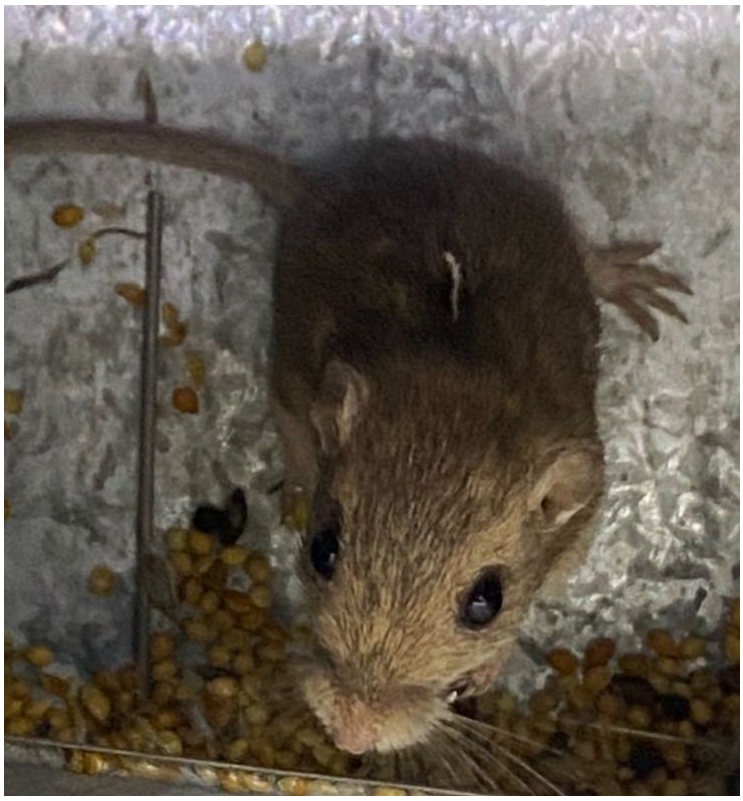
BEFORE THE CALIFORNIA FISH AND GAME COMMISSION

A Petition to List the Pacific pocket mouse (*Perognathus longimembris pacificus*) as Threatened or Endangered under the California Endangered Species Act (CESA)



Pacific pocket mouse, Dana Point Preserve
Photo credit: Center for Natural Lands Management

Center for Biological Diversity

March 25, 2025

Notice of Petition

For action pursuant to Section 670.1, Title 14, California Code of Regulations (CCR) and Division 3, Chapter 1.5, Article 2 of the California Fish and Game Code (Sections 2070 *et seq*.) relating to listing and delisting endangered and threatened species of plants and animals.

I. SPECIES BEING PETITIONED:

Species Name: Pacific pocket mouse (*Perognathus longimembris pacificus*)

II. RECOMMENDED ACTION: Listing as Endangered or Threatened

The Center for Biological Diversity submits this petition to list the Pacific pocket mouse (*Perognathus longimembris pacificus*) as Threatened or Endangered pursuant to the California Endangered Species Act (California Fish and Game Code §§ 2050 et seq., "CESA").

This petition demonstrates that the Pacific pocket mouse is eligible for and warrants listing under CESA based on the factors specified in the statute and implementing regulations. A species is an "endangered species" when it is "in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease." Cal. Fish & Game Code § 2062. A "threatened species" is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts " Cal. Fish & Game Code § 2067.

As detailed in this petition, given the Pacific pocket mouse's extremely restricted range with only three extant populations, limited remaining habitat, and known threats, listing as an endangered or threatened species clearly "may be warranted." We respectfully request the Department of Fish and Wildlife and the Fish and Game Commission should make such recommendations and findings pursuant to their respective authorities. Cal. Fish & Game Code §§ 2073.5 & 2074.2.

I. AUTHORS OF PETITION:

I hereby certify that, to the best of my knowledge, all statements made in this petition are true and complete.

Lisa T. Belenky, Senior Counsel
Center for Biological Diversity

Signature:  Date: March 25, 2025

Elizabeth Reid-Wainscoat, Campaigner
Center for Biological Diversity

Signature:  Date: March 25, 2025

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The Center for Biological Diversity submits this petition to list the Pacific pocket mouse (*Perognathus longimembris pacificus*; PPM) as either Threatened or Endangered pursuant to the California Endangered Species Act (California Fish and Game Code §§ 2050 *et seq*., "CESA"). This petition demonstrates that the Pacific pocket mouse is eligible for and warrants listing under CESA based on the factors specified in the statute and implementing regulations. Under CESA, a "threatened species" is "a native species or subspecies…that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts…" California Fish and Game Code § 2067. An endangered species is "a native species or subspecies…which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease." California Fish and Game Code § 2062.

In response to the dramatic loss of habitat experienced by PPM, it was listed as Endangered by the U.S. Fish and Wildlife Service (USFWS) in 1998. All but three of the ten known historic locales are considered extirpated, one as recently as 2003, and the subspecies now exists at only 3 locations. Occupied habitat is now estimated to be less than 300 hectares (740 acres), far short of the 1998 USFWS Recovery goal of 2,000 hectares, and no critical habitat has been designated.

Given the small number and sizes of Pacific pocket mouse populations, its limited historic and current range, the continuous habitat loss, fragmentation, and degradation, and mounting threats of disease and predation, climate change, and human land use activities, the subspecies requires all protections available to ensure its persistence. Federal protection of the Endangered Species Act has been inadequate to protect PPM from known and escalating threats. CESA listing will: provide further protection to the current population, particularly on non-federal lands in the Dana Point Preserve that represents one-third of extant populations, and to future populations (established through translocation or release of captive-bred mice) per the Recovery Plan goals.

1. INTRODUCTION

The Pacific pocket mouse (*Perognathus longimembris pacificus*) is a subspecies of heteromyid rodent endemic to coastal southern California that is endangered, or at a minimum, threatened, in California. It faces numerous threats to its continued existence including habitat loss and fragmentation, predation, climate change, and military and recreation

impacts, among others. Listing the Pacific pocket mouse under CESA would provide necessary protection against many of these direct and indirect threats. CESA protection would aid in ensuring the continued survival and eventual recovery of the species in California. As this petition documents below, Pacific pocket mouse in California meets the criteria for protection as an endangered, or at a minimum, threatened species under CESA, and would benefit greatly from such protection. This petition reviews the natural history and status of Pacific pocket mouse in California, focusing on trends and threats to the three extant populations located within the state. The petition describes the importance of protecting these populations, and future reintroductions, under CESA and explains why this is crucial for the survival and recovery of this species in California.

The Pacific pocket mouse historically occurred along the coast of southern California, from Marina del Rey and El Segundo in Los Angeles County, south to the vicinity of the Mexican border in San Diego County (summarized in Erickson 1993) on fine-grain, sandy substrates in open coastal sage scrub, coastal strand, coastal dune, and river alluvium habitats. The majority of records are within 1 mi (1.6 km) of the coast, at less than 600 ft (180 m) in elevation. PPM was considered extinct for several decades until rediscovered at the Dana Point Headlands in Orange County in 1993 and was emergency listed as endangered by the U.S. Fish and Wildlife Service (USFWS) in 1994 due to immediate threats to the remnant population (USFWS 1998). Subsequently, three additional population sites were discovered on Marine Corps Base Camp Pendleton, San Diego County (Ogden 1997, MBA 1997). Despite more than 150 surveys within their historic range, no additional PPM populations have been discovered since 1995 and one rediscovered population has since become extirpated (Brehme and Fisher 2008, USFWS 1998; 2024). The most recent USFWS 5-year Review of PPM (USFWS 2020) concluded that the principal threats identified at the time of listing remain, including habitat destruction and fragmentation due to development, habitat degradation from human disturbance, high fire frequencies and invasion of nonnative plants (especially grasses), small population size, and reduction of habitat quality in extant PPM populations due to vegetation succession and loss of bare ground and openings within senescent sage scrub. In spite of the protections currently in place, habitat degradation from human disturbance continues and seems to be increasing – particularly that from foot traffic and impacts from recreation and trespass.

The Pacific pocket mouse now occurs in the wild at only three sites within the increasingly rare open coastal sage scrub habitats: the Dana Point Headlands in Orange County, and two locations within the Marine Corps Base Camp Pendleton (MCCBP) in San Diego County (Figure 1). Urbanization and land conversion have led to habitat loss and have fragmented the historical range of PPM, isolating the extant populations from one another. Due to the demand

for further coastal development within its range, habitat loss and degradation can be expected to continue indefinitely. Given the small number of extant populations, the small area known to be currently occupied, continued loss and degradation of habitat, and the requirement for intensive and perpetual management required to sustain existing populations, the Pacific pocket mouse remains highly endangered and vulnerable to extinction.

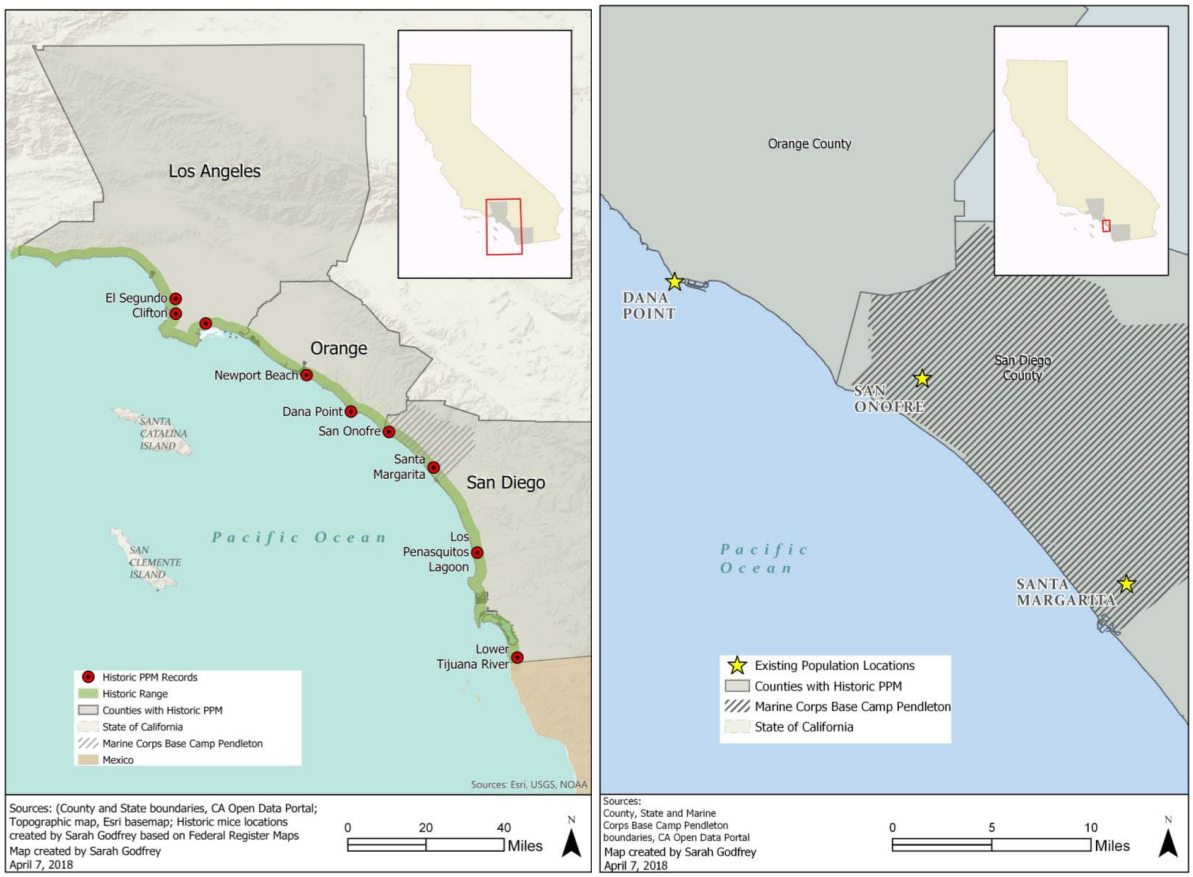

Figure 1a. Historic Range of PPM; Figure 1b. Current Range of the Pacific Pocket Mouse in San Diego and Orange Counties. Credit: Godfrey (2018)

2. NATURAL HISTORY

2.1 Description

The Pacific pocket mouse is a nocturnal, aggressively solitary, and semi-fossorial rodent in the family Heteromyid that is physiologically adapted to warm and dry climates. PPM is one of the

smallest rodents in North America (USFWS 1998) with an adult body mass generally ranging between 7-9 grams (USFWS 1998). Body length from nose to tip of tail for PPM ranges up to 131 millimeters (5.2 inches) in length from nose to tip of tail (Hall 1981) with the ratio of length of tail to head and body usually ranging between 1.03-1.40 (Williams et al. 1993). The length of the tail, hind foot, and skull, and the small size of the skull sutures, distinguish this subspecies from other subspecies of the little pocket mouse, including the Los Angeles pocket mouse (*P. l. brevinasus*)—the only other little pocket mouse subspecies to occur in cismontane southern California (Hall 1981). They have fur-lined external cheek pouches used to store seed while foraging and transport to cache sites. The body pelage of the PPM is spineless and bristle free and predominately brown, pinkish buff or ochraceous buff above and light brown, pale tawny, buff, or whitish below (Hall 1981, USFWS 2010). Typically, there are two small patches of light-colored hairs at the base of the ear (Ingles 1965). The tail can be either distinctly or indistinctly bicolored (Hall 1981).

Average life expectancy in the wild is approximately one year, with survival for as long as 3–5 years not uncommon (French et al. 1967, 1974). In winter, if environmental factors are unfavorable, the Pacific pocket mouse may hibernate underground until spring brings better conditions. However, if adequate food supplies are available, the mouse will remain active during winter.

2.2 Taxonomy

The Pacific pocket mouse is one of 16 currently recognized subspecies of the little pocket mouse (*Perognathus longimembris*, USFWS 2010). This subspecies is the smallest member of the family Heteromyidae, which consists of spiny pocket mice (*Heteromys* and *Liomys*), pocket mice (*Perognathus* and *Chaetodipus*), kangaroo rats (*Dipodomys*), and kangaroo mice (*Microdipodops*). PPM was originally described by Mearns (1898) under the name *Peragnathus pacificus*, based on the type specimen from the Tijuana River Valley at the U.S./Mexico in San Diego County, California. Von Bloeker (1932) subsequently concluded *P. pacificus* represented two subspecies of the little pocket mouse, *P. longimembris pacificus* and *P. longimembris cantwelli.* Subsequent to a biometric analysis of 331 specimens of the little pocket mouse, Huey (1939) synonymized *P. l. pacificus* with *P. l. cantwelli*, assigning the name of the earlier described subspecies, *P. l. pacificus*. Huey's treatment continues to be recognized by recent authors (Hall 1981, Williams et al. 1993).
Most recently, Patton and Fisher (2023) suggested animals from the type locality described by Mearns (1898) at the U.S./Mexico border are morphologically distinct from the extant populations and that extant populations all belong to the previously described *P. l. cantwelli*.

Because all existing populations are still considered a single subspecies, this subspecies is currently referred to as the Pacific pocket mouse (*Perognathus longimembris pacificus*).

Photo credit: Joanna Gilkeson/USFWS

2.3 Habitat

PPM are associated with fine grain, sandy or gravelly substrates in coastal strand, coastal dunes, river alluvium and coastal sage scrub habitats within approximately 4 kilometers (2.5 miles) of the Pacific Ocean (Mearns 1898; von Bloeker 1932; Grinnell 1933; Bailey 1939, USFWS 2010). Historic records report Pacific pocket mouse populations in coastal dunes and river alluvium; however, these habitats were described as rare to virtually eliminated in coastal southern California in the 1990s (USFWS 1998) and have only become rarer and more impacted in recent decades.

The presence of loose or friable soils appears to be the most important factor in determining distribution (USFWS 1998). PPM are typically not found in areas covered by dense nonnative grasses and thatch, or shrub cover, as they require open ground to forage efficiently for diverse seeds and use openings for dust bathing to remove ectoparasites, absorb oil, and communicate with conspecifics (USFWS 1998, Brehme et al. 2023b). Modeling by Brehme et al. using data largely collected from the two extant populations at Camp Pendleton (2019, 2023b) found that increased nonnative grass cover was a strong predictor of decreased colonization and increased extirpation probability in those areas. This study also found that the likelihood of PPM occupancy increased with moderate to high forb cover (40-80%) and open ground (20-70%), but decreased with even moderate nonnative grass cover (>30%) (Brehme et al. 2023b).

