

Survey of Small Mammals at the Presidio, San Francisco

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This report describes the results of mammal surveys conducted as a portion of the Presidio Forest Management Plan, Task Items A2b and A2c. The survey included a review of relevant literature and museum records, live-trapping, track plate surveys and search for sign and sightings of mammals on the Presidio.

The report includes a list of species found by literature or field survey to be present on the Presidio as well as a list of species of doubtful occurrence and species likely to be present but not found during the study. Habitat use, with respect to Presidio habitat types, is discussed for each species, and there is a general discussion and summary of habitat quality and mammal - habitat relationships.

Methods

Literature Review and Museum Search

I reviewed distributional literature in order to obtain distributional records, to generate a list of expected mammalian species and obtain information regarding habitat relationships of species found to occur on the Presidio. In addition to literature review, I searched the collections of the California Academy of Sciences and the Museum of Vertebrate Zoology, University of California for specimens collected in San Francisco County. Some additional records of occurrence were obtained by interviewing National Park Service personnel.

Field Surveys

Field surveys included searching suitable habitat for sightings and sign of mammals, live-trapping for small mammals, and track surveys using smoked aluminum track plates. I did not establish baited camera stations because of the heavy human use of the area and lack of suitable undisturbed locations. I spent several days making a general examination of the entire area in order to identify suitable habitat for further survey work, gain a general impression of habitat quality and structure, and to search for sign of mammals, including feces, burrows, runways, etc.

I selected thirteen sites at which to conduct live-trapping for small mammals. I used Sherman live-traps baited with a combination of mixed bird seed, rolled oats and peanut butter. Because population density information was not required, the number and placement of traps was not standardized, and was adjusted to fit the size and shape of the area being sampled. I placed traps in such a way as to select particularly promising microhabitats, in order to maximize the opportunities to determine the presence of species. I attempted to hide traps in order to minimize human disturbance. Nonetheless, traps were frequently disturbed, probably by dogs, cats and raccoons.

Smoked aluminum track plates were placed in the same general areas at which live-trapping was conducted (Table 3). The plates were approximately two feet by three feet, sooted with kerosene, and were baited using canned cat food. Track plates 1-8 were operated during the week of June 20-24, 1994. Track plates 9-14 were operated during the week of June 27-July 1, 1994. Track plates 15-18 were operated during the week of July 5-8, 1994.

Site Descriptions

The habitat at each live-trapping site is described below. The numbers of traps and trap days are summarized in Table 1 following the site descriptions. Sites 1-5 were sampled during the week of May 30-June 3, 1994. Sites 6-10 were sampled during the

week of 20-24, 1994 and sites 11-13 were sampled during the week of June 27-July 1, 1994.

Site 1. This sampling site was located along Lobos Creek, roughly parallel to the construction yard adjacent to the riparian woodland. The riparian woodland along this section was dominated by willows and coast live oak. A nearly continuous, dense understory was present throughout. Wet areas near the edge of the creek were had an herbaceous layer dominated by sedges, with shrubby thickets of willow, blackberry, and poison oak interspersed. Drier areas away from the edge had an herbaceous/shrub layer with ivy, blackberry and poison oak with various herb and grass species scattered within this matrix. Thirty live-traps were placed along the creek over a total length of approximately 200 meters. About half of the traps were placed in sites near the edge of the creek, where the understory was dominated by sedges and other herbaceous cover. The remaining half of the traps were placed within the riparian woodland but not necessarily immediately adjacent to the creek. These traps were in a dense understory of ivy, blackberry and poison oak.

Site 2. This site was also located along Lobos Creek, just below the parking area for the Public Health Hospital. This site was a willow thicket with a continuous cover of willows. The understory was open in places, with bare ground and woody debris. The edge of the thicket, and scattered locations under the canopy of willows, had an understory of grasses, ivy and other herbs. Traps were located both within the thicket and along the edge.

Site 3. This sampling site was located in a patch of dune scrub situated between Wedemeyer Street, the Presidio Golf Course, and the Public Health Hospital. The area of dune scrub was characterized by sandy soil and a dense cover of shrubs. Among the shrubs were ferns, grasses and other herbaceous plants such that a nearly continuous understory provided cover suitable for rodents and shrews. There were some patches of open sand, but most of the sandy soil was occupied by a dense cover as described.

Site 4. This site was an area of grassland adjacent to Site 3. The grassland was tall and dense enough that rodent runways could be completely under cover. This patch of grassland was very moist. Although no standing water was present in the area where traps were set, there were several small channels which probably hold water during the rainy season. Scattered trees and shrubs were present on the site, but all traps were located in dense grass cover.

Site 5. This site was a riparian willow thicket adjacent to Sites 3 and 4. A small drainage channel along the edge of a parking lot supports a line of willows with grassland along one edge. Several pools of water were present and there were patches of wet mud in which the tracks of mammals were observed. A dense cover of grasses and sedges formed the understory under the willows.

