severely impacting the island fox, which has no native predator. Golden eagles first arrived on Santa Cruz Island, and then spread to San Miguel and Santa Rosa Islands, in the 1990s. The first golden eagle nest was observed in 1999. Prior to that time, golden eagles were only occasional visitors to the Channel Islands. Feral pigs, introduced by early settlers on the islands in the 1850s, provide abundant year-round prey for the golden eagles, which now have established resident populations. The eagles also use the island fox as a prey species. The pigs adversely altered the native vegetation on the Channel Islands and restructured the food web. The pigs, and other introduced non-native animals, have fragmented native vegetation and converted stands of coastal sage scrub, chaparral, and oak woodlands to non-native annual grassland. The loss of plant species limits the native plant food sources available to the fox and reduces the numbers and availability of small animal prey species. Loss of vegetation structure has eliminated cover for the island fox, increasing its vulnerability to predation.

Island fox populations have declined dramatically as a result of predation by golden eagle. Research has provided correlation between the establishment of eagles on the islands and the decline of the island fox. On Santa Cruz island, the population of 1500 - 2000 individuals in 1993 dropped to fewer than 100 individuals in the wild by 2003. The cause of death in 21 of 29 foxes was due to golden eagle predation. On San Miguel Island, the first recorded fox mortality attributed to eagle predation was in 1995, the year in which the first golden eagle was sighted on the island. The San Miguel Island fox population showed dramatic decline, similar to that on Santa Cruz Island over the same time period, dropping from about 450 individuals to 39. A radiotelemetry study during 1998-1999 confirmed that golden eagle predation was the major cause of fox mortality on San Miguel Island. All but one of the 39 remaining foxes is now in captivity. Of the ~1700 foxes reported on Santa Rosa Island in 1994, 56 remain. All 56 individuals are in captivity. Similar trends are seen on Santa Catalina Island (~1300 in 1994; 220 in 2003). A monitoring study of the San Nicholas Island population was begun in the summer of 2000. There are an estimated 734 animals in the wild. In an attempt to safeguard remaining foxes and augment natural reproduction, the entire wild populations of San Miguel and Santa Rosa Islands and a portion of the populations of Santa Catalina and Santa Cruz islands were placed into captive breeding programs. Captive-breeding began on San Miguel Island in 1999, on Santa Rosa Island in 2000, and on Santa Cruz Island in 2002.

Possibly related to the influx of golden eagles is the decline and elimination of the bald eagle on the Channel Islands. The bald eagle occurred historically on the islands but disappeared by the 1960s as a result of egg-thinning caused by eating prey contaminated with DDT. Bald eagles nested on the perimeters of the islands near to their marine prey base. The bald eagle is highly territorial, and golden eagles were not resident on the Channel Islands when bald eagles were there in large numbers. Once the bald eagles were eliminated, a niche that could be occupied by another large raptor was available. NPS is reintroducing the bald eagle to the islands in conjunction with capturing the remaining golden eagles on the Channel Islands. The Santa Cruz Predatory Bird Group is working the USFWS, NPS, and TNC to remove golden eagles from the Santa Cruz, Santa Rosa, and San Miguel Islands. They have removed 32 eagles and relocated them into suitable habitat in northern California. None of these eagles has returned to the Channel Islands according to telemetry data obtained from the released eagles. NPS estimates that six golden eagles, two pair and two lone eagles, remain on Santa Cruz Island. There were active nests on Santa Cruz and Santa Rosa Islands in 2003. Golden eagle predation on the island fox continues on Santa Cruz Island. The most recent eagle predation event occurred in November 2003.

The interactions between the golden eagle, bald eagle, feral pig, and island fox exemplify one of many challenges facing conservation biologists: how to protect a critically endangered species being impacted by another protected species. The proposal to removal golden eagles from the Channel Islands is not without controversy although capturing the remaining eagles is critical to the survival of the island foxes. Removal of feral pigs is part of a conservation plan prepared by NPS for Santa Cruz Island. The plan is based on the eradication of the island pigs with the goal of eliminating the eagles' prey base. Removal of the eagles must be concurrent with eradication of the feral pigs so that the eagles do not concentrate prey activities on the island fox.