The population within the Dana Point Preserve occurs in coastal sage scrub vegetation of various densities growing within loamy sand soils on a coastal terrace. The Dana Point Preserve site is a remnant coastal bluff top habitat fragment that is bounded by Dana Point Harbor, the Pacific Ocean and urban development. The San Mateo North population, now extirpated, occurred on a south-facing slope in the northwest corner of MCBCP within habitat described as predominately mature coastal sage scrub growing within loamy coarse sands and sandy loams (MBA and LSA 1997). The remaining San Mateo Creek population, San Mateo South, is located near the San Margarita River, and is found in small patches of coastal sage scrub, bare ground, and in low-density non-native grassland within a larger matrix of dense non-native grassland, chiefly in fine sandy loam and loamy coarse sand soils (Ogden 1997, USFWS 1998, Spencer et al. 2000). This site is located within a military training area on MCBCP approximately 3.2 km (2 mi) from the coastline. The third extant population, Santa Margarita, is the southernmost site and the largest of the PPM sites, consisting of both the Oscar One and Edson Range training areas within MCBCP. This site has the greatest range of habitat conditions including areas predominated by coastal sage scrub to sage scrub-grassland ecotonal areas, mixed native and nonnative grassland and forblands, and dense nonnative grasslands (USFWS 2010).

2.4 Home Range and Spatial Distribution

Pacific pocket mouse populations are dynamic and fluctuate considerably from year to year both in numbers and areas of occupied habitat (Brylski 1993, USFWS 1998). PPM exhibit substantial individual variability in movement with some individuals appearing to remain relatively sedentary and others making long distance excursions of 150 meters or more; sometimes coinciding with a shift in use area (USFWS 2010). The average PPM core home range size is estimated to be 0.017 hectares, or ~13 meters in diameter (Shier 2009) but individuals have been recorded traveling 181 meters in a single night, with average movement distances reported of 10 meters to 30 meters between successive captures (Dodd et al. 1998, 1999, USFWS 2008). Mark-and-release studies indicate limited adult movement and juvenile dispersal distances (Swei et al. 2003). Males consistently are observed to have larger home ranges than females, with additional variability in movement over time and space possibly relating to breeding status, the age composition of the population, population density and/or site conditions. According to USFWS (2020, p. 4), mean observed range length (ORL) is significantly different between male and female PPM. Over a 4-year monitoring period, mean ORL was 29.3 and 17.9 meters (96.1 and 58.7 feet) for males and females, respectively. Some PPM were observed to go on longer distance excursions and relocate to different areas within the monitoring grids (USFWS 2020).

2.5 Diet

PPM is largely granivorous, specializing forb and grass seeds (USFWS 1998), and may occasionally include insects and green vegetation in its diet (Reichman and Price 1993, Meserve 1976a). PPM obtain both metabolic water and energy from seeds and are highly efficient at minimizing evaporative water loss (French 1993). Diet studies have shown that PPM primarily select forbs (Iwanowicz et al. 2016), and prefer forbs, perennial herbs, and native bunch grasses over perennial shrubs and grasses for food resources (Vandergast et al. 2023), particularly in the early spring months to support their energetic needs for reproduction (Brehme et al. 2019b, 2020. A positive relationship was found between forb cover and PPM occupancy at Marine Corps Base Camp Pendleton (MCBCP; Brehme et al. 2014) and at the Dana Point Preserve (Brehme et al. 2020) and years with low forb growth and early forb die-offs have been associated with PPM declines (Brehme et al. 2019).

2.6 Reproductive Biology

Generally, the PPM breeding season begins in early spring and lasts through July but varies with temperatures, food supply, and plant growth (USFWS 1998). The time period during which a female PPM is in peak estrus can be extremely limited, however, lasting as little as one hour per cycle (D. Shier pers. comm.) This is one of several features that reflect vulnerability of the subspecies—i.e., if this period is affected or interrupted by environmental factors. Females typically produce one litter with two to eight young per litter, but may have up to two litters in high resource years (USFWS 2008). The gestation period is approximately 3 weeks, young are born in a nest in an underground burrow and are weaned after 30 days (Shier et al. 2016). The Pacific pocket mouse reaches sexual maturity in two to five months and is capable of reproduction in their natal year during favorable conditions (USFWS 2008). Reproduction is influenced by food availability and in years of poor resource availability (e.g., drought) PPM may delay breeding or forego breeding altogether, resulting in little to no recruitment to the population (Beatley 1969, French et al. 1967, Kenagy and Bartholomew 1985, USFWS 2008, Brehme et al. 2019). As such, PPM may be particularly vulnerable to the impacts of rapid climate change. In high resource years, adult females may have up to two litters with their female offspring mating and reproducing in a single season (USFWS 2008). Because of this, PPM abundance can be highly variable within and among years.

2.7 Behavior

PPM create and live much of the time in burrows beneath the soil surface, and cache seeds below ground and within burrow systems for sustenance throughout the year (e.g., Randall 1993, Merrill et al. 2023). More recent research has provided evidence that both pit caches and larders may be used (Chock et al. 2019). In sand dunes in Oceanside, CA, burrows were found approximately one foot below the surface under vegetation edges and ended in a single nest chamber (Bailey 1939). Burrows and tunnels can sometimes be even closer to the surface—as little as 1 to 4 inches below ground (D. Shier pers. comm.). As such, sounds and vibrations from above-ground disturbances—such as foot traffic and human voices—could affect PPM below ground. In sandy habitats, burrows are particularly vulnerable to compaction by foot traffic. Brehme et al. (2014) reported a strong negative effect of human foot traffic on PPM occupancy. Although much remains to be studied regarding burrow architecture, recent observations have indicated that the height of the burrows themselves may be very shallow (e.g., 1 inch)—further indicating their vulnerability to collapse.

PPM use seasonal heterothermy (winter torpor and facultative summer aestivation) in response to environmental stresses of food shortage and/or low temperatures (Chew et al. 1965, Bartholomew and Cade 1957). The onset of torpor is marked by a large drop-off in activity that can occur from June to November and is highly spatially variable within and among years (Meserve 1976a, Shier 2009, Brehme et al. 2014, 2020). During torpor, the mice alternate between periods of dormancy and feeding on cached seeds. Periods of dormancy have neither a daily nor strictly seasonal pattern (Brehme et al. 2014). In captivity, dormant individuals may show some activity each day within their burrows. Emergence typically occurs in late winter to early spring (February-March) and is thought to coincide with seed availability (Meserve 1976b). It has been suggested that the trigger for emergence may be changes in soil temperature (French 1977). As the beneficial aspect of torpor or aestivation is to reduce energy expenditure, any disturbance that disrupts these states can have a negative effect. Again, such disturbances could include human-caused sounds or vibrations—especially if burrows are shallow and/or close to the surface. Further, because Heteromyids have expanded middle ears, they are especially sensitive to low frequency sound (D. Shier pers. comm.).

PPM are solitary and nonsocial. In captive breeding setting, PPM, particularly females, display aggression towards male conspecifics (King et al. 2018). PPM is the smallest, least dominant species in the community, and appear to actively avoid larger rodent species (Chock et al. 2018), as evidenced by lower probabilities of detecting PPM with the presence of other larger rodent species (except western harvest mouse) (Brehme et al. 2019). Like other Heteromyids,

PPM use sandbathing to clean their fur, and as a form of chemical communication (Eisenberg 1963, USFWS 2020) such as communication between sexes during estrus and the breeding period (Shier et al. 2016).

2.8 Survivorship

PPM has a short lifespan in the wild, with an average of one year, although survival for as long as three to five years is sometimes observed (French et al. 1967, 1974). In captivity, PPM have lived up to 10 years (GSRC and SDZWA 2022). A demographic study estimated distinct monthly survivorship rates during summer and winter months, which generally corresponded to periods of above ground activity and inactivity associated with these seasons, where mean monthly survivorship was lower in summer than in winter (USFWS 2008). An exception to this was lower winter and spring survival associated with near record rainfall during that winter and spring. Overall, these seasonal survivorship rates estimated in this study indicate that PPM has a mean annual survivorship rate of around 17%, which is consistent with monitoring results (USFWS 2008). Generally short but variable individual lifespans, coupled with much variation in annual reproductive success, contribute to much annual variability in population size and generally more vulnerability in persistence.

2.9 Genetics

Genetic diversity is the basis for populations to change in response to environmental conditions—i.e., adaptation. As such, genetic diversity is one metric for consideration of a population's (and, by extension, a species') ability to persist. Analyses of genetic variation suggest that effective population sizes within the extant PPM populations are universally low and cause for concern (USFWS 2020; 2024, Wilder et al. 2020, Shier et al. 2022). The estimated effective population sizes are: Ne=14.9 at Dana Point, Ne= 20.5 at South San Mateo, and Ne=36.5 at Santa Margarita (Wilder et al., in prep.) Further, genomic and karyotypic analysis indicates there are fixed chromosomal differences among the PPM populations, with the Santa Margarita and South San Mateo populations having a diploid (2n) chromosome number of 56 and Dana Point having 2n=58 (Wilder et al. in prep). These chromosomal differences are important considerations for any genetic intervention (e.g., introducing individuals from other populations with a goal of increasing genetic diversity) as this not only significantly undermines any likelihood of successful reproduction between these two types in the wild but, if successful, may lead to outbreeding depression. As such, an ex-situ cross-breeding program has been planned and is in progress, discussed further below. However, results are uncertain and may require many attempts and considerable time to produce backcrossed hybrids that may be suitable for introduction.

3. RANGE AND DISTRIBUTION

Historically, the Pacific pocket mouse occurred along coastal southern California, from Marina del Rey and El Segundo in Los Angeles County, south to the vicinity of the Mexican border in San Diego County (Hall 1981, Williams et al. 1986, Erickson 1993). The majority of records are within 1.6 km (1 mi) of the coast and there are no reliable reports of occurrences more than 4 km (2.5 mi) from the ocean. Pacific pocket mice have been recorded in elevations as high as 180 meters (600 feet) in the San Joaquin Hills, but most localities are found at considerably lower elevations, at less than 600 ft (180 m) (Erickson 1993). Available data indicate that the historical distribution of the Pacific pocket mouse was much more extensive prior to the large-scale development of the coastal lowlands of southern California.

Pacific pocket mice were thought to be extinct when the last known population of PPM (Newport Beach, CA) was extirpated in the early 1970s. PPM was then rediscovered in 1993 at what is now the Dana Point Preserve in Orange County (Brylski 1993, USFWS 1994). In 1995, PPM were found in three additional locations on Marine Corps Base, Camp Pendleton in San Diego County (North San Mateo, South San Mateo, and North Santa Margarita). Despite 166 surveys within their historic range, no additional PPM populations have been discovered since 1995 (USFWS Carlsbad Fish and Wildlife Office Survey Report Database, 2023), and the North San Mateo population on USMCBCP is presumed extirpated since 2003 (Brehme and Fisher 2008, USFWS 2010; 2015). Currently, PPM exists in three recognized extant populations: Dana Point Headlands Preserve, owned and managed by the Center for Natural Lands Management (CNLM), and San Mateo South and Santa Margarita, located on MCBCP lands. All other historical locations are believed extirpated (USFWS 2012). These remaining locations are isolated and are therefore each are assumed to represent a distinct population. This lack of connectivity means that natural dispersals and exchanges of genetic diversity are not feasible; thus, substantial and unproven interventions would be needed to provide this historically occurring influx of genetic diversity.

Occupied habitat for the Pacific pocket mouse in 1998 was estimated to total less than 400 hectares (1,000 acres) at all known localities combined (USFWS 1998). Current (2022) estimated occupied habitat is now less than 200 hectares (500 acres) (Brehme et al. 2023a, CNLM 2024). The range has contracted since 1998 when the USFWS declared that "…Loss or degradation of any of the populations at the three known extant locales could irretrievably diminish the likelihood of the subspecies' survival", because one population has already been extirpated and potential habitat has been further degraded and lost. Currently, the Pacific pocket mouse

population persist only in three distinct locations where their viability is threatened by land use activities and their persistence relies on intensive, perpetual management.

3.1 Historic Range

Between 1894 and 1972, the Pacific pocket mouse was recorded from 9 general locales and 30 specific localities from Los Angeles County south to the Mexican border in San Diego County (Erickson 1998); approximately 80 percent of all records were from 1931 or 1932 (Erickson 1993). Since the 1930's, the majority of suitable and historic habitat for the Pacific pocket mouse has been destroyed, fragmented, and significantly reduced by urbanization and agricultural conversion. By 1998, only one percent of potential habitat for the PPM remained undeveloped in Los Angeles County, less than twenty percent in Orange County, and a comparable amount of natural habitat remains in coastal San Diego County (USFWS 1998). Populations at six of the historic localities are considered extirpated and numerous recent surveys within the historic range of the subspecies have failed to detect additional extant populations (USFWS 1998).

Los Angeles County (Historic)
In Los Angeles County, the Pacific pocket mouse has been observed in the vicinity of Marina del Rey/El Segundo, Clifton, and Wilmington (Erickson 1993). These sites, none of which are currently occupied by Pacific pocket mouse populations, are now urbanized, as is most of the Los Angeles Basin. Little suitable habitat remains in Los Angeles County, and what does remain is isolated and fragmented. There have been no records of Pacific pocket mice from Los Angeles County since 1938 (Erickson 1993, Brylski 1993, U.S. Fish and Wildlife Service 1998a).

Orange County (Historic, Extant)
The Pacific pocket mouse has been observed in two areas of coastal Orange County: the vicinity of Signal Peak ("Spyglass Hill") in the northern San Joaquin Hills, and the Dana Point Headlands in Dana Point. Pacific pocket mice were detected at the Spyglass Hill locale in the course of several rodent surveys conducted at the University of California, Irvine, from 1968 to 1971 (Meserve 1972, 1976). Spyglass Hill has since been urbanized and only remnant habitat patched remain. The Dana Point Headlands population was first recorded in 1932, and was re-discovered after presumed extirpation in July 1993 (Brylski 1993). This location, now the Dana Point Preserve owned by CNLM, supports one of three known extant populations.

San Diego County (Historic, Extant)
PPM have been recorded from four localities in San Diego County: San Onofre, the Santa

Margarita River mouth, Los Penasquitos Lagoon, and the lower Tijuana River (Erickson 1993, Erickson 1998, USFWS 1998). In 1995, two additional populations were discovered on Marine Corps Base Camp Pendleton. The "Oscar One" population was located on in the vicinity of the Santa Margarita River and another two were located on the gentle slopes and hillsides on either side of San Mateo River, near the historic San Onofre population. The "Edson Range" extension of the Oscar One population was discovered in 1998.

The now-extirpated San Mateo Creek North population formerly occupied approximately 6.5 hectares (16 acres) across the river from the San Mateo South population. PPM were last observed at San Mateo North in 2003 (Natural Resources Assessment 2003, Montgomery 2005, Brehme and Fisher 2009, USFWS 2010), and multiple comprehensive surveys performed that site since then have not detected PPM (Brehme et al. 2015, Brehme et al. 2019). This is likely due to a combination of a small population that is geographically restricted, habitat degradation due to increased human activity on site as well as nonnative plants, invasive Argentine ants and maturation of existing habitat. North San Mateo is in close proximity to a residential community that increases access by domestic cats and dogs, as well as creation of unauthorized trails, dumping and other human activities (Montgomery 2003, Brehme et al. 2009). Additionally, the part north of San Mateo Creek exists immediately adjacent to the proposed alignment of a six lane toll road, the Foothill Transportation Corridor South, the construction of which would adversely impact the likelihood of dispersal amongst north and south parts of the locales.

3.2 Current Distribution

PPM currently exists in three recognized extant populations: Dana Point Headlands Preserve, owned and managed by CNLM, and two locations on MCBCP lands: San Mateo South and Santa Margarita. These three locales are isolated and considered distinct populations. Only one locale (Dana Point Preserve) is permanently protected through a legal instrument (Conservation Easement), and all locales have been impacted by habitat destruction or fragmentation, land use activities, human-caused fire, and other disturbances.

Dana Point Preserve, Orange County

The Pacific pocket mouse has persisted on the Dana Point Headlands in southern, coastal Orange County. At the time it was rediscovered, this PPM population was located on land under consideration for development (e.g., City of Dana Point 1994, EDAW 1994). On April 28, 1998, the Dana Point City Council supported a development proposal and in 2004 adopted the Headlands Development and Conservation Plan (HDCP), approving commercial development of

a 49 hectare (122 acre) site with 27.7 hectares (68.5 acres) of the site designated as open space (City of Dana Point 2004). The open space areas include the Dana Point Preserve and several City parks, including Hilltop Park, Harbor Point Park, and Strand Vista Park, as well as the County Strand Beach. The Dana Point Headlands PPM population is within the 29.4-acre Dana Point Preserve (Preserve), and is the only known existing population of PPM off MCBCP.