Site 6. This site was a riparian thicket located along a drainage between Inspiration Point and El Polin Spring. Unlike the other riparian sites, trees along this drainage were primarily Eucalyptus and Monterey pine. The understory consisted of a dense cover of ivy with poison oak and blackberry also common. The area was quite moist but did not have flowing surface water.

Sites 7,8. These two sites were located in Monterey Pine woodlands below Inspiration Point. Both sites had an understory with dense grass cover, large woody debris and standing snags, and scattered shrubs. Other tree species, including cypress and eucalyptus, were also present in the general area.

Site 9. This site was located in a small patch of redwoods below Inspiration Point. Within the redwood grove, there was a fairly deep layer of duff, but little understory vegetation. Half of the traps were placed in this type of situation. Half of the traps were placed along the edge of the redwood grove, where a dense cover of grasses and scattered shrubs were present.

Site 10. This woodland site was located across Arguello Way from Inspiration Point, adjacent to the golf course. The woodland consisted of a uniform, apparently even-aged stand of cypress. The understory was a dense, tall cover of grasses. Half of the traps were placed in a line through this grass understory. The remaining traps were placed in a line along the edge of the woodland adjacent to the golf course. Here, in addition to grasses, scattered clumps of blackberry and poison oak, with large woody debris, were present.

Site 11. This site was located along the edge of a patch of dune scrub between Washington and Lincoln Blvds., just south of the World War II Memorial. The site had a dense cover of shrubs and ferns, with grasses and other herbaceous plants scattered throughout. All traps were placed within the dune scrub vegetation along the south edge of the patch.

Site 12. This coastal scrub site was located near Battery Crosby, between Lincoln Blvd. and the coastline. A line of traps was placed along a trail leading from the battery to the beach. Vegetation consisted of scattered shrubs with a nearly continuous mass of blackberry and poison oak.

Site 13. This site was a mixture of coastal scrub (the primary vegetation) with some riparian willow thickets. The site occupied a fairly steep bank just north of Battery Crosby. The vegetation was similar to that of Site 12 except for occasional willow thickets along a seep leading from the base of the steep bluffs to the beach.

Table 1
Live-trapping study plots

Site	Habitat	Number of Traps	Number of Days
1 (Lobos Creek)	Riparian	30	4
2 (Lobos Creek)	Riparian	10	4
3 (Pub. H. Hosp.)	Dune Scrub	30	4
4 (Pub. H. Hosp.)	Annual Grassland	10	4
5 (Pub. H. Hosp.)	Riparian	10	4
6 (Insp. Pt.)	Riparian	10	4
7 (Insp. Pt.)	Monterey Pine	15	4
8 (Insp. Pt.)	Monterey Pine	5	4
9 (Insp. Pt.)	Redwood	10	4
10 (Insp. Pt.)	Cypress	29	4
11 (WW II Mem.)	Dune Scrub	20	3
12 (Batt. Crosby)	Coastal Scrub	14	3
13 (Batt. Crosby)	Coastal Scrub	16	3

Results

The presence or former presence of twelve species of wild mammals was documented in this study (Appendix 1). Records of occurrence were obtained by live-trapping, track plates, field observations, and by searching museum collections.

Results of small mammal live trapping are shown in Table 1 below. Only five species were captured by live trapping: California Vole (*Microtus californicus*), Western Harvest Mouse (*Reithrodontomys megalotis*), Roof Rat (*Rattus rattus*), Vagrant Shrew (*Sorex vagrans*) and Ornate Shrew (*S. ornatus*). Two species made up 89% of the total captures: California Vole (20 captures) and Western Harvest Mouse (21 captures). These two species were captured in a wide variety of Presidio habitats, including riparian, annual grassland, dune scrub, coastal scrub, monterey pine woodland and cypress woodland. The consistent feature of situations in which these species were found is the presence of dense, moist cover in the herb/grass layer. This is of course the main component of grassland habitats, but is also a common feature of riparian and woodland habitat types, often in combination with patches of blackberry thicket or ferns. At the sites where voles and harvest mice were captured, sign was evident, including small pits and burrow entrances as well as runways. This type of sign was found in nearly all locations with grassy understory cover, even when there were no captures (specifically sites 5,6,7,8).

Table 2
Numbers of captures of small mammals at live-trapping study sites

Site	Habitat	M. californicus	R. megalotis	Other species
1	Riparian	0	0	0
2	Riparian	1	1	0
3	Dune Scrub	8	6	0
4	Ann. Grassland	4	0	0
5	Riparian	0	0	0
6	Riparian	0	0	3 <i>Rattus rattus</i>
7	Monterey Pine	0	0	0
8	Monterey Pine	0	0	0
9	Redwood	0	0	0
10	Cypress	3	6	1 <i>Sorex vagrans</i> 1 <i>S. ornatus</i>
11	Dune Scrub	0	3	0
12	Coastal Scrub	2	3	0
13	Coastal