Populations of the fox on the southern three islands have faced other threats. The San Clemente Island population (~1000 animals in 1994; 500-875 in 2003) has been impacted by a history of severe overgrazing, use of the island as a Navy bombing range, a widespread feral cat problem, and predator management activities to protect the island loggerhead shrike, another federally-listed species. In an attempt to offset fox predation of the shrikes, the Navy implemented control activities for non-native predators (black rat and feral cat), as well as for the island fox. The Navy euthanized 13 foxes and shipped 15 foxes off the island to zoos. Euthanasia ceased in 1999. Subsequently, foxes were captured and held in captivity while fledgling shrikes were vulnerable to predation. Vehicle collisions are another source of fox mortality on San Clemente Island. On San Nicolas Island, vehicle collisions are the largest documented mortality source, with an average of 13 fox carcasses attributed to vehicle collisions recovered each year. The population on Santa Catalina Island was decimated by an outbreak of canine distemper in 1999-2000. The disease was likely introduced by an unvaccinated pet dog brought to the island. The Catalina Island Conservancy, with assistance from the Institute for Wildlife Studies, began a field vaccination program for wild foxes and a captive breeding program. The field vaccination program is part of a multifaceted

recovery program initiated in 2000. According to Institute for Wildlife Studies, the wild population of foxes on Santa Catalina Island is estimated at about 220 adults.

Morphological and genetic variation within and among populations of island foxes has been studied by a number of researchers. The levels of variability found support differentiation of the island fox into subspecies. The genetic data shows that inter-island diversity is greater than intra-island diversity. Genetic evidence suggests that the island foxes descended from the gray fox on the California mainland during one colonization event that occurred approximately 10,000-16,000 years before present. The genetic studies have also revealed that the populations on San Miguel and San Nicholas Islands have the lowest genetic variability of the island fox populations. This lack of variability could be attributed either to extensive inbreeding or a genetic bottleneck resulting from low population densities. A genetic bottleneck refers to a reduced pool of genetic material usually due to a catastrophic event that reduces the size of the original population. The foxes on San Nicholas Islands have essentially no variability and their population consists largely of adult animals. Low levels of reproduction observed for the foxes on San Nicholas Island and in captivity may be due to such a bottleneck. Genetically, the foxes on San Miguel are most closely related to foxes on Santa Rosa Island. Populations on these islands also occur at such low population numbers that they are highly vulnerable to random extinction events. NPS has funded genetic studies on all foxes in the captive breeding program. The results are being used to ensure that interbreeding between closely-related animals does not occur and to maximize the limited diversity that does occur. Introduction of foxes to the captive breeding program from another island may be necessary to increase the genetic diversity of the San Nicholas and Santa Rosa Island foxes.

In 2001, DFG received funds to initiate a candidate conservation agreement for island fox on Santa Cruz Island. This effort will include implementation of many of the actions included in the NPS recovery strategy. In 2002, the DFG used federal funds to help eliminate feral pigs from Santa Cruz Island. Six fenced enclosures will be built by TNC. Each enclosure will constitute a discrete management unit of about 12,000 acres. The DFG will manage public hunts within each enclosure to eliminate pigs.
DFG has participated in the Island Fox Conservation Working Group (IFCWG). The IFCWG is a team of experts convened by the NPS in 1999 and 2000 to recommend appropriate recovery actions for the island fox, The group is a loose affiliation of representatives of public agencies, landowners, conservancies, zoological institutions, non-profits, and academia concerned about conservation efforts for the island fox. Its initial purpose was to evaluate the status of island foxes on park lands and to make findings regarding appropriate recovery actions. Their focus later broadened to include all six subspecies. Individual working groups exchanged information on a variety of topics including captive breeding, veterinary care, and management of wild populations. They contributed to development of a recovery plan for the fox on the three northern islands.