The Dana Point Preserve is owned and managed by the Center for Natural Lands Management, which acquired the property in 2005 for the purpose of protecting the rare coastal sage scrub community and habitat for the endangered PPM as well as the threatened coastal California gnatcatcher (*Polioptila californica californica*, CAGN). CNLM's management of the Preserve is overseen by the USFWS and the California Department of Fish and Wildlife (CDFW) through, in part, the Orange County Central and Coastal Subregions Natural Communities Conservation Plan/Habitat Conservation Plan (NCCP/HCP). The City of Dana Point holds a Conservation Easement over the Preserve and USFWS and CDFW are third-party beneficiaries. PPM occupancy has fluctuated greatly at Dana Point in recent years (CNLM 2024). Active habitat management for PPM on the property has included thinning of duff and dead shrubs, removal of invasive species, detection and treatment of non-native Argentine ants, and other intensive activities (Merrill 2023). Habitat at the Dana Point Preserve is also managed for the federal-threatened coastal California gnatcatcher (*Polioptila californica californica*, CAGN), a species which has habitat requirements that are not fully aligned with those of PPM. The requirement to manage the preserve for CAGN populations limits the extent of habitat management on the Preserve that can be focused solely on PPM.

The Preserve has distinct and hard edges on most boundaries: it is bounded by the Pacific Ocean on the west and by hardscaped city streets and residential development on most of the rest of its perimeter. As a portion of Preserve is comprised of steep coastal bluff, the effective potential habitat of the Preserve approximates 0.4 hectares (22 acres).

While the Preserve is designated as conservation open space under local zoning and the local coastal program, the City parks are designated as recreational open space. The intensity of use allowed in recreational open space is higher than in conservation open space and these parks are designed to facilitate recreation and views. Adjacent to the Preserve, the City of Dana Point (City) owns and manages the Hilltop, South Strand, and Harbor Point parks totaling 8 ha (20 ac) of coastal sage scrub habitat. Hilltop Park also has some areas designated as environmentally sensitive habitat areas under the Coastal Act, which the City is required to conserve. PPM has been intermittently observed in the City of Dana Point-owned Hilltop Area, but trapping data has not indicated this habitat is occupied (Brehme et al 2020).

In accordance with the Local Coastal Plan and Headlands Development and Conservation Plan, a trail was designed and created on the Preserve, and initially opened for public access in December 2009. Since the opening of the trail to the public, public visitation has increased substantially, essentially doubling from 2011 to 2017 (CNLM 2023), and appears to be continuing to increase.

U.S. Marine Corps Base Camp Pendleton

Two extant populations were discovered (or rediscovered) in 1995 on the U.S. Marine Corps Base, Camp Pendleton in the vicinity of two historic locales: San Mateo Creek and Santa Margarita. Each location is surrounded by land uses (e.g., roads, military training activities, agriculture, residential development) that act as barriers to dispersal and genetic exchange among the populations. In 1995, the rediscovered San Mateo Creek location consisted of two separate small pockets of animals detected immediately north and south of San Mateo Creek. The northerly site, which has been designated by Camp Pendleton as the San Mateo-North Site and is now extirpated, is approximately 1.4 kilometers (0.9 mile) from the coast. The southerly site, which has been designated as the San Mateo-South Site is approximately 2.1 kilometers (1.3 miles) from the coast. The second, separate Camp Pendleton locale with an extant population occurs on a marine terrace north of the Santa Margarita River in an area that is designated by Camp Pendleton as training area Oscar One The extent of occupied habitat in the Oscar-I training area ranged from approximately 2.5 to 4 kilometers (1.6 to 2.5 miles) from the coast in 1996 (USFWS 1998).

San Mateo Creek South, San Diego County

The San Mateo Creek South population, located on the southern side of San Mateo Creek in northern San Diego County. Trapping data from San Mateo Creek South indicates that this population has occupied an average of 34 hectares (84.26 acres) across 2012-2022 (Brehme et al. 2024) or about 32% of the 105 ha (259 ac) area that is monitored as potential habitat (Brehme et al. 2023a). It is likely that the San Mateo wash was dominated by sandy alluvium prior to agricultural development and that it may have supported a significant population of PPM. The north and south parts of the San Mateo Creek population may at one time have been part of a more extensive population. The locations are adjacent to urban development and transportation facilities, but are connected to extensive natural open space. Many of the areas occupied by PPM at South San Mateo is covered with mature shrub vegetation with little open

ground, which monitoring suggests is of lower habitat quality for PPM relative to more open vegetation communities with higher amounts of bare ground and forb cover.

Santa Margarita (Oscar One / Edson Range Population)

The largest PPM population is located north of the Santa Margarita River within Camp Pendleton Marine Corps Base and spans two troop training areas. The Oscar One target range supports the largest portion of this population (USFWS 1998a, Spencer et al. 2000). An apparent extension of this population was discovered in 1998 on the Edson Range (Spencer et al. 2000). The combined area of the Oscar One / Edson population suggests a total of about 900 hectares (2,250 acres) of habitat, although much of this habitat may be lacking appropriate soils (Spencer et al. 2000). The Oscar One / Edson Range population is less vulnerable to development, habitat fragmentation, and isolation than the other extant populations due to its location on the Marine base. However, Pacific pocket mouse habitat on the site is impacted and continues to be threatened by military activities such training exercises and the development of training facilities. The Edson Range and Oscar One each have different training regimes and operational restrictions and because of this, PPM monitoring for the Santa Margarita population is split between the two training areas, although these two areas adjoin one another and are connected demographically, thereby acting as a single population.

<u>Oscar One</u>

Within the 411-ha (1,016 ac) area delineated for PPM monitoring within Oscar One, estimated habitat use between 2012 and 2022 has averaged 41 ha (101 ac), approximately 10 percent of the monitored area (Brehme et al. 2023a). Oscar One has had relatively high PPM numbers historically, but these numbers declined following a wet winter in 2004 to 2005, that also appeared to be exacerbated by a dramatic expansion of troop training activities in 2006 (USFWS 2012). Beginning in 2012, the Marine Corps started implementation of a comprehensive monitoring program that uses Percent Are Occupied (PAO) statistical methods to track the status each of the extant populations on Base. Since these monitoring efforts began, PPM occupancy at Oscar One has remained low across the training area (Brehme et al. 2023a) except for some observed increase along Powerline Road where core grids are located within more suitable PPM habitat (diverse forbs with open ground). The presence of non-native grasses has been found to negatively impact PPM occupancy at Oscar One, and native fire ants may negatively affect PPM populations in these areas of suitable habitat (Brehme et al. 2023a).

Edson

Within the 474-hectare (1,171 acre) area delineated as potentially occupied by PPM within the Edson Range, estimated habitat use between 2012 and 2022 has averaged 139 ha (343 ac), which is about 29% of the monitored area (Brehme et al. 2023). The estimated occupancy at Edson has seen a relatively steady and rapid decline (Brehme et al. 2023a); in 2016, estimated PAO at Edson was 282 ha but as of 2021 PAO was only 28 ha (Brehme et al. 2023a). Within this training area, there has been a documented strong positive relationship between PPM populations and prescribed burns (Brehme et al. 2023b). Burns occurred at Edson in 2011 (prescribed burn), 2012 and 2014 (wildfires). In 2020, a prescribed burn was conducted at Edson in the hopes of an increase in PAO but which resulted in lower than expected improvements, possibly due to existing low PPM populations on site in 2020 combined with a 2021 drought

3.3 Captive Breeding and Release Locations

The establishment of new PPM populations through translocation and/or the release of captive-bred individuals is identified as a primary recovery strategy in the USFWS 1998 Recovery plan. Between 2007 and 2011 it was concluded that there were insufficient numbers of mice in the source populations to safely conduct translocations without harm to the source populations. As an alternative, a conservation breeding program was initiated in 2012. The Pocket Mouse Conservation Breeding Facility Animals was established at the San Diego Zoo Safari Park with an explicit goal of providing sufficient animals to establish three new PPM populations. Individuals from the extant populations have been brought into captivity and are being bred to provide a source of animals for population creation. Animals from the conservation breeding facility have been released at one site in Orange County since 2016 but the population is not currently considered established or self-sustaining.

4. ABUNDANCE AND POPULATION TREND

Pacific pocket mouse populations are small, dynamic, and fluctuate considerably from year to year both in both of numbers and areas of occupied habitat (Brylski 1993, USFWS 1998). Such small sizes predispose these populations to extirpation by stochastic events, catastrophes, inbreeding depression, or other factors (Noss and Csuti 1997). Information on population demographics and trends is informed by monitoring efforts on Dana Point and at MCBCP. Population monitoring in these locales focuses on the total Population Area Occupied (PAO), which is determined using track tube surveys and live trapping surveys on sample plots and provide the number of hectares estimated to be occupied by year (Brehme et al. 2023a).

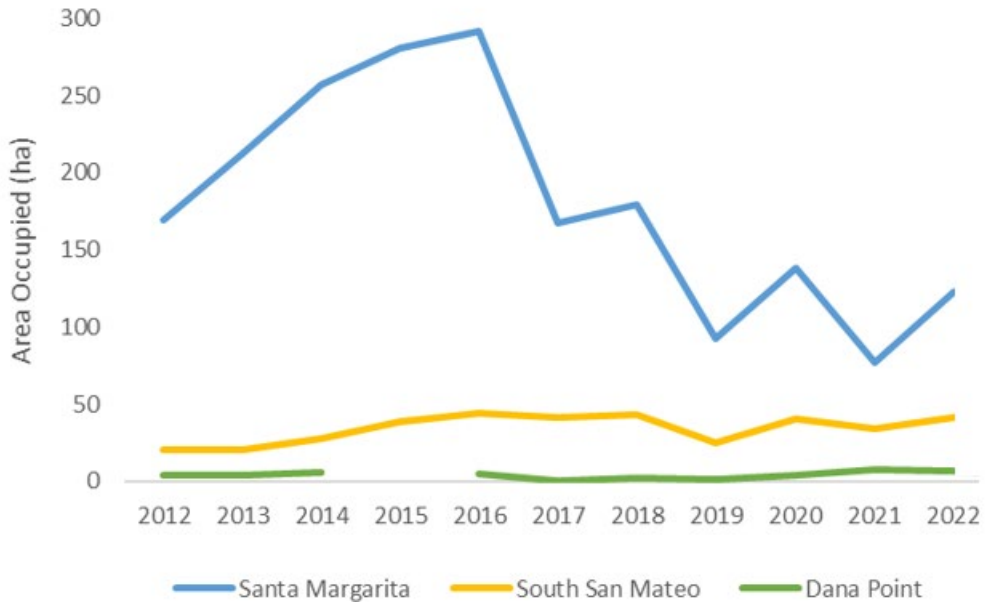

Figure 2. Total area in hectares (ha) estimated to be occupied by PPM for each population from 2012 to 2022. Data sourced from Brehme et al. 2023a and CNLM 2024.

4.1 Dana Point Preserve

Since the establishment of the Preserve, CNLM has conducted annual PPM surveys either through live-trapping, track-tube monitoring, or a combination of both (see review Merrill 2019, 2020, 2021). Prior to CNLM acquiring the Preserve, a comprehensive trapping effort performed in 2001 only detected 4 individual mice onsite (USFWS 2002). This was followed by an expansion in habitat use and abundance that occurred after CNLM acquired the Preserve and commenced active habitat management in 2005. In 2009, the Dana Point PPM population reached its peak, as indicated by 82 PPM detections within the 7.24 ha (17.9 ac) of monitored suitable habitat (Brylski et al. 2010; Table 2) and an estimated habitat use around 81% (Carranza 2014). This was followed by a population crash with only 6 individuals detected in 2017 (Miller 2017), and then only 2 individuals detected in 2019. This population experienced a rebound in 2020, with 77 individuals detected and an estimated habitat use around 46% (Merrill et al. 2023). This rebound coincided with increased habitat management and the COVID-related closure of the popular public trail that traverses the site, which has since reopened. Overall, these fluctuations indicate this population is highly vulnerable to extirpation from isolation and small population size. As USFWS and CDFW have noted, “[r]egardless of the cause of the observed fluctuations in the PPM population, the monitoring results clearly illustrate that this population remains vulnerable to extirpation due to its isolation and small

population size." (USFWS and CDFW 2022).

Table 1. Results from all live-trap Pacific pocket mouse monitoring events since CNLM acquisition, 2008-2020. Source: Merrill et al. 2023.

Month(s) and Year of Trapping Events	Level of Effort (trap nights)	Trapping Results (unique PPM)
May – June 2008	3280	30
May 2009[1]	3770	82
May 2012	3330	57
May 2017	2286	6
June 2019	792	2
June 2020[2]	1254	77

[1] The trail was opened to public access in December 2009.

[2] The trail was closed to public access in March 2020.

Track-tube monitoring provides information on presence/absence of mice and the areas of the Preserve where they are active above-ground. This can reflect general population size and trends when data are available across years. The Proportion of Area Occupied (PAO) is an estimate of amount of area where PPM are likely to occur based on track-tube detections. Similar to the trends from the live-trapping data, the population appeared low around 2017, with a notable increase starting in 2020, to a peak in 2021—that period corresponding to a reduction in public visitation due to COVID-related restrictions and later, reduced, trail hours. See Table 3 below. Thereafter, the PAO has declined since the trail hours were increased to 7 am to sunset daily, due to a court order sought by the City of Dana Point in ongoing litigation against CNLM. A decline in the proportion of area occupied indicates a decline in total population.

Table 2: Pacific pocket mouse track-tube monitoring data from the Dana Point Preserve 2017-2024

Track-Tube Monitoring Year	Estimated Proportion of Area Occupied
2017	0.08
2018	0.24
2019	0.14
2020	0.46
2021	0.95
2022	0.81
2023	0.78
2024	0.56

The high and increasing level of public use of the Preserve is hypothesized to be detrimentally impacting habitat suitability for PPM and there is a strong scientific basis in principle and case studies, as well as evidence from the Preserve, of negative direct (i.e., mouse fatality) and indirect impacts (CNLM 2023).

The high degree of public access to the Dana Point Preserve has consequences for the PPM population that include impacts from both permitted trail use and non-permitted activities. Impacts from permitted pedestrian use alone are myriad and include direct mortality (CNLM 2023) as well as potential behavior alterations, displacement, and effective habitat loss due to the sight, sounds, smells and vibrations of trail users (reviewed in Merrill et al. 2023). Non-permitted activities that occur on the Preserve include trail users bringing dogs on- and off-leash, which exacerbate impacts of human-only trail use (Banks and Bryant 2007, Steven et al. 2011, Hennings 2016, Reilly et al. 2017), leaving food or trash onsite (may attract predators), and off trail trespass which can crush PPM burrows and food-source plants.

Any disruption of a PPM's above- and below-ground activities can negatively impact that individual's health, longevity, and likelihood of successful reproduction. PPM, while remaining below-ground for substantial amounts of time, need to conduct life-sustaining activities at the surface including feeding and food collection, selecting mates and mating, territory exploration and expansion, and hygiene (i.e., sand baths). Above-ground activities are typically conducted at night or during low-light levels. Low-light times of day include early morning, cloudy or foggy conditions, early evening and night. Presence of humans (including the sight of humans, their scents and sounds) can shorten or discourage these essential activities, or directly impact mice (e.g., a dead PPM was found on the trail in June 2023; a necropsy revealed it had traumatic injuries resulting from being crushed, likely by a pedestrian on the trail during open hours). Sounds and vibrations from trail use can also affect mice while below ground, interrupting their energy-saving state (torpor or aestivation) and depleting their energy reserves. In addition, these effects can disrupt the female's reproductive cycle, which can have devastating impacts on the population. Cumulative over the entire population, a decline in survivorship and lower number of offspring can cause a downward spiral for the population that could result in local extirpation (extinction of this population), bringing the species closer to the brink of extinction.

Data have been collected on public use of the trail at the Dana Point Preserve since 2011 – the trail opened in 2009. These data are derived from trail counters at both entrances to the trail, which count the number of times a person passes the counter to enter the trail. There are two primary conclusions that can be drawn from these data (Table 1):

- The estimated average number of daily visitors has increased over time, doubling between 2011 and 2017, and currently is an average of approximately 654 per day (= 238,710 per year).
- When the trail was open three days per week, 8:00 a.m. to 4:00 p.m. (modified schedule June/2021 – Nov/2022), the estimated daily visitation rates decreased, but there were still higher numbers than in 2011 when the trail counters were first installed.

Table 3. Visitation Data at the Dana Point Preserve, 2011-2024

Year (period)	Estimated No. of visitors (daily average)	Estimated Yearly number (extrapolated)
2011	345 (7 am to sunset, daily)	125,740
2017	673 (7 am to sunset, daily)	245,740
2020 (Jan – March)	713 (immediately pre-COVID) (7 am to sunset, daily)	260,245
2021-2022	481 (modified schedule)	175,565
2023	620 (7 am to sunset, daily)	226,300
2024 (January – August)	654 (7 am to sunset, daily)	238,710

The Dana Point PPM population may also incur some risk from domestic and feral cats (USFWS 1998). The Dana Point Preserve itself is isolated by an increasing amount of urban development and is subject to associated edge effects from the surrounding residential and commercial development that continues to occur. A large hotel being developed adjacent to the Preserve, on what was formerly open space, will further exacerbate edge effects, including artificial night lighting and noise pollution, Argentine ants, and PPM predators.

4.2 Marine Corps Base Camp Pendleton

The total area occupied within defined population areas at MCBCP (Santa Margarita and South San Mateo) was estimated to be 164.5 ha (17% PAO) in 2022, a 29% increase since 2021 (Brehme et al. 2023a). This occupancy is currently 51% below its peak estimate of 335 ha in 2016 (Figure 2). Additional data analysis of PPM abundance at MCBCP corroborates that the Edson population experienced a substantial decline between 2016 and 2019 (Table 4).

Table 4. Estimated area occupied (ha) and population area occupied (PAO) for each population with Santa Margarita also broken out into the individual sampling areas (Oscar One and Edson). Source: (Brehme et al. 2023a, CNLM 2024)

	Oscar One (411 ha)		Edson (474 ha)		Santa Margarita (885 ha)		S. San Mateo (105 ha)		Dana Point (12 ha)	
Year	Area Occupied	PAO	Area Occupied	PAO	Area Occupied	PAO	Area Occupied	PAO	Area Occupied	PAO
2012	39.3	0.10	130.1	0.27	169.4	0.19	20.2	0.19	4.0	0.54
2013	45.0	0.11	167.4	0.35	212.4	0.24	20.6	0.20	3.7	0.51
2014	67.8	0.16	189.1	0.40	256.9	0.29	27.7	0.26	5.8	0.81
2015	28.0	0.07	253.1	0.53	281.1	0.32	38.2	0.36		
2016	9.7	0.02	281.6	0.59	291.3	0.33	43.8	0.42	5.3	0.71
2017	22.2	0.05	145.0	0.31	167.2	0.19	41.1	0.39	0.6	0.08
2018	37.4	0.09	142.2	0.30	179.6	0.20	43.6	0.41	1.8	0.24
2019	22.6	0.05	70.2	0.15	92.8	0.10	24.9	0.24	1.1	0.14
2020	68.6	0.17	69.2	0.15	137.8	0.16	40.1	0.38	3.7	0.46
2021	48.5	0.12	28.4	0.06	76.9	0.09	33.9	0.32	7.4	0.95
2022	65.5	0.16	57.4	0.12	122.9	0.14	41.8	0.40	6.4	0.81

4.2.2 South San Mateo

The estimated amount of habitat used by PPM between 2012 and 2022 at South San Mateo has averaged 34 ha (84 ac), or about 32% of the 105 ha (259 ac) area that is monitored as potential habitat (Brehme et al. 2023a). South San Mateo has a higher percent occupancy due to its smaller size, although the occupied area is similar to Oscar One. This population experienced a PAO decline in 2019 associated with an early forb die of in 2018 then followed by a population increase after targeted vegetation management (Brehme et al. 2022). PPM declined slightly from a PAO of 40 ha in 2020 to 33 ha in 2021, likely due to little documented reproductive activity within the core plots and no recruitment (Brehme et al. 2022).

4.2.3 Santa Margarita

The Santa Margarita population spans two troop training areas, Edson Range and Oscar One and is the largest of the three PPM populations with a monitoring footprint of 885 ha (2,187 ac) and an average of 181 ha (447 ac) occupied in the last 10 years. The two areas have different training regimes and operational restrictions and because of this, PPM monitoring for the Santa Margarita population is split between the two training areas, although these two areas adjoin one another and are connected demographically, thereby acting as a single population.

The Santa Margarita population experienced a significant population increase in 2012-2016,

reaching a population high of more than 23,000 individual PPM, followed by a dramatic decrease in 2017-2019 (Table 4; Brehme et al 2023a). A recent preliminary population viability assessment (PVA) for this population determined that the population has a 100% chance of extirpation within 100 years, running 100 iterations and starting population sizes of both 3,101 and 1,550 (Figure 3; GSRC and SDZWA 2022).

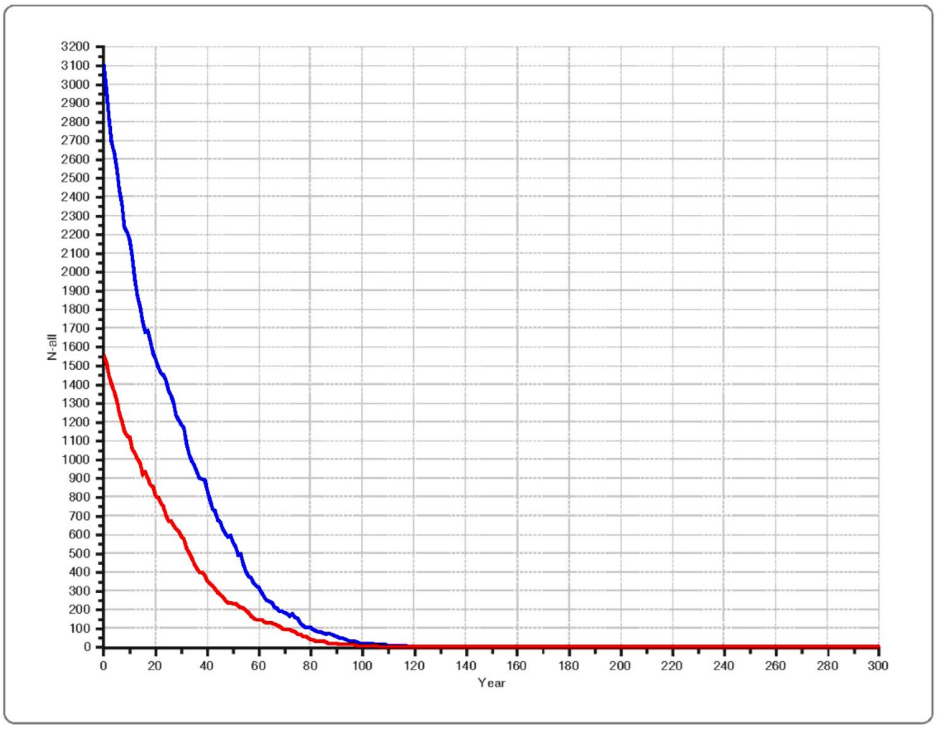

Figure 3. Results from preliminary population viability assessment (PVA) (GSRC and SDZWA 2022, p. 57) running 100 iterations with 2 starting population sizes of 3,101 (blue) and 1,550 (red).

Oscar One

Within the 411-ha (1,016 ac) area delineated for PPM monitoring within Oscar One, estimated habitat use between 2012 and 2023 has averaged 41.9 ha (104 ac) representing about 10 percent of the monitored area (Table 1; Brehme et al. 2024). Oscar One contains a land navigation training area, sandy soils, and extensive areas of non-native grass. Oscar One has had relatively high PPM numbers historically, but these numbers declined following a wet winter in 2004 to 2005, that also appeared to be exacerbated by a dramatic expansion of troop training activities in 2006 (USFWS 2012). Beginning in 2012, the Marine Corps started implementation of a comprehensive monitoring program that uses PAO statistical methods to track the status each of the extant populations on Base. Since these monitoring efforts began, PPM occupancy at Oscar One has remained low across the training area (Table 4). PAO and

PPM captures have increased in recent years along Powerline Road where some monitoring grids are located; this area differs from other monitoring areas in that it experiences a lower concentration of military training activities and contains sandy soils that allow for good drainage. The presence of non-native grasses has been found to negatively impact PPM occupancy at Oscar One, and it is hypothesized that native fire ants may negatively affect PPM populations in these areas of otherwise suitable habitat (Brehme et al. 2023b).

Edson Range

Within the 474-ha (1,171 ac) area delineated as potentially occupied by PPM within the Edson Range, estimated habitat use between 2012 and 2023 has averaged 135 ha (334 ac), which represents about 28% of the monitored area (Brehme et al. 2023a). The estimated occupancy (PAO) at Edson has seen a relatively steady and rapid decline (Table 1), dropping from 282 ha in 2016 to only 28 ha in 2021 (Brehme et al. 2023a). PPM populations have responded positively to burns at Edson (Brehme et al. 2023b) and prescribed burns have been conducted in the hopes of an increase in PAO. However existing low PPM populations on site in 2020 combined with a drought year in 2021 that limited forb growth likely resulted in lower than expected improvements (Brehme et al. 2023b).

5. FACTORS AFFECTING SUCCESSFUL REPRODUCTION AND SURVIVAL

The principal threats identified in the 1998 Recovery Plan for the Pacific pocket mouse as contributing to the decline of the subspecies remain unabated in 2024. These threats include a small number of populations (which is even smaller now than in 1998), small population sizes, habitat destruction and fragmentation due to development, habitat degradation from human disturbance, invasion of nonnative plants (especially grasses), and reduction of habitat quality due to vegetation succession.

In addition to these threats, PPM populations are known to be imminently threatened by land use activities at and surrounding the extant locales, including impacts of heavy pedestrian and military use (soil compaction and associated vegetative loss), predation risks (fire ants, Argentine ants, domestic cats, native predators), competition for seed resources (co-occurring rodent species, harvester ants, Argentine ants); negative impacts from vibrations, noise, and artificial lighting (USFWS 1998, 2010, Brehme et al. 2013, 2014, Shier pers. comm.), and the uncertain impacts from rapid climate change.

While vegetation is manageable to some extent (influencing the amount of ground cover and species composition with trimming and removal, possibly some planting), it is still a function of natural processes and affected by weather conditions and climate change—largely unmanageable factors. Some of the growing threats to the PPM cannot be directly managed or controlled, such as climate change, loss of habitat through coastal erosion, or the spread of certain diseases and viruses.

5.1 Habitat Availability

Land uses and habitat management practices in the range of the PPM are the main influences that determine the availability of PPM habitat. Urbanization and land conversion have led to habitat loss and have fragmented the historical range of PPM, and extant populations are now isolated from one another (Gilpin 1987). Fragmentation increases barriers to dispersal and makes remaining populations smaller and more vulnerable to catastrophes, deleterious effects of inbreeding, and environmental and demographic stochasticity. The quality of fragmented habitat may also decline as a result of edge effects, which increases vulnerability of habitat to disturbance, invasion by nonnative species, and exposure to artificial night-time lighting which may cause problems for nocturnal rodents by increasing their vulnerability to visually aided predators (Clarke 1983, Dice 1945) or result in direct habitat avoidance (Brown et al. 1988, Kotler 1984, Price et al. 1984). These edge effects also increase the likelihood of local extirpation of populations. Bolger et al. (1997) studied the effects of habitat fragmentation on rodents in southern California and found that species with highly stochastic populations were more frequently extirpated from small habitat fragments. This suggests that a restricted and fragmented distribution (coupled with small population sizes; see Section 4.2) continues to be a factor that threatens the viability of PPM.

5.1.1 Habitat Modification and Destruction

The large majority of remnant, suitable habitat within the historic range of the Pacific pocket mouse in coastal Los Angeles, Orange, and San Diego counties has been converted to urban, suburban, and agricultural uses (USFWS 1993, 1998). By 1998, at the time USFWS Recovery Plan was published, less than 400 hectares (1,000 acres) or 1% of approximately 11,340 hectares (28,000 acres) within 3.2 kilometers (2 miles) of the coast in Los Angeles County remained undeveloped (i.e., potential PPM habitat). In Orange County, about 17,600 hectares (43,500 acres), or 81% of approximately 21,600 hectares (53,500 acres) within 3.2 kilometers (2 miles) of the coast, have been developed (USFWS 1998). Land uses in coastal

San Diego County are reportedly similar. Oberbauer and Vanderwier (1991) reported that 72% of the original coastal sage scrub, 94% of native grasslands, 88% of coastal mixed chaparral, 88% of coastal salt marsh, 100% of coastal strand, and 92% of maritime sage scrub habitats in San Diego County had been converted to urban and agricultural uses by 1988. Although the historic distribution of the coastal sage scrub element of PPM habitat was undoubtedly patchy to some degree, this condition evidently has been greatly exacerbated by urban and agricultural development. All of the published literature on the status of coastal sage scrub vegetation in California supports the conclusion that this plant community is one of the most depleted habitat types in the United States (USFWS 1993). The available information further suggests that the quantity of potential PPM habitat associated with river alluvium substrate has significantly declined since the subspecies was last recorded in numbers in the 1930's. With few exceptions (such as the Santa Margarita River), essentially all of the rivers and creeks within the historic range of the Pacific pocket mouse are now partially or completely channelized. In many cases (e.g., Los Angeles River, San Gabriel River, Santa Ana River), stream and sediment flows are regulated or inhibited by dams, reservoirs or other water conservation or impoundment facilities (Erickson 1993).

During the 1930s, when Pacific pocket mice were detected at the mouth of the Santa Margarita River, the Marine Corps Base, Camp Pendleton did not exist. The southern half of the Santa Margarita River Estuary was destroyed in the early 1940's during the establishment of Camp Pendleton and the related construction of a boat basin and harbor facilities. In addition, the adjacent Oceanside area has been extensively developed since the Pacific pocket mouse was last recorded there in the 1930s. Within Orange County, the Pacific pocket mouse has been confirmed at two locales: the San Joaquin Hills and Dana Point. Development of the "Spyglass Hill" area in the San Joaquin Hills began in 1972 and has resulted in the destruction of the site where the Pacific pocket mouse inhabited.

Within Los Angeles County, the Pacific pocket mouse historically was detected in three areas: Marina del Rey/El Segundo/Hyperion, Wilmington, and Clifton. Two of the three historic locales for the Pacific pocket mouse (Clifton and Wilmington) in Los Angeles County have been developed and are no longer potential habitat (Erickson 1993). The third historic locale (Marina del Rey/El Segundo/Hyperion) apparently has been substantially altered since the subspecies was last detected there (Erickson 1993). The Hyperion area, which formerly contained relatively large expanses of coastal strand and wetland habitats, has been extensively developed.

In addition to habitat loss, fragmentation is a major threat to PMM populations. Habitat fragmentation reduces habitat quality and increases local extirpation of native wildlife (e.g., Torborgh and Winter 1980; Wilcox 1980; Ehrlich and Ehrlich 1981; Wilson 1992; Bolger et al. in press; Soulé et al. 1992). Bolger et al. (1997) concluded that habitat fragments supported fewer species of native rodents than equivalently sized plots in large plots of unfragmented chaparral indicating that local extinctions have occurred following fragmentation and insularization. When the distribution of native rodents in 25 urban habitat fragments was assessed by live-trapping, over half of the fragments surveyed (13 of 25) did not support populations of native rodents. Fragments supported fewer species than equivalently sized plots in large expanses of unfragmented habitat, and older fragments (fragments that had been isolated for a longer period of time) supported fewer species (Bolger et al. 1997). Both results implied that local extinctions occurred in the fragments following insularization. Soulé et al. (1992) further noted that "...urban barriers including highways, streets, and structures, impose a very high degree of isolation."

The Dana Point Preserve, which harbors one third of the world's PPM populations, has been reduced to a habitat fragment, surrounded by an increasing amount of urban development. Ongoing development adjacent to the Preserve includes a significant housing subdivision and a hotel that is currently being built on what was previously natural open space. The threats to PPM associated with fragmentation and urban development include the number of domestic cats and other non-native and native predators that generally accompany human development (crows, ravens, raccoons, red foxes, opossums), as well as negative impacts from vibrations, noise, artificial lighting (USFWS 1998, 2010, Brehme et al. 2013-2020, D. Shier pers. comm.), and increased recreation on the Preserve (Merrill et al. 2023).