The NPS released the recovery strategy for review in August 2003. Recovery strategy objectives are to remove mortality factors for all populations, augment fox populations through captive breeding, establish monitoring and management programs to protect the fox populations, and implement habitat restoration activities. The overall goal of the recovery strategy is to minimize the threat of extinction for the three subspecies of foxes under NPS jurisdiction. This recovery strategy can also be applied to the other islands. A Channel Island Fox Integrated Recovery Implementation Team was formed in 2004 and is currently working on developing a coordinated recovery implementation strategy. In the absence of active, intensive management based on the best available science, the island fox is in danger of extinction.

Guadalupe fur seal

Arctocephalus townsendi

State	Threatened	1971
	Fully Protected	
Federal	Threatened	1985

General Habitat:

The Guadalupe fur seal is a pelagic species most of the year, occurring in Pacific Ocean waters as far south as the Mexico/Guatemala border, and as far north as the Point Reyes National Seashore in California. When ashore, this seal occupies rocky caves and crevices and sandy beaches.

Description:

Guadalupe fur seals are medium-sized eared seals (Family Otariidae). They have dense gray-brown underfur covered with course guard hairs that tend to bleach out on the head and shoulders of adult males. Their appearance is very similar to the northern fur seal (*Callorhinus ursinus*) but the Guadalupe fur seal is distinguished by a pointed muzzle. Males reach six feet in length and 350 pounds in weight, while females reach five feet in length and 100 pounds in weight. The maximum life span is estimated to be 17 to 20 years.

Status:

Guadalupe fur seals were thought to be extinct in the late 1800's and early 1900's but in 1928, two fur seals were sighted at Isle de Guadalupe off the coast of Mexico. The major cause of the Guadalupe fur seal's decline was commercial hunting in the late 1700's and early 1800's. The species was exterminated in southern California waters by 1825. Commercial sealing continued in Mexican waters through 1894. The Guadalupe Fur Seal is included in the *IUCN Red List of Threatened Animals* as Vulnerable. Potential threats to the seal include injury or mortality due to entanglement in gill nets. Although human-caused mortalities to the Guadalupe fur seal have not been reported in California waters since specific records were kept starting in 1983, similar information is not available for Mexican waters. Juvenile female Guadalupe fur seals have been found stranded in central and northern California with net abrasions around the neck, fish hooks and monofilament line, and polyfilament string.

Guadalupe fur seals breed on Isla de Guadalupe and Isla Benito del Este off the coast of Baja California, Mexico. Mating occurs approximately one week after pups are born; females bear a sole pup. In 1997 one Guadalupe fur seal was born on San Miguel Island off the California coast. The population is considered to be a single stock because all are recent descendants from one breeding colony at Isla Guadalupe, Mexico. The species has undergone

an extreme genetic bottleneck; this reduction in genetic diversity may influence further population expansion. Male seals are occasionally observed on rocky beaches of the southern Channel Islands. Little information exists on the diet or foraging behavior of this subspecies. However, it is believed that Guadalupe fur seals feed in deep waters on species of krill, squid, and small, schooling fish.

The most recent population estimate was made in 1993, and the estimate was 7,408 fur seals. Researchers estimate that the population is growing at a rate of approximately 14 percent. Mexican law fully protects the species and Guadalupe Island was declared a pinniped sanctuary by the Mexican government in 1975. The IUCN/SSC Seal Specialist Group recommended research to determine numbers and population limits for the Guadalupe Fur Seal, allowing an assessment of population status and development of conservation measures. No information is available for gillnet fisheries or related mortalities in Mexican waters.

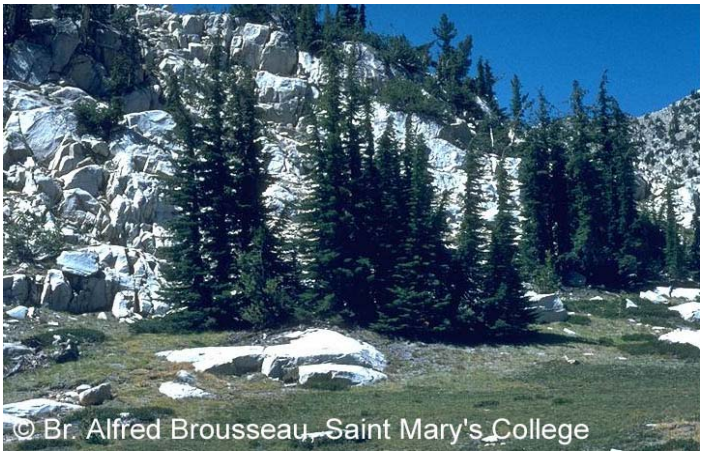
The Status in 1997-1999 of the Guadalupe fur seal: *Increasing to Stable*

Wolverine *Gulo gulo*

State: Threatened 1971
Fully Protected
Federal: None

General Habitat:

The wolverine is reported from a series of habitat types within an elevation range of 1,600 feet to over 14,000 feet. Based on the number of sightings in California, habitat generally consists of open terrain near or above timberline.



Description:

The wolverine resembles a small, short-legged bear with a coarse shaggy coat and a bushy tail. The coat is heavy and dark brown with two broad, light-colored bands extending from the shoulder to meet at the base of the tail. Wolverines typically weigh 35 to 60 pounds and measure 35 to 45 inches long, including a six to 10 inch tail. They stand about 14 to 18 inches at the shoulder. Their jaws are very powerful and are adapted to crush and shear frozen meat and bones. Sexes appear similar except that males are 25 to 35 percent larger than females. Wolverines subsist on a variety of foods including small- and medium-sized mammals, birds, insects, berries, and fungi. Carrion, especially in the form of large ungulates, is believed to be an important component of the diet, particularly during winter.

Status:

Wolverines are often regarded as animals of high-elevation habitats; however, sightings collected by the DFG over the past several decades indicate that the species inhabits a variety of habitat types within an elevation range between 1,600 feet and 14,200 feet. The mean elevation of over 150 sightings in California is about 8,000 feet. Habitat generally consists of open terrain at or above timberline.

The present and historical ranges of the species are rather similar. The historic range encompassed an area from Mount Shasta in the southern Cascade Range south to Monache Meadows in the Sierra Nevada of Tulare County. Portions of the North Coast Range are also included in the historical range. No population density data are available on the wolverine in the State due to difficulties involved in studying such an elusive and far-ranging species. An estimate of 50 to 100 wolverines was made over 20 years ago based on available habitat and home range information from studies in other parts of North America.

Specific threats to the wolverine are unknown. No management plans for this species have been prepared, partly because of the difficulty in collecting data and limited financial resources. No State or federal land-use planning documents address the habitat needs of wolverines at the present time.

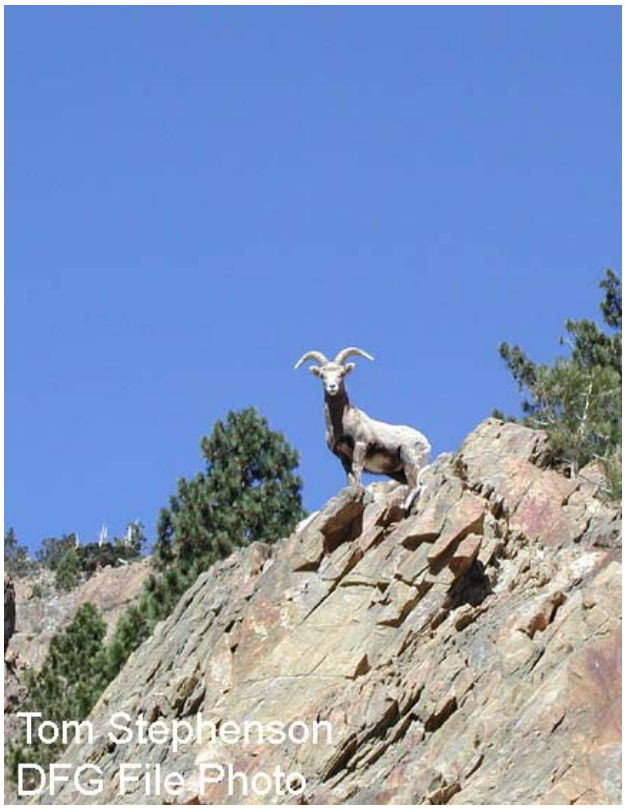
Individual research programs, being carried out primarily by USFS and university biologists, continue to place remote camera stations out each winter in an attempt to photograph wolverines. The technique works well with a variety of species, including wolverines in other states, and has been adapted to a variety of research objectives since the DFG's initial attempts with wolverines. Although none have been recorded yet, the primary goal of the ongoing study remains to document the occurrence of wolverines in selected habitats within the suspected range by the use of remote sensor cameras associated with a carrion bait station. An ongoing study, begun in 1997 in Lassen Volcanic National Park, to locate and capture Sierra Nevada red foxes for radio telemetry may offer a further opportunity to incidentally photograph wolverines.