An additional threat to habitat availability is the loss of land due to erosion. This is currently an issue at the Dana Point Preserve, and potentially to any coastal bluff locations that may support PPM as future translocation sites. Indeed, a property immediately adjacent to the Dana Point Preserve experienced considerable erosion resulting in an impactful landslide in February 2024.

5.1.2 Non-native Vegetation and Habitat Succession

For PPM, the introduction and dominance of nonnative grasses and other weeds is an ongoing threat to habitat quality. Historically, PPM habitats were largely open and dominated by native bunch grass and forbs but the invasion of European annual grasses in the mid-1800s, alongside intensified agriculture and livestock grazing, led to these nonnatives dominating many of these

habitats (Barry et al. 2006, Brehme et al. 2023b). Non-native grass cover is a strong negative predictor of PPM occupancy and colonization and a positive predictor of localized extirpation, especially as the amount of nonnative grasses increases above 20 percent (DOD 2019, Brehme et al. 2023b). Non-native grasses were found to make up approximately 5 to 40 percent of the total cover within PPM sites in MCBCP during surveys from 2012 to 2017 (Brehme et al. 2023b). Because non-native grasses grow more thickly than the native bunchgrasses they replace, they likely hinder PPM movements and foraging success (Rieder et al. 2010) and studies across MCBCP in 2016 and 2017 found that non-native grass seed do not appear to be a favored food resource and make up only a trace amount of PPM diet (DOD 2019, Brehme et al. 2023b).

Habitat succession---changes in the amount and composition of vegetation and associated soil conditions—occurs over time in the absence of disturbance or intense management. With fire having largely been eliminated as a natural disturbance within PPM habitat, and the options for PPM dispersal to more favorable areas having been curtailed by development, prescriptive intensive management has become essential in providing suitable habitat conditions. Even management, though, is restricted to certain stewardship tools, limited in its implementation and efficacy by weather and appropriate financial resources, and cannot control all influences on PPM habitat. For example, weather conditions and soil seedbank can lead to growth of shrubs and annuals and decrease the bare ground component that is an important component of PPM's preferred microhabitat (Loda et al. 1999, p. 8; Spencer et al. 2000, pp. 12-15; Montgomery 2005, pp. 7-8). Management efforts can include trimming perennial vegetation and removing some annual vegetation cover, but appropriate seed plants must be available as a food source for PPM, and adequate perennial vegetation must be present to provide protective cover, conserve soil moisture, help prevent erosion, and provide soil stability for under-ground burrows. Several years of increasing cover of shrubs, woody debris, and duff with associated decreases in forb cover led to reduced habitat suitability for PPM on Dana Point. This vegetation succession corresponded with relatively low recorded occupancy of PPM at Dana Point from 2017–2019 (Merrill 2019, 2020, 2021) as well as increasing numbers of visiting public.

5.1.3 Habitat Management

Loss of historical habitat through PPMs range combined with alterations to disturbance regimes that historically created and maintained suitable habitat for PPM, has resulted in the confinement of PPM to its three extant and isolated locations. Without adjacent areas available to disperse to, habitat where the three populations occur must be continuously and intensively managed to prevent extirpation.

5.1.3.1 Prescribed Fire

The seasonality, size, intensity, and frequency of fire in coastal southern California has likely changed drastically over the last century in association with human settlement. As a result of fire suppression activities, many of coastal southern California's natural areas may be subject to less frequent fire than occurred historically (USFWS 2010, p. 46). Not allowing habitat to burn reduces habitat quality for PPM by increasing the continuity of shrub cover and eliminating habitat openings that are thought to be an important component of PPM's preferred microhabitat (Loda et al. 1999, p. 8; Spencer et al. 2000, pp. 12-15; Montgomery 2005, pp. 7-8). Too frequent burning, however, can result in long term vegetation composition change; coastal sage scrub may decline and convert to grasslands when the fire frequency becomes extremely high (Syphard et al. 2006, p. 1754). Prescribed fire is considered an important management tool for PPM habitat at MCBCP for reducing non-native grasses and banked seeds, as well as thatch build up (e.g., Brehme et al. 2023b). However, the long-term impacts of prescribed fire on PPM habitat have not been studied (Brehme et al. 2023b, p. 8), a potential risk given that this is frequent and primary management activity at MCBCP.

Prescribed fire cannot be used at Dana Point due to the proximity of the Preserve to residential development and mowing is impractical because of the terrain. Thus, the only management options at Dana Point for maintaining good habitat for the PPM population are resource-intensive activities such as native plant seeding; hand removal of nonnative grasses, brush, and thatch; and selective, targeted use of appropriate pesticides.

5.1.4 Land Use and Activities

There are several land uses and human activities that affect habitat availability within the range of the PPM by contributing to direct loss, degradation, and fragmentation of habitat, and/or reducing effective habitat size and quality.

5.1.4.1 Development/Project Construction

Development and construction are ongoing threats to the extant PPM population and to the potential locales for reintroduction. Development and projects have had a large historical impact on the PPM and have been major drivers of habitat lost and degradation.

Development and construction significantly affected the Dana Point population historically, and

currently. In February of 2005, the City of Dana Point approved the Dana Point Headlands Development and Conservation Plan, which involves residential and commercial development on about 29-ha (71-ac) of the 48.0-ha (121-ac.) Dana Point Headlands site (USFWS 2020). Habitat permanently conserved in association with the development includes the 11.9-ha (29.4 ac) Dana Point Preserve. The hiking trail within the Dana Point Preserve was constructed in 2007 with access to the trail during daylight hours provided to the public beginning in December of 2009 (see Merrill et al. 2023). Since being listed under the USFWS Endangered Species Act, the quantity of habitat available to PPM has decreased, impacts from edge effects have increased from new residential and commercial development (e.g. increased ambient light levels, irrigation runoff, intrusion from pets), and human intrusion into PPM habitat has and continues to increase, despite a conservation easement on the property (USFWS 2010, USFWS 2020).

Impacts to the PPM habitat in the area of MCBCP began in the early 1940s when the Santa Margarita River Estuary was destroyed during the establishment of Camp Pendleton and the related construction of a boat basin and harbor facilities. Progressive impacts to habitat occurred in the subsequent decades until PPM was rediscovered on MCBCP and received regulatory protection under the USFWS Endangered Species Act. In 1996, the USFWS completed consultation with the Marine Corps on the Crucible Challenge Course, which was built within the Oscar One training area (USFWS 1996, USFWS 2010)—a project that resulted in the loss of an additional 3.2 ha (8 ac) of occupied or suitable PPM habitat (USFWS 2020). Maintenance, adjustments, and modifications of the Crucible Course, continues to accrete habitat impacts. The use of the Crucible Course was contemplated to result in the take of one PPM per company of recruits using the Crucible Course, and one PPM per year due to road maintenance activities USFWS 1996, USFWS 2010). The Marine Corps recently proposed moving the Land Navigation Course portion of the Crucible Challenge Course from Oscar One to Oscar Two; with certain activities to remain at a 10.9 ha (27 ac) section of Oscar One. The proposed Oscar Two course would cover 218.1 ha (539 ac) and include the construction of a fence along the northern perimeter of the training area, and the installation of 65 additional land navigation points, as well as regular road and site maintenance at the new site (MCBCP 2021). Another project, the 51 Area Reservoir Repair Project, included repairing and restoring damage caused to facilities and the environment from the accidental release of water from the Reservoir in 2012; cumulatively, impacts from this project are estimated to have impacted 0.72 ha (1.79 ac) of PPM habitat, including the permanent loss of 0.17 ha (0.43 ac) of habitat (USFWS 2020).

5.1.4.2 Military Training Activities

Two of the extant populations—those on Marine Corps Base, Camp Pendleton—are vulnerable to impacts from military training activities. Military training is currently a primary threat to PPM at the Santa Margarita population. Training activities are frequent, with 17,000 troops training annually on approximately 134.8 ha (333 ac) of potential PPM habitat. A proposed shift and expansion of existing training activities in PPM-occupied habitat further north could result in additional impacts to PPM at Santa Margarita. At present, the South San Mateo area is subject to occasional on-road military vehicle use and on and off-road foot traffic training but is not regularly used by the Marine Corps for training (USFWS 2010).

In addition to the direct impacts to PPM habitat from military activities (i.e., loss, degradation), there are numerous indirect impacts to habitat quality related to these activities, including artificial lighting, anthropogenic noise, vibrations and trampling, rodenticide use, predator attractant, areas of avoidance due to human presence, and an increase in non-native plants in the area (Chock and Shier 2021, pp. 8-9).

Military training at Santa Margarita consists of approximately 17,000 recruits completing the training annually at the Crucible Course, across 36 to 40 weeks per year with 250 to 550 Marines present weekly. Training activities are impactful, and include land navigation, troop movement, live firing ranges, bivouac sites, dirt roads and trails and associated facilities (USFWS 2010, MCBCP 2021). Training activities were expanded in 2006 (USFWS 2007b) and impacts from this expansion were observed within undeveloped areas include removal or reduction of vegetation, soil compaction, addition of new training elements, and increased foot and off-road vehicle traffic over a large portion of the Lower Mesa within Oscar One. One of the primary new training activities includes land navigation training across 134.8 ha (333 ac) of suitable PPM habitat. These activities involve the movement of large numbers of troops on foot through habitat areas (MCBCP 2021). This has resulted in a reduction of vegetative cover, creation of trails, and compaction of soils throughout portions of the Lower Mesa documented to be historically occupied by PPM. In addition to the potential for direct impacts to mice from crushing of burrows, these impacts have degraded habitat quality for PPM by reducing vegetative cover and availability of seed resources, reducing the quality of soils for constructing burrows, and facilitating extensive proliferation of non-native invasive plant species (e.g. Sahara mustard, *Brassica tournefortii*). Given the pre-existence of nonnative annual grasses and weeds in this area, the movement of troops throughout this area is also likely to degrade habitat quality for PPM by facilitating their continued invasion and spread (D'Antonio and Vitousek 1992, USFWS 2010).

Following the documentation of the 2006 expanded training activities, the Marine Corps modified the location of some of these training areas to minimize impacts but land navigation and other training practices continue to degrade PPM habitat south of Macs road, where PPM were once densely concentrated (USFWS 2008) but are now are absent or only detectable in trace numbers (Brehme et al. 2019, Brehme et al. 2020, USFWS 2020). In 2012, about 0.61 ha (1.5 ac) of PPM-occupied habitat within Santa Margarita were disturbed due to the establishment of a temporary training/bivouac site (USFWS 2020), which ultimately resulted in consultation with USFWS and consequent restoration (USFWS 2020). In 2022, MCPCP proposed a new project for improvements and maintenance of 52 targets at Edson Range 501 at Santa Margarita, covering 25 ha (61.8 ac), which would be used to train approximately 15,000 recruits annually (USFWS 2023). This work would require ground disturbing berm work in the near and long-term. Potential and expected impacts to PPM from these activities could include direct mortality from vehicles and foot traffic, as well as habitat degradation and soil compaction.

Artificial night-time lighting: PPM above-ground activities are typically conducted at night or during low-light levels. As such, artificial night-time lighting may disrupt nocturnal rodents such as the Pacific pocket mouse, through potential modification of predation rates, obscuring of lunar cycles, and/or causing direct habitat avoidance (USFWS 1998, Shier et al. 2020). A study of the effect of different levels and orientation of (artificial) night lighting on PPM at Marine Corps Base Camp Pendleton indicated that anthropogenic light negatively affected foraging of PPM (Wang and Shier 2017).

Noise: Increased anthropogenic noise can interfere with avian acoustic communication (Slabbekoorn and Ripmeester 2008, Barber et al. 2010). Impaired communication resulting from anthropogenic noise has been linked to altered predator avoidance behaviors (Anze and Koper 2018), lower lek attendance in greater sage-grouse (*Centrocercus urophasianus*) (Blickley et al. 2012), reduced pairing success in ovenbirds (*Seiurus aurocapilla*) (Habib et al. 2007), and impaired nestling development in house sparrows (*Passer domesticus*) (Schroeder et al. 2012), indicating that the impacts of noise on communication have the potential to interfere with reproductive processes. Anthropogenic noise may function as a deceptive signal to wildlife, causing animals to engage in false responses that may be energetically and biologically costly. Evidence of this is provided by a study of endangered Stephens' kangaroo rat, in which traffic noise not only masked but also mimicked foot-drumming signals (Shier et al. 2012). For vulnerable species such as PPM, the combined effects of communication disruption and signal deception may further tax already endangered populations.

Reproductive behavior: Above ground disturbances can affect PPM reproductive behavior as the time period during which a female PPM is in peak estrus can be extremely limited (i.e., as brief as one hour per cycle, D. Shier pers. comm.) and reproductive behavior may potentially be dissuaded by disturbances or perceived threats during this time.

Burrow destruction: Burrows and tunnels can sometimes be as little as 1 to 4 inches below ground (D. Shier pers. comm.) and are vulnerable to trampling. As such, sounds and vibrations from above-ground disturbances could affect PPM below ground. In sandy habitats, burrows are particularly vulnerable to compaction by foot or off-road vehicle traffic. Brehme et al. (2014) reported a strong negative effect of human foot traffic on PPM occupancy.

Impact on Torpor: As the beneficial aspect of torpor or aestivation is to reduce energy expenditure, any disturbance that disrupts these states can have a negative effect. Again, such disturbances could include human-caused sounds or vibrations—especially if burrows are shallow and/or close to the surface. Further, because Heteromyids have expanded middle ears, they are especially sensitive to low frequency sound (D. Shier pers. comm.).

5.1.5.3 Fire and Fire Management Practices

Current fire prevention measures and unnaturally high fire frequencies resulting from anthropogenic ignitions, particularly training activities at MCBCP, may directly or indirectly impact the PPM (USFWS 1998). Furthermore, PPM colonization of cleared habitat following creation of firebreaks, combined with firebreak maintenance practices at South San Mateo, is likely resulting in some ongoing incremental impacts to PPM habitat and direct harm to individual PPM on a periodic basis.

Occasional wildfire may be beneficial to PPM if fire frequency and intensity remains low enough. While fire is generally considered to be beneficial to PPM and prescribed fire is used as a habitat management tool (see Habitat Management, above), if fire occurs too frequently or at the wrong time of year, displacement of native forbs and shrubs by the invasion of nonnative grasses and forbs can result in habitat type conversion (O'Leary and Westman 1988, D'Antonio and Vitousek 1992, Minnich and Dezzani 1998, Keeley et al. 2005) resulting in a long term loss of habitat suitability for PPM from the accumulation of nonnative grasses and thatch. Further, prescribed fire as a beneficial tool for PPM habitat depends heavily on the nature of the fire not affecting under-ground PPM and the availability of nearby habitat refugia as food sources while the fire-affected area recovers.

PPM residing within habitat where there is a fire have potential to succumb to the fire from burning, asphyxiation or heat prostration, or may survive either by fleeing or by sheltering in place. Studies that have been performed to understand the potential for fire to result in direct harm to small mammals suggest many small mammals are able to shelter in place within crevices in rock outcroppings, burrows, and unburnt or protected areas within the burn perimeter that provide insulation from direct heat and fresh air (Howard et al. 1959, Tevis 1956, Gashwiler 1959, Lawrence 1966, Quinn 1979, Price et al. 1995). Due to its burrowing habit, PPM are likely to be predisposed to be able to survive and withstand fire by sheltering in place within burrows, where there is adequate insulation from heat (USFWS 2020).

The Marine Corps and California State Parks maintain fire breaks in the vicinity of South San Mateo and the historical North San Mateo population, respectively (USFWS 2010). Fire breaks are maintained by disking or blading soil, which may crush PPM burrows and/or harm individuals through direct injury or displacement. Following the discovery of PPM at South San Mateo in 1995, the Marine Corps abandoned maintenance of some of the fire break segments, or portions thereof, in the vicinity of this population to minimize and avoid impacts to PPM, but fire breaks occupied by PPM are still occasionally disked or created by facilities maintenance staff on site (USFWS 2014, USFWS 2019).In 2012, about 0.13 ha (0.32 ac) of occupied PPM habitat was impacted within a former east-west trending ridgeline firebreak at South San Mateo. MCBCP restored this habitat for PPM (USFWS 2019), and monitoring indicates this area was recolonized by PPM in 2017, approximately 5 years after the disking incident.

In 2014, PPM habitat was disked when a new fire break was created near Base housing off of Basilone Road at South San Mateo. This activity likely crushed burrows and harmed individual PPM residing within the footprint of the fire break. To monitor the response of PPM to this habitat disturbance, the MCBCP PPM monitoring program placed an “Impact” monitoring grid within the disked area that detected PPM in the cleared and adjoining area the following season (Brehme et al. 2018). Following recolonization of this area by PPM, this area was disked again in June of 2017 (USFWS 2019). However, continued monitoring of the impact grid indicates that this firebreak has again been recolonized by PPM following the second disking incident (Brehme et al. 2019).