The status in 2003 of the wolverine: *Unknown*.

Sierra Nevada bighorn sheep

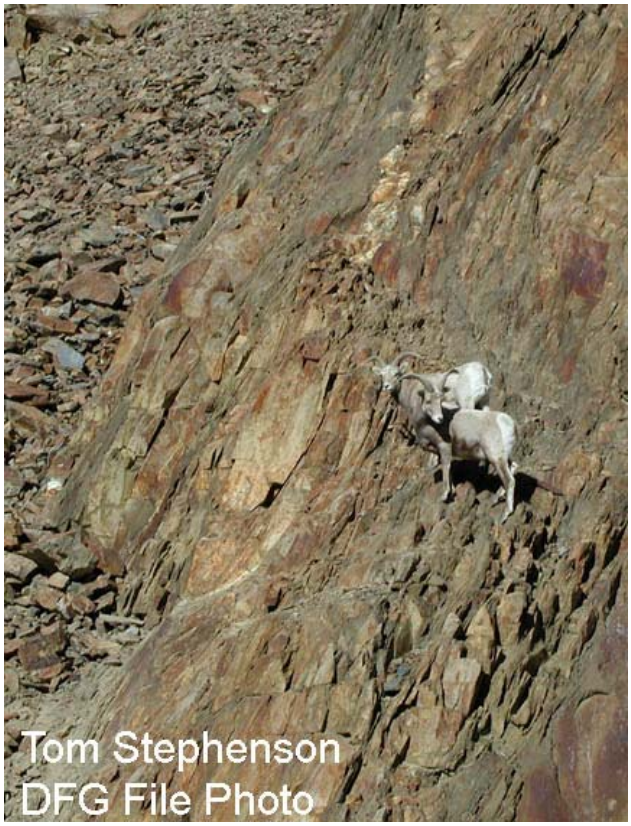
Ovis canadensis sierrae
(O. canadensis californiana)

State	Threatened	1971
	Endangered	1999
	Fully Protected	
Federal	Endangered	2000



General Habitat:

The Sierra Nevada bighorn sheep is found on the eastern slopes of Sierra Nevada from alpine habitat down to Great Basin scrub. Sierra Nevada bighorn sheep occur in five distinct geographic areas along the Sierra Nevada that are defined, from north to south, as: Lee Vining Canyon, Mono County (reintroduced); Wheeler Ridge, Inyo County (reintroduced); Mount Baxter, Inyo County (native); Mount Williamson, Inyo County (native); and, Mount Langley, Inyo County (reintroduced). Basic habitat requirements include open, rocky, and precipitous slopes that are important to sheep for detecting and evading predators. These bighorn sheep occur as high as 14,000 feet in the summer and typically descend to lower elevations in the winter, depending on severity of storms.