Prior to extirpation of the North San Mateo PPM population, State Parks would periodically spread plant mulch over the fire break adjoining this population to suppress new plant growth and reduce maintenance needs. This layer of mulch created moist soil conditions favoring the proliferation of invasive Argentine ants, which colonized the adjoining habitat and are believed to have contributed to degradation of habitat quality for PPM at this locale (Suarez et al. 1998,

Brehme et al. 2009).

5.1.5.4 Road and Utility Maintenance

Dirt roads on MCBCP are maintained either by the Base, or by utility companies [San Diego Gas and Electric (SDGE), Southern California Edison (SCE)] (USFWS 2020). For routine road maintenance, SDGE and SCE are allowed small scale ongoing take of 1-3 PPM annually (USFWS 2017, USFWS 2022) and thus routine road maintenance potentially results in some individual PPM injured or killed on an annual basis.

During 2014, the Marine Corps started surfacing the dirt roads that intersect the distribution of the PPM population within the Oscar One training area with pea gravel and/or crushed stone (USFWS 2020). Based on alteration of the road surface from dirt to a composite rock substrate, and the observation of decreasing road permeability to movements of another pocket mouse across a change of road type from low-use dirt, low-use secondary paved, to rural 2-lane highway (Brehme et al. 2014), it is possible that this road surfacing could contribute to the fragmentation of PPM habitat within the Santa Margarita population from road avoidance behavior (USFWS 2020).

In 2012, an emergency access road was created through PPM habitat while performing repairs in response to damage to drainage ditches from the accidental release of water from the San Onofre Reservoirs (USFWS 2020, p. 14). This resulted in the grading of an estimated 0.34 ha (0.83 ac) of PPM habitat within the South San Mateo population, and likely resulted in the death or injury of at least seven PPM (Snyder 2012, p. 2). Monitoring of the PPM population indicates that the emergency access roadbed was recolonized by PPM following this grading incident but was subsequently disked in 2017 in association with the creation of an adjoining fire break (see Fire and Fire Management Practices, above; Brehme et al. 2019, p. 18). The Marine Corps has consulted to place a composite surface on this road and establish it as a permanent access road for maintenance of the San Onofre reservoir facilities (USFWS 2019, USFWS 2020, p. 14).

5.1.5.6 Recreation Activities and Unauthorized Habitat Disturbances

Residential communities fall within close proximity to the Dana Point Preserve and South San Mateo PPM populations, and a pedestrian trail is located on the Dana Point Preserve (Figure 4). Public use of these areas has potential to degrade PPM habitat through creation of

unauthorized trails and other habitat disturbances from human activities.

Negative effects related to recreational disturbance have been documented across a wide variety of species and taxa including, mammals, birds, reptiles, amphibians, and even invertebrates (e.g., Steven et al. 2011, Bennett et al. 2013, Larson et al. 2019). Human disturbance on wildlife from non-consumptive recreation can result in altered spatiotemporal habitat use (Kangas et al. 2010), extirpate wildlife from otherwise suitable habitat, or cause animals to shift geographically into areas of lower quality habitat to avoid areas with human activity (Taylor and Knight 2003, Ficetola et al. 2007, Finney et al. 2005, Kangas et al. 2010, Mallord et al. 2007, Dertien et al. 2021). Thus, recreational disturbances can both reduce habitat suitability and ultimately result in functional habitat loss (Gutzwiller et al. 1994, Frid and Dill 2002, Tost et al. 2020). Fragmented habitats may present unique stressors if there is no adjacent habitat for animals to relocate to, forcing individuals to remain in proximity to disturbance that they would otherwise avoid (Frid and Dill 2002). Indirect effects of increased human presence can occur when humans create an environment of higher predator pressure or cause animals to temporally shift their activities to avoid human activity. In an urban park, white-footed mice (*Peromyscus leucopus*)—primarily a crepuscular-nocturnal forager—spent less time foraging in areas of high human use even though people were not allowed in this park after dusk, possibly due to increased predator presence along trails (Persons and Eason 2017). Temporal shifts to avoid human activity can cause some species to become more nocturnal; such "diel shifts" can bring predator-prey species into greater overlap, with increase predation risks (Patton et al. 2019), or lead to suboptimal foraging conditions (Wheat and Wilmers 2016). The cumulative, compounding adverse effects of predator-avoidance behaviors can have impacts on fecundity and every component of offspring survival, with long-term implications for population growth (Allen et al. 2021). For PPM, impacts from public access may include trampling the burrows; damaging plants that serve as food sources, nesting locations, and shelter; changes in predator dynamics; and impacts on reproduction. For example, the time period during which a female PPM is in peak estrus can be extremely limited (i.e., as brief as one hour per cycle, D. Shier pers. comm.) and reproductive behavior may potentially be dissuaded by disturbances during this time.

The effects of trail use are not limited to the trail itself, and impacts can be further-reaching. This has particular implications for a small site like the Dana Point Preserve. For example, the sights, sounds, vibrations, and smells (and the latter can linger for quite some time) of human presence radiate out from the trail for some distance and some time. Based on a study of impacts of public access to trails by Dertien and Larson (2018), in which "threshold buffers" (distances from the trail within which effects might be expected to occur for various taxonomic

groups) were assessed, CNLM examined three threshold buffers (13, 50, and 100 meters) for the Dana Point Preserve trails (Figure 4). Given the meandering nature of the trail, even the shortest (potential) impact zone (13 meters) covers a significant portion of the Preserve (16%). That distance was selected on the basis that this may be the average diameter for PPM core home range (Shier 2009). The other two distance zones, 50 and 100 meters, reflect some literature that found that smaller rodent species avoided areas within 50-100 meters of trails or people (Dertien et al. 2021). At 100 meters, almost 90% of the Preserve is included in the potential impact zone, which does not include impacts from the adjacent parking lot and roads. If those (latter) impacts are included in the threshold buffer for the Preserve, the entire Preserve would be potentially impacted.

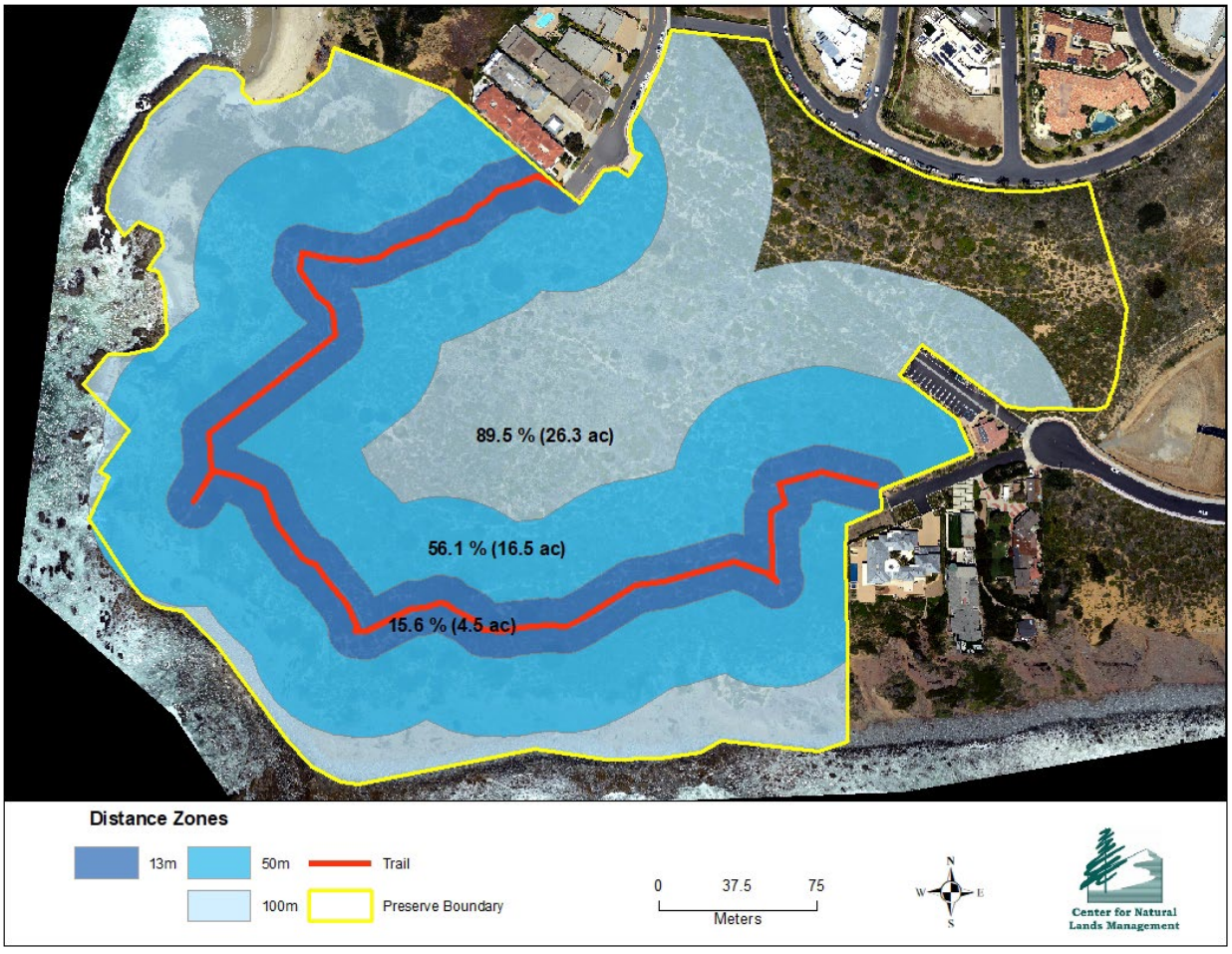

Figure 4. Zones of varying distance (13 meters, 50 meters, 100 meters) from the trail at the Dana Point Preserve. Values show proportion (%) and area (acres) of the Preserve covered by each zone. Source: Merrill et al. (2023).

Prior to CNLM acquisition of the Dana Point Preserve, the area was fenced and closed to the

public, but was subject to unauthorized trespass and other unlawful activities including dumping, growing marijuana, and as location for habitation by the unhoused (Miller, 2008, pers. obs.). In December of 2009, the public was granted access during daylight hours to a formal trail that was constructed within the Dana Point Preserve in 2007. This led to a dramatic increase in the amount of human presence within the Dana Point Preserve during daytime due to the popularity of the trail with the public (Miller, 2010, pers. obs.; Merrill et al. 2023). The trail was closed in 2020, at the start of the Covid pandemic, and reopened later that year with limited hours, opening later and closing earlier to limit public access in low-light times of day when PPM are most likely to be active aboveground (Merrill et al. 2023). In November 2022, the trail was opened for increased daily hours of 7 am to sunset, due to a court order sought by the City of Dana Point in ongoing litigation against CNLM. Public use of the Preserve has been increasing every year, as reflected in trail use counter data. Average per-day use doubled over a seven-year period (2011-2017), and recent data indicates the upward trend in visitation is continuing. In 2023, the average number of visitors per day (during open days) was 648.3 (± 21.9 SE), which is an increase of approximately 28% from 2022 (497.4 ± 33.4 [SE]), and an increase of approximately 46% from the 2011-2017 average (444.4 ± 53.6 SE) (Merrill 2024). Further, plans for a hotel adjacent to the Preserve could result in additional visitation, and associated impacts related to development (e.g., the use of rodenticide, artificial lighting, noise, vibration, and disease/virus transmission).

Due to the small population size of PPM on the Preserve, its cryptic nature and imperiled status, as well as the size and trail configuration on the Preserve, conducting experimental studies to determine the full impact of increased human presence and recreation is impracticable. However, likely impacts to the PPM population can be inferred from studies elsewhere including those focused on small rodents (Baharudin et al. 2022). Such impacts include altered behaviors and activity patterns, which could result in decreased time spent in essential activities such as foraging or reduced time spent in torpor, degraded habitat quality due to increased disturbance adjoining the trail, and increased presence of nonnative species such as domestic dogs (*Canis familiaris*), house mice (*Mus musculus*), rats (*Rattus rattus, Rattus norvegicus*) and Argentine ants (literature review in CNLM 2023). Although the public is prohibited from venturing off trail, there are instances of off trail recreation (such as hiking and mountain biking), as well as dogs off leash (Merrill and Rogers 2019). In addition to trampling vegetation, and compacting soils, ongoing off-trail trespass increases the potential to crush PPM burrows. From June 2017 to February 2023, despite numerous signs, fencing, and CNLM staff presence, 220 incidents of people going off-trail were reported. In that same time period, there were 81 recorded instances of pet dogs or cats on the trail (Merrill et al. 2023, p. 13). On June 5, 2023, a dead PPM was found on a trail that appeared to have been stepped on by a

pedestrian, as trauma was confirmed to be cause of death via necropsy (Merrill 2023, Shier 2023, pers. comm).

After a long decline trend since 2012, as indicated by trapping data, PPM occupancy increased at Dana Point following the temporary closure of the public trail in 2020 and subsequent modified hours, and then decreased again once the trail hours were increased, which suggests the hours of trail use is a contributing factor to the observed increase and then decrease in population and area occupied (Merrill 2023), CNLM 2024 (Table 2). The impact of public use in this small and fragmented preserve can be considered a permanent threat to the PPM population that will likely suppress viability and occupation of PPM on the site in perpetuity. However, while some limited public access is a legal requirement associated with the Preserve's establishment, the hours that the trail is open and the numbers of visitors are controllable. More limited hours of public use are likely more protective of the PPM population at Dana Point and will likely increase that population's viability.

Because South San Mateo falls entirely within a military installation, it receives the least impact from trail creation and public trespass. However, nearby base residents occasionally use the existing road network for mountain biking, hiking, and dog walking (USFWS 2020). These recreational activities, especially the presence of domestic dogs, are known to degrade habitat quality through disturbances associated with noise, smells, vibrations, and anti-predator responses (reviewed in Larson et al. 2016)

Of the MCBCP locales, the now extirpated North San Mateo, which has both trails and residential areas within close proximity, has experienced the greatest habitat impacts from recreational use and habitat disturbances from the public (USFWS 2010). While it is unknown if recreational use and unauthorized habitat impacts led to the presumed extirpation of this population, it is likely that these impacts contributed to the decline of this population. Overall, recreation activities and unauthorized habitat disturbances at the two extant northern PPM populations create a low level of continual disturbance. While any of these activities may affect only a small portion of the habitat within a site at any one time, their cumulative impact may exacerbate the extirpation risks of these populations by degrading habitat quality and depressing what are likely already small PPM populations.

5.2 Small Population

Urbanization and land conversion have fragmented the historical range of PPM such that extant populations now operate as independent units rather than parts of a stable metapopulation that is maintained by immigration/emigration dynamics. Isolated populations are more susceptible to long-term/permanent extirpation by accidental or natural catastrophes because the likelihood of recolonization following such events is negatively correlated with the extent of isolation (Gilpin 1987, p. 136). Small populations have higher probabilities of extinction than larger populations because their low abundance renders them susceptible to inbreeding, loss of genetic variation, high variability in age and sex ratios, and other random naturally occurring events such as droughts or disease epidemics. Owing to the probabilistic nature of extinction, some small populations will survive in the short term when faced with these demographic, environmental, and genetic stochastic risks, but they are likely to eventually become extirpated.

Analysis of genetic samples collected during population monitoring suggest that effective population sizes within the extant populations are universally low and cause for concern (USFWS 2020). The estimated effective population sizes at Dana Point, South San Mateo and Santa Margarita are (respectively) Ne=14.9, Ne= 20.5, and Ne=36.5 (Wilder et al., in prep.). These results suggest that all three populations are vulnerable to loss of genetic variation and adaptive potential over time and below the threshold at which reduced fitness from mating of closely related individuals is expected (Frankham et al. 2014). Poor reproductive performance of Dana Point animals in captivity, and loss of Dana Point genetic representation within the captive colony over time, further suggests that this population is already suffering from reduced fitness relative to the other PPM populations (Wilder et al. 2020). Finally, a comparison of contemporary genetic variation with variation measured from tissue collected prior to 2003 indicates that all populations have suffered recent population declines and a significant loss of genetic variation, with the Dana Point population exhibiting the greatest and most concerning loss (Swei et al. 2003, pp. 511–512; Wilder et al. 2020, unpaginated; USFWS 2020, pp. 16-17). By maintaining genetic diversity and increasing the number of PPM populations, current captive breeding and reintroduction efforts may help to ameliorate the threat of small population size in the future. However, this threat is currently high in overall magnitude, and is exacerbated by other threats to PPM from habitat disturbance, degradation, human use, and fragmentation.