Description:

The Sierra Nevada bighorn sheep is one of two subspecies of mountain sheep found in California, and one of four found in North America. Both males and females have horns. The horns of males are massive and may grow to full curl when viewed from the side, and horns of females are 10 to 12 inches long and rather goat-like in appearance. Adult males may be 40 inches tall at the shoulder and weigh 200 pounds. Females weigh approximately 140 pounds. Formerly called *Ovis canadensis californiana*, the accepted name for the species is now *O. canadensis sierrae.*

Status:

Action was taken in 1999 by the California Fish and Game Commission to list Sierra Nevada bighorn sheep (SNBS) as endangered under the State endangered species act. In addition, it was listed as endangered under the Federal endangered species act the same year. Listing under the Federal act became permanent in 2000. Those actions were taken in response to a significant decline in the population, from an estimated 310 individuals in 1985

to an estimated 100 individuals in 1999. Causes of the decline remain uncertain, but may have included predation, changes in habitat use, severe winters, and accidental deaths.

The Sierra Nevada bighorn sheep is one of the most endangered subspecies of large mammals in North America. Because of this, and concomitant high levels of public concern, the Department of Fish and Game was provided funding through a member's legislative request to implement a recovery program for these sheep. That funding allowed the Department to establish a long-term, comprehensive population recovery program. Elements of the recovery program include intensive population monitoring, reducing mortality, reestablishing additional populations in historical range of the species, and preparing for, and potentially implementing, captive breeding as a means to ensure the availability of translocation stock to increase populations and geographic distribution. Funding for the recovery program has since become part of the Department's budget base. Continued monitoring of all bighorn sheep populations in the Sierra Nevada remains a high priority, and recovery will be dependent upon continued availability of monies for this important conservation effort. Since the recovery effort was initiated, the number of Sierra Nevada bighorn sheep has increased to an estimated 300 individuals.

The status in 2003 of the Sierra Nevada bighorn sheep: *Increasing*.

Peninsular bighorn sheep

Ovis canadensis cremnobates

State	Threatened	1971
Federal	Endangered	1998

General Habitat:

Peninsular bighorn sheep inhabit dry, rocky, low-elevation desert slopes, canyons, and washes from the San Jacinto and Santa Rosa Mountains near Palm Springs, California south into Baja California, Mexico. Mountains in this geographic area collectively are referred to as the Peninsular Ranges. Bighorn sheep in the Peninsular Ranges seldom occur above 4,000 feet. Proximity to sources of standing water such as springs, creeks, and oases are also important elements of their habitat.

Description:

Males and females both have horns; those of males are curled but those of females are slightly curved and are goat-like in appearance. Adult males can weigh in excess of 200 pounds, and females weigh approximately 125 pounds.

Status:

Bighorn sheep inhabiting the Peninsular Ranges were recognized originally as a distinct subspecies (*Ovis canadensis cremnobates*), but recently have been assigned to *O. c. nelsoni*. State-listed threatened status remains for the bighorn sheep occupying the Peninsular Ranges, and sheep in that area were listed in 1998 as an endangered population segment under the Federal Endangered Species Act. In listing the Peninsular bighorn sheep as endangered, the USFWS determined that the sheep are in danger of extinction throughout a significant portion of their range due to disease, insufficient lamb recruitment, habitat loss, habitat degradation and fragmentation by urban and commercial development, and predation coinciding with low population numbers. The greater bighorn sheep population in the Peninsular Ranges is considered a metapopulation; each ewe group, or subpopulation, is essential for the survival and recovery of the overall population.

Loss of winter forage sites and lambing sites, off-highway vehicle use within the range of the species, impacts to water sources, overgrazing by cattle and domestic sheep, exposure to diseases of domestic livestock, and the spread of rangeland weeds have adversely affected these animals. Habitat fragmentation, often a result of human encroachment into native habitat, restricts the sheep to small or isolated areas, limits movement of the sheep between subpopulations (referred to as ewe groups), and results in genetic isolation. Since 1970, metapopulations of bighorn sheep have experienced additional fragmentation as a result of the expansion of the interstate highway system in southeastern California. Some reestablishment of populations has occurred since then via translocation. In the 1990's, heavy mountain lion predation in conjunction with lowered lamb recruitment rates suppressed bighorn populations. Although a healthy bighorn population can withstand predation, a population debilitated by low survivorship and disease is often not able to survive additional threats.

The impacts of human encroachment into bighorn sheep habitat have been well documented in the preparation of the Coachella Valley MSHCP. Hiking trails located in bighorn habitat and vehicular use in proximity to the sheep have resulted in sheep avoidance of areas normally used. When golf courses and residential developments have been located within Peninsular bighorn sheep habitat, some ewe groups have become habituated to foraging in urban areas. Foraging around dwellings is especially problematic during the warm season when native food plants dry out and become less palatable. At least five bighorn sheep apparently died after eating toxic ornamental plants in the Coachella Valley (oleander has been implicated), and intestinal nematode parasites have been detected in bighorn sheep that graze regularly on lawns. Bighorn sheep at the urban interface are also threatened by domestic dogs, automobiles, and drowning. For example, a six-year study conducted by the Bighorn Institute, a conservation and research group working with USFWS, BLM, and DFG, showed that urbanization accounted for 34% of the adult bighorn mortalities in the Coachella Valley area. Over a three-month period, law enforcement officers and Bighorn Institute personnel herded groups of bighorn sheep off Highway 111 over 24 times.

The Coachella Valley MSHCP Plan Area supports four of the eight subpopulations, or ewe groups, of the Peninsular bighorn sheep metapopulation. Each ewe group is designated by the name of the area in which they occur: the San Jacinto Mountains group, the northern Santa Rosa Mountains group, the southern Santa Rosa Mountains group, and the Deep Canyon group. These ewe groups form the basis for the four recovery regions in the federal recovery plan. The Plan ensures conservation of habitat and connectivity among the four areas through conservation of 168,350 acres of essential habitat (97%). Three conservation areas will protect essential habitat for the bighorn sheep: Cabezon Conservation Area, Snow Creek/Windy Point Conservation Area, and Santa Rosa and San Jacinto Mountains Conservation Area. Special measures will be implemented in these areas to ensure protection of bighorn during lambing season and to minimize human impacts on bighorn habitat.

In 1997, a working group was formed to collaborate on a federal recovery plan for bighorn sheep in the Peninsular Ranges. The working group included representatives from the DFG, DPR, BLM, USFWS, USFS, University of California, Agua Caliente Band of Cahuilla Indians, Bighorn Institute, and the Zoological Society of San Diego. Following listing of the peninsular bighorn sheep in 1998, the working group was reorganized as a recovery team. In 2000, the *Recovery Plan for Bighorn Sheep in the Peninsular Ranges* was completed, and currently is being implemented. The primary charge of the recovery team is to advise the USFWS with respect to actions that will conserve and maintain bighorn sheep in viable numbers through the application of scientifically based management decisions.

Critically important to the long term survival of bighorn sheep in the Peninsular Ranges, and in California in general, is the maintenance of "connectivity" between areas occupied by subpopulations, which facilitates emigration and immigration and, thereby, gene flow and opportunities to colonize vacant habitat. In 1994, the number of bighorn sheep in the Peninsular Ranges was estimated at 360 adults, distributed among eight distinct population segments. Subsequent surveys have yielded population estimates that suggest an upward trend in numbers. In 2002, the total number of bighorn sheep occupying the Peninsular Ranges was estimated to be 670. Population assessments from ground monitoring and aerial surveys will continue as part of the recovery effort. Long-term monitoring provides information on the ecology of the sheep and documents habitat use, nutritional levels, disease exposure, nursing rates, survival rates, and causes of death.

In 2001, the Federal Cooperative Endangered Species Conservation Fund was been used to protect one particular ewe group in the Coachella Valley. These grants are authorized by Section 6 of the Endangered Species Act and enable states to work with private landowners, conservation groups, and other agencies to initiate conservation planning efforts and acquire and protect habitat to support the conservation of threatened and endangered species. The Northern Santa Rosa ewe group was most impacted by the urban environment where its home range corresponds to the boundaries of the City of Rancho Mirage. This ewe group declined considerably from its historic levels in the 1970's. Given high levels of mortality, it was unlikely that the Northern Santa Rosa ewe group would survive without intervention. The City of Rancho Mirage, USFWS, DFG, and the Recovery Team