Given the small sizes of the populations at the three known extant locales, its dispersal habits , and the severe fragmentation and loss of the subspecies' habitat, the Pacific pocket mouse is highly susceptible to extinction as a result of environmental or demographic factors alone (see Mace and Lande 1991).

5.3 Climate Change

Since the listing of the PPM, the potential impacts of ongoing, accelerated climate change have become a recognized threat to the flora and fauna of the United States (IPCC 2007, PRBO 2011). Current models suggest that southern California will likely be adversely affected by global climate change through prolonged seasonal droughts and rainfall coming at unusual periods and different amounts (Pierce 2004, Cayan et al. 2005, CEPA 2006, Jennings et al. 2018). Mean annual temperatures are also predicted to increase. Climate change models indicate a 4 to 9 degrees Fahrenheit (2 to 4 degrees Celsius) increase in average temperature for the San Diego Area of southern California by the end of the century (Jennings et al. 2018). Coastal sage scrub habitats, of which PPM is associated, are also likely to be impacted by climate change. Altered precipitation timing, soil moisture, and drought severity may affect species composition, distribution, and survival of this community and many native sage scrub associated species are projected to experience a >50% decline in suitable habitat in southern California by mid-century (EcoAdapt 2017).

Information is not available to make accurate predictions regarding its effects to PPM (USFWS 2020) and predicting impacts to PPM due to climate change are further complicated by the timing, frequency, and amount of increased or decreased rainfall, which can impact soil moisture, fire regimes, vegetation cover, and seed availability for PPM (Brehme et al. 2023b). Excessive seasonal precipitation and/or extreme weather events can impact PPM survivorship in a number of ways. In years of poor resource availability (e.g., drought) PPM may delay breeding or forego breeding altogether, resulting in little to no recruitment to the population (Beatley 1969, French et al. 1967, Kenagy and Bartholomew 1985, USFWS 2008). Yet prolonged drought 5-year was associated with an increase in the area occupied by PPM within MCBCP (USWS 2024). While high rainfall may result in increased seed resources, high rainfall may negatively impact PPM by reducing open ground to unsuitably low levels needed for them to forage, by spoiling seed caches, or by reducing survivorship by negatively affecting the ability of PPM to retain body heat during their winter torpor (Valone et al. 1995, Brehme et al. 2023b). In 2017, rainfall was above average, and over one-third of the PPM population was lost in a single year. However, rainfall was not a strong direct predictor of PPM occupancy dynamics (Brehme et al. 2023b).

The impacts of predicted future climate change to PPM remain unclear, though any significant changes from historic patterns will undoubtedly have consequences, and climate change has potential drastic effects to the PPM and its habitats. Given the timeframe presented in climate

change studies, while major climate impacts to the region are unlikely to occur in the next 20 to 30 years, there may be short-term climate impacts, such as increased periods of drought, increased fire frequency and/or severity, or periods of heavy rainfall, which are likely to affect PPM population fluctuations. Therefore, the magnitude of this threat is unknown at this time but is unlikely to have major, novel impacts in the next decade or two.

5.4 Disease, Predation, Competition

Predation by the non-native red fox (*Vulpes vulpes*) and feral/domestic cats (*Felis catus*) were recognized as threats to PPM at the time of listing (59 FR 49762) and since that time numerous other potential native and non-native predators of PPM have been revealed by camera surveys at the Dana Point Headlands which detected at least seven potential predators (USFWS 2010, USFWS 2020, K. Merrill pers comm.).

Domestic pet activity has been documented at North San Mateo and at South San Mateo, and domestic cats have been directly observed entering occupied PPM habitat (Montgomery 2003). Predation from cats is an ongoing threat to PPM at Dana Point Headlands, South San Mateo, and potential habitat at North San Mateo. Feral and domestic cats are known to be efficient predators of rodents (e.g., George 1974). A study by Pearson (1964) concluded that the removal of 4,200 mice from a 14-hectare (35-acre) test plot was accomplished largely by 6 cats over 8 months. Compounding the threat of predation from cats is the explosive proliferation of non-native populations of red foxes in coastal southern California (e.g., Lewis et al. 1993). Given the relative abundance of the red fox in coastal southern California (Lewis et al. 1993) and the fact that the diet of red foxes invariably include mice (e.g., Ingles 1965, Lewis et al. 1993), red foxes could substantially impact populations of Pacific pocket mice where they are sympatric.

The invasive, nonnative Argentine ant (*Linepithema humile*) is an ant species that is known to prey on hatchling birds and is present at each of the extant PPM populations. Brehme et al. (2019) hypothesized that native fire ants (*Solenopsis xyloni*) and invasive Argentine ants may be predators of PPM that could be responsible for PPM population declines at some locations. PPM mortality due to native fire ants has been observed three times since the mid-1990s. Mortality occurred when PPM confined in Sherman live-traps (placed for population monitoring) were attacked and killed by ants. An instance of mortality due to ants was first recorded during monitoring in 1995 or 1996, and also occurred in 2004 (Miller 2004, pers. comm., unpaginated) and 2014 (Brehme 2018). Native fire ants are the more likely threat to the Santa Margarita population, and Argentine ants a potential threat to the Dana Point and South San Mateo populations. Argentine ants were found during trapping events at MCBCP in traps

with and on PPM and were also noted scavenging on two dead PPM, which were casualties associated with a live trapping event in 2020 (Merrill et al. 2023). A study by USGS suggested that, of the two ant species, native fire ants are more likely to forage below ground and prey upon PPM when they are in their burrows (Matsuda 2020). It is possible that Argentine ants directly also impact PPM through predation in their burrows (Brehme et al. 2019) by foraging on young, and indirectly through harvesting seed caches.

Argentine ants are present throughout the Dana Point Preserve (Merrill 2019) and appear to be present at higher densities than when the first CNLM Argentine ant survey was conducted in 2014. At that time, the Argentine ant naïve occupancy estimate (the number of points with ants detected out of the number of points monitored) was 65.6% (82/125 grids) while in 2018 the naïve occupancy estimate was 94.6% (123/130) with more grids (87/130) having a "high number" of Argentine ants present on bait (i.e., >250 individuals) than in 2014 (32/125) (see Merrill 2014 and 2019). Trash left by the many visitors on the Dana Point Preserve (i.e., food and beverages) exacerbates the threat by providing additional resources (sugary drinks in particular) to Argentine ants along the trail, in the adjacent parking lot, and within PPM habitat (K. Merrill pers. comm.)

Extent of and impact of disease or parasites are affecting PPM is not well understood (USFWS 2020), however, the introduction of an exotic pathogen is increased in areas where there is frequent human visitation or foot traffic, as is the condition at the Dana Point Preserve. During a 2023 trapping effort at the South San Mateo site, three of three PPM captured were found to be infected with coccidia, an intracellular parasite that infects the intestinal tracts of animals. Coccidiosis in mice can cause fever, vomiting, diarrhea, muscle pain, and nervous system effects and changes to behavior, and may lead to death (Haberkorn et al 1983). Healthy animals may recover without medication—but immunocompromised or young individuals are particularly vulnerable to more severe infection that can be fatal.

In summary, predation remains a threat to PPM across the subspecies range. Increasing residential development near Dana Point Preserve could increase native and non-native predators generally associated with human development (cats, crows, ravens, raccoons, red foxes, opossums, Argentine ants) that could have an impact on PPM populations (Merrill et al. 2023). The impact of disease and parasitic infection is unknown, but recent evidence indicates that PPM does at least experience coccidiosis in wild populations (Pacific Pocket Mouse Working Group Meeting, February 13, 2024).

5.6 Captive Propagation, Reintroduction, and Translocation

A PPM captive breeding program was initiated in 2011 with the San Diego Zoo Institute for Conservation Research to create additional populations as called for in the PPM Recovery Plan (USFWS 1998, USFWS 2020). After seven years of failed efforts to establish a new population through this program, it is uncertain whether a self-sustaining population can be established at this location at all.

6. INADEQUACY OF EXISTING REGULATORY MECHANISMS

The vulnerability of the subspecies is caused by persistent and escalating threats discussed above and inadequate conservation discussed below.

6.1 Federal Regulatory Mechanisms

The USFWS has conducted valuable research and implemented certain efforts to address PPM population declines, which are discussed above. However, effective federal-level conservation efforts for the Pacific pocket mouse are still inadequate as discussed below.

Federal protections have not and can not adequately protect habitat. As of 1998 when the Recovery Plan was published, the current occupied habitat for the Pacific pocket mouse was estimated to total less than 400 hectares (1,000 acres) at all sites combined, and is now less than 200 hectares (Brehme et al 2023a, CNLM 2024). Of the nine historic locales (Erickson 1994, Erickson 1998) only Dana Point is permanently protected and all have been damaged or are threatened by habitat destruction or fragmentation, human-caused fire, or other disturbances. Populations at six of the historic localities have been extirpated.

As documented above, human land use modifications have greatly reduced the extent, quality, and functionality of PPM historical habitat. Listing PPM as federally Endangered in 1994 and implementation of the Recovery Plan (1998) have done little to stop the loss, fragmentation, and degradation of habitat and associated populations.

Although two PPM populations occur on federal (MCBCP) land, training activities that conflict with PPM conservation are considered higher priority thus limiting the protection of PPM in those locations.

6.1.1 Federal Endangered Species Act

The USFWS emergency listed the Pacific pocket mouse in February 1994 (59 FR 5306) following the rediscovery of a single population at the Dana Point Headlands in 1993. Upon expiration of the emergency rule, PPM was federally listed the subspecies as endangered on September 29, 1994, in accordance with the Endangered Species Act (59 FR 49752). The subspecies was given a recovery priority number of 3C which means it is facing a high degree of threat, including conflicts with development projects, yet has a high recovery potential. However, in the 30 years since its ESA listing, no benchmarks defined as Recovery Criteria, for either down-listing (to threatened status) or delisting, have been realized (as described in 6.4.1 USFWS Recovery Plan for the Pacific Pocket Mouse)

6.1.2.1 Critical Habitat Designation

No Critical Habitat has been designated for the Pacific pocket mouse. When the Service listed the Pacific pocket mouse as an endangered species in 1994, it declined to designate critical habitat, determining that to do so would not be "prudent." Specifically, the Service concluded that designating critical habitat for the Pacific pocket mouse (1) would lead to an increased threat to the species through the publication of maps identifying the location of the sole Pacific pocket mouse population then known to exist; and (2) would not provide any conservation benefit to the species because the only population then known was located on private property that lacked a "federal nexus" subjecting it to the critical habitat provisions of the ESA. These conclusions can no longer be justified. In September 2000, the Center for Biological Diversity and Natural Resources Defense Council petitioned USFWS to revise its critical habitat determination for the Pacific pocket mouse and designate Pacific pocket mouse critical habitat pursuant to the federal Endangered Species Act ("ESA or Act"). The USFWS again declined to designate Critical Habitat.

6.1.2.2 ESA Section 7 Consultation and Biological Opinions

- Biological Opinion on the Proposed Crucible Challenge Course, Marine Corps Base, Camp Pendleton, San Diego County, California (1-6-96-F-35) addressed impacts that the proposed construction, operation and maintenance of the Crucible Challenge Course (project) in the Oscar-I and Edson Range areas of Marine Corps Base (MCB), Camp Pendleton may have on the endangered least Bell's vireo *(Vireo bellii pusillus)* (LBV), Pacific pocket mouse *(Perognathus longimembris pacificus)* (PPM), and threatened coastal California gnatcatcher *(Polioptila californica californica)* (CAGN).

- Intra-Service Formal Section 7 Consultation on the Amendment of a Section 10(a)(1)(A) Permit for Captive Breeding and Reintroduction/ Population Augmentation of the Pacific Pocket Mouse. FWS-OR/MCBCP-11B0255-12F0091.

  This biological opinion addresses the effects of the proposal entitled *Captive Breeding, Anti-Predator Behavior and Reintroduction of the Pacific Pocket Mouse (Perognathus longimembris pacificus)*" (Shier and Swaisgood 2010) and is based on the following information: (1) the above referenced captive breeding proposal; (2) a 2011 Traditional Section 6 Grant Project Statement (Proposal) submitted to the California Department of Fish and Game (CDFG); (3) the "*Genetic Management Plan for Captive Propagation of the Pacific Pocket Mouse* (Perognathus longimembris pacificus)" (Miller and Shier 2011); (4) the "*Population Modeling Report: Establishing a Captive Population of the Pacific Pocket Mouse (*Perognathus longimembris pacificus*)*" (Ivy 2011); and (5) other correspondence and information compiled during discussions with the principal investigator, Dr. Debra M. Shier, regarding the proposal.

- Oct 09 2015. Unauthorized Impacts to Pacific Pocket Mouse, Marine Corps Base Camp Pendleton, San Diego County, California, addressed unauthorized impacts to the federally endangered Pacific pocket mouse *(Perognathus longimembris pacificus,* PPM) associated with disking of habitat in the 51 Area of Marine Corps Base Camp Pendleton. The affected population of PPM is referred to as the South San Mateo population.

6.1.2.3 Habitat Conservation Plan

(See 6.3 Regional and Local Regulatory Mechanisms)

6.1.3 The Department of the Navy

(from 1998 Recovery Plan) The Department of the Navy (Navy) is charged with protecting trust resources on multiple areas of land containing potential Pacific pocket mouse habitat. Biologists with the Navy's Environmental Planning and Natural Resource Management Division (Southwest Division) have coordinated and conducted five focused surveys for the Pacific pocket mouse on Federal lands. Because no Pacific pocket mice have been detected during the course of these surveys.

6.1.4 U.S. Army Corps of Engineers

(from 1998 Recovery Plan) U.S. Army Corps of Engineers (Corps) regulates and permits the discharge of fill into wetlands and waters of the United States in accordance with various provisions of section 404 of the Clean Water Act. Because the Pacific pocket mouse could occur in areas that are designated as wetlands or waters of the United States, the Corps may regulate some projects that could affect the subspecies. For the International Wastewater Treatment Plant Project in the Tijuana River Valley, the Corps funded surveys for the Pacific pocket mouse within the action area of the project. Like any Federal agency, the Corps is required to consult with us in accordance with section 7 of the Endangered Species Act if their discretionary authority to issue permits "may affect" federally listed species, including the Pacific pocket mouse. Avoidance or compensation measures are generally integrated into projects that may affect listed species.

6.1.5 Federal Highways Administration

(from 1998 Recovery Plan) The Federal Highways Administration has required and authorized focused surveys for Pacific pocket mice in conjunction with the proposed Foothill (South) Transportation Corridor project. It is expected that the Federal Highways Administration will continue with informal consultation (ongoing as of April 1998) and will initiate formal consultation with us in accordance with the regulations at 50 CFR 402 if the project may adversely affect the Pacific pocket mouse population(s) near San Mateo Creek. At the present time, the project applicant, the Transportation Corridor Agencies, apparently is redesigning the proposed project to avoid direct impacts to the local Pacific pocket mouse occupied habitat as it was defined in the last survey effort. The applicant's proposed preferred alternative currently parallels San Mateo Creek. One alternative alignment for the proposed project avoids San Mateo Creek drainage altogether by connecting with Interstate-S farther to the north. We are evaluating a number of alternatives in coordination with the Federal Highways Administration.

6.2 State Regulatory Mechanisms

To date, California has limited state-level protections in place for the conservation of the Pacific pocket mouse, despite its being limited to only three extant population, and ongoing translocations that have failed to establish, and drastic and continuing loss of potential suitable habitat to development. Conservation of the Pacific pocket mouse requires enforceable, coordinated state action to mitigate the numerous, multifaceted threats that this species faces. Below is a comprehensive list of existing protections for Pacific pocket mouse in California

and the reasons why each of these is insufficient to conserve the Pacific pocket mouse in the state.

6.2.1 Species of Special Concern

The Pacific Pocket mouse is designated as a Species of Special Concern (SSC) by the California Department of Fish and Wildlife (CNDDB 2024). While this designation provides that impacts to the species must be considered in decision making and other circumstances, SSC designation has not provided significant protection for the PPM.

6.2.2 State Wildlife Action Plan

To date, there is no State Wildlife Action Plan for Pacific pocket mouse which is only included generally as a SSC.

In 2000, Congress enacted the State Wildlife Grant (SWG) program to support state government projects that broadly benefit wildlife and habitats, but particularly species of greatest conservation need (SGCN). As a trustee agency focused on safeguarding natural resources in California, the California Department of Fish and Wildlife (CDFW) manages funding from the Federal SWG program. To receive funding from this program, the United States Fish and Wildlife Service (USFWS) requires each state government to develop a comprehensive wildlife conservation strategy outlined in a State Wildlife Action Plan (SWAP).

A major component of the State Wildlife Action Plan is the identification of SGCNs in the State. The 2015 update to SWAP defined SGCNs to include all SSC in addition to listed species and those species particularly vulnerable to climate change. SGCNs (including SSCs) listed in the SWAP are eligible for conservation funding via State Wildlife Grant funds. SWAP 2015 includes threat assessments for habitats that support SGCNs and provide conservation goals and actions for these habitats.

6.2.3 California Coastal Act

The California Coastal Act guides how land along the California coast is developed and protected, and emphasizes the importance of preservation of coastal biodiversity, including environmentally sensitive habitat areas. In Dana Point, the City's Local Coastal Program guides the application of Coastal Act policies to certain coastal areas, including the Dana Point Preserve.

6.2.4 California Environmental Quality Act

The California Environmental Quality Act (CEQA), enacted in 1970, provides for the disclosure and mitigation of project impacts to State-designated rare animals and plants in accordance with the CEQA environmental review process conducted by the Department. The rediscovery of the Pacific pocket mouse in 1993 was a result of the Department's formal request for a focused survey for this subspecies on the Dana Point Headlands. The Department is also responsible for enforcing various codes established to protect native California plants and animals. In this capacity, the Department could issue citations for the unauthorized capture of Pacific pocket mice. As such, authorization to trap and collect the Pacific pocket mouse is excluded from standard collecting and trapping permits.

The California Environmental Quality Act ("CEQA") is California's landmark environmental law and establishes a state policy to prevent the "elimination of fish or wildlife species due to man's activities, ensure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities (Cal. Pub. Res. Code § 21001(c).) Towards this end, state and local agencies are required to analyze and disclose the impacts of any discretionary decision or activity. CEQA contains a substantive mandate that agencies should not approve projects as proposed if there are feasible alternatives or mitigation measures which would substantially lessen the significant environmental effects of such projects. (Cal. Pub. Res. Code § 21002.) CEQA requires a "mandatory finding of significance" if a project may "substantially reduce the number or restrict the range of an endangered, rare or threatened species." (Cal. Code Regs., tit. 14, § 15065(a)(1).) CDFW has interpreted this provision to apply to SSC as defined above. CDFW further provides that SSC "should be considered during the environmental review process." (*Id*.; Cal. Code Regs., tit. 14, § 15380.) Thus, a potentially substantial impact on a SSC, threatened species, or endangered species could be construed as "per se" significant under CEQA. (*Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 449.) And under CEQA, when an effect is "significant," the lead agency approving the project must make a finding that changes or alterations have been incorporated into the project to avoid or mitigate its significant impacts, or that such changes are within the responsibility of another agency, or that mitigation is infeasible. (Cal. Pub. Res. Code § 21081(a).) These provisions therefore provide some protections to species that are listed as species of special concern, threatened, or endangered. CEQA also requires a "mandatory finding of significance" if a project may "substantially reduce the habitat of a fish or wildlife species; cause a fish or wildlife population to drop below self- sustaining levels; threaten to

eliminate a plant or animal community." (Cal. Code Regs., tit. 14, § 15065.) Moreover, CEQA's "Environmental Checklist" in Appendix G of the CEQA Guidelines characterizes a project's effects as "significant" if the project would "interfere substantially with the movement of any native [] wildlife species or with established native resident or migratory wildlife corridors." While these provisions might theoretically offer some protection for California's sage-grouse, in practice they have not provided sufficient protection. Sage-grouse are listed as a SSC, such that a project that has the potential to significantly impact one of these populations may qualify as having a "significant effect" under a lead agency's interpretation of CEQA. In such case, CEQA's substantive mandate to adopt all feasible alternatives or mitigation measures may be triggered.

However, even when a lead agency acknowledges that an effect is "significant," CEQA allows a lead agency to adopt a "statement of overriding considerations" and approve a project if the agency finds that other factors outweigh the environmental costs of the project or that further mitigation is infeasible. (Cal. Code Regs., tit. 14, § 15093(b); Cal. Pub. Res. Code § 21081.) This means that even if a project may have a significant effect on a "wildlife population", an agency could interpret CEQA as still allowing approval of the project. CEQA therefore cannot be relied on to consistently protect the greater sage-grouse populations in California.

6.3 Regional and Local Regulatory Mechanisms

6.3.1 Natural Community Conservation Plan

The Department's Natural Community Conservation Planning (NCCP) program is an effort by the State of California, and numerous private and public partners, to take a broad-based ecosystem approach to plan for the protection and perpetuation of biological diversity. The NCCP program began in 1991 as a cooperative effort to protect habitats and species. It is broader in its orientation and objectives than the California and Federal Endangered Species Acts, as these laws are designed to identify and protect individual species that have already declined in number significantly.

An NCCP identifies and provides for the regional protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity. Working with landowners, environmental organizations, and other interested parties, a local agency oversees the numerous activities that create the development of an NCCP. CDFW and the U.S. Fish and Wildlife Service provide the necessary support, direction, and guidance to NCCP participants. Currently 17 approved NCCPs (includes 6 subarea plans) have been approved

and implemented. More than nine NCCPs are in various stages of planning (includes two subarea plans). Together these NCCPs will cover more than 8 million acres provide conservation for nearly 400 special status species and a wide diversity of natural community types throughout California.

Orange County Central and Coastal Subregions Natural Communities Conservation Plan/Habitat Conservation Plan (NCCP/HCP)

- under the NCCP/HCP, "Participating landowners" are required to address impacts to and conservation of PPM, gnatcatcher, and other species on certain property, including the Preserve. The City of Dana Point is also a Participating Landowner.
- While at least one developer was required to provide funds to the NCCP Orange County due to impacts to PPM, we do not know of any funds being designated for PPM in in NCCP implementation.

6.3 Non-Regulatory Federal and State-level Actions

6.4.1 USFWS Recovery Plan for the Pacific Pocket Mouse (*Perognathus longimembris pacificus*)

The Endangered Species Act (ESA) calls for preparation of recovery plans for those listed species that are likely to benefit from the effort. A recovery plan must establish, if practicable, recovery goals and objectives, describe site-specific management actions recommended to achieve those goals, and estimate the time and costs required for recovery. A recovery plan presents a set of recommendations, but it is not a regulatory document. Since the 1998, when the PPM Recovery was published, USFW has revised its approach to recovery planning and implementation to include the recovery plan within a three-part framework; which now includes the Species Status Assessment and Recovery Implementation Strategy. PPM has had neither a Species Status Assessment or Recovery Implementation Strategy although a SSA is currently in review. Furthermore, the Recovery plan is now more than a quarter century old, and in the 26 years since it was drafted, PPM have become more endangered because of the loss of one of the populations, the increasing threats on the others, and the failure, to date, to establish any new populations.

The Recovery Plan (USFWS 1998) stated Reclassification to threatened status may occur by the year 2023, assuming full implementation of this plan. Unfortunately, none of the benchmarks identified in the plan for delisting or downlisting to threatened have been met:

Recovery Criteria for reclassifying the Pacific pocket mouse to threatened status according the USFWS (1998) is if and when:

1. Ten populations are independently viable and stable or increasing, and their habitats are secure (free of risk of loss) and fully protected through fee ownership by a resource agency or conservation program, conservation easement, or other means of permanent protection. Populations of Pacific pocket mice shall be considered viable if the appropriate analysis of measured population parameters indicate that each of the 10 populations has a 95 percent or greater chance of surviving for 100 years.
2. Occupied habitat consists of a minimum of 2,000 hectares (4,940 acres) that are secure and fully protected through fee ownership by a resource agency or conservation program, conservation easement, or other means of permanent protection.
3. All Pacific pocket mouse populations are managed through a program to maintain genetic diversity for future generations.
4. All Pacific pocket mouse populations and essential habitat are managed so that current and potential threats (e.g., predation and disease) are eliminated or minimized to the extent that each population is not at risk of extirpation. Essential habitat is defined to mean both suitable and potential habitat that is necessary for the full recovery of the subspecies.

We may consider delisting the Pacific pocket mouse if and when:
1. All actions necessary for reclassification to threatened have been implemented.
2. Any necessary protection, restoration and enhancement activities (on all sites that have been determined to be essential to the recovery of the subspecies) are successfully completed.
3. Populations of the Pacific pocket mouse should be representative of the full (existing) genetic variability and historical geographical range of the subspecies and occur in habitats that collectively represent the full range of parameters observed and described in the past or during prescribed, future research and monitoring efforts. In order to delist the subspecies, we must also determine that the following five factors no longer continue to adversely affect the survival and recovery of the subspecies: (1) the present or threatened modification, or curtailment, of the subspecies' habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease and predation; (4) inadequacy of existing regulatory mechanisms; and (5) other human-made or natural factors affecting the continued existence of the subspecies (50 CER 424.11). A final decision relating to the delisting of the subspecies would be made only after a thorough review of all relevant information, including prescribed research

The recovery strategy for the Pacific pocket mouse consists of two components.
The first is to stabilize the existing populations by protecting currently occupied habitat. In addition to providing adequate protection to the known populations. The second component involves establishing additional populations through: 1) natural colonization/recolonization into nearby and adjacent habitats, coupled with habitat management in these areas, and 2) translocation and/or the release of captive-bred individuals.

- Address whether these strategy efforts have been successful, and to what extent.
- A captive breeding and reintroduction program was initiated in 2012 (USFWS 2020) and still there are no self-sustaining introduced populations in the wild (Pacific Pocket Mouse Working Group Meeting, February 13, 2024).
- According to the USFWS 1998 recovery plan, "Loss or degradation of any of the populations at the three known extant locales could irretrievably diminish the likelihood of the subspecies' survival."….since this plan was published, one population has been extirpated.
- The 1998 recovery plan "Recovery of the Pacific pocket mouse will likely take approximately 25 years (until the year 2023)." None(?) of the criteria for downlisting the species, as outlined in the 1998 Recovery plan has been met at the 25 year mark
    - 10 populations
    - 4,940 acres occupied habitat
    - All Pacific pocket mouse populations are managed through a program to maintain genetic diversity for future generations
    - All Pacific pocket mouse populations and essential habitat are managed so that current and potential threats (e.g., predation and disease) are eliminated or minimized to the extent that each population is not at risk of extirpation. Essential habitat is defined to mean that habitat necessary for the full recovery of the subspecies.

  Additional strategies for recovery that are provided in the Recovery Plan include
  1) Enhance and expand Pacific pocket mouse habitat.
  2) Prepare and implement habitat management plans
  3) Conduct research on the life history, ecology, and population biology of the Pacific pocket mouse.
  4) Identify and implement measures to create additional populations.
  5) Enhance public awareness of, and appreciation for, the Pacific pocket mouse recovery program through educational and interpretive programs.

Few of these strategies have been implemented other than research and largely unsuccessful efforts to create additional populations.

6.4.3 USFWS Species Status Assessment

A Species Status Assessment was recently drafted (USFWS 2024) and is currently under review. Funding for the SSA is being provided by MCBCP.

A Species Status Assessment (SSA) provides foundational information for implementing recovery actions. An SSA includes much of the information and analyses that may also be found in the "background" section of a recovery plan, but it also assesses this information in a more explicit and deliberative manner. Similar to the "background" in traditional recovery plans, an SSA includes analysis of the species' historic and current conditions, and also includes further analyses such as future projections of population trends under varying threat conditions, and potential management regimes. An SSA is structured around the conservation biology principles of the 3Rs – Resiliency, Representation and Redundancy.

6.4.4 USFWS Recovery Implementation Strategy

A recovery implementation strategy helps prioritize and guide recovery actions for listed species. PPM does not have a Recovery Implementation Strategy.

6.5 Regional and Local Plans and Policies

6.5.1 Marine Corps Pendelton Integrated Natural Resource Management Plan

MCI-WEST MCB Camp Pendleton (Camp Pendleton, Base) is a premier amphibious training Base which is home to 19 federally listed species. Integral to the success of military mission aboard Camp Pendleton is maintaining and protecting natural resources. The Base has successfully implemented the installation's Integrated Natural Resources Management Plan by close coordination and collaboration with Base operators, federal and California state agencies, and the regional scientific community. Camp Pendleton's Wildlife Management Section oversees management of 12 federally protected species of mammal, bird, amphibian and fish on Base, as well as many other sensitive species of various taxa. These species are distributed widely over approximately 125,000 acres of largely undeveloped training land in Southern California, including 17 miles of shoreline, three major watersheds and coastal foothills with elevations up to 3,000 feet above sea level. MCIWEST-MCB Camp Pendleton and MCAS Camp Pendleton developed the INRMP Revision in coordination with the US Fish and Wildlife Service, National Oceanic and Atmospheric Administration National Marine Fisheries Services, California Department of Fish and Wildlife, and the California Department of Parks and Recreation, Orange County District.

6.5.2 MCBCP Pacific pocket mouse Management Plan

The Crucible Challenge Course Biological Opinion (USFWS 1996) committed the Marine Corps to development of a Pacific pocket mouse management plan. The plan provides a framework of various habitat management activities to occur on the Base. Actions related to the implementation of the management plan are preceded by consultation with USFWS (MCBCP Staff, PPM Working Group Meeting 12/13/2024). The implementation of the plan is dependent on receipt of congressionally approval federal funds. The receipt of funding is inconsistent in both timing and quantity, which can constrain management planning and efforts.

6.5.3 Dana Point Preserve Draft Habitat Management Plan

In 2005, a habitat management plan was drafted by a consultant for Headlands Reserve, LLC, the developer of the Headlands area, for the Dana Point Preserve and adjacent City parks. This plan was never finalized and approved as required under Headlands Reserve, LLC's coastal development permit. CNLM has followed the general goals of the draft plan and has prepared annual work plans and annual reports for USFWS and CDFW review and approval. In 2023, CNLM prepared a draft Habitat Management Plan for Public Access for the Dana Point Preserve

(cite) and prepared an update to that draft plan in 2024 (cite). The protections in the plan have not been able to be fully implemented due to legal action taken by the City of Dana Point.

6.5 Non-Regulatory Planning

Plans have been created by stakeholders in specific areas to benefit PPM. While the plans are voluntary and non-binding, they identify some of the threats to PPM and goals to improve habitat.

6.6.1 Pacific Pocket Mouse Working Group. This is a group of entities that have some direct interest in or responsibility for PPM and is variously represented by individuals from those entities in working group meetings (approximately once per year).

6.6.2 Reintroduction Program. As noted above, a captive breeding program has been undertaken but largely unsuccessful to date.

7. CESA PROTECTION IS WARRANTED FOR PACIFIC POCKET MOUSE

The threats to California Pacific pocket mouse are numerous, multi-faceted, and require enforceable measures specific to each threat with a cohesive and legally mandated strategy on how to avoid, minimize and if necessary, mitigate such threats. Therefore, it is incumbent upon the State of California to provide protections under the CESA for the dwindling populations of PPM that persist in California. Listing will further efforts to stabilize populations and move towards recovery. Once listed, the following recommendations need to be implemented:

Recommendations

In this context, recommendations for the management and recovery of the Pacific pocket mouse are as follows:

1. CDFW prepare a recovery plan for Pacific pocket mouse pursuant to Cal. Fish & Game Code § 2079.1.
2. The California Department of Parks and Recreation (CDPR) develop and implement management plans (including fire management plans) focused on PPM for any state park units within the species' range.

3. The CDPR seek to acquire habitat to establish new parks/natural reserves for protection and restoration of PPM habitat and opportunities to expand and connect existing state parks and natural reserves for protection and restoration of PPM habitat as part of California's 30x30 conservation goals.
4. CDFW expand its cooperative work with relevant federal agencies (DOD, USFWS) to protect Pacific pocket mouse and its habitat on federal land.
5. CDFW and USFWS work with other state and federal agencies (DOD) and public entities more aggressively to implement agreements for PPM introductions.
6. CDFW make recommendations to the City of Dana Point regarding sustainable public access at the Dana Point Preserve -- one of the three extant PPM populations.
7. CDFW make recommendations to the City of Dana Point regarding improvements in its management and monitoring for PPM on its property that lies adjacent to the Dana Point Preserve.
8. CDFW seek a transfer of the Conservation Easement for the Dana Point Preserve, currently held by the City of Dana Point, for long-term management to benefit the PPM.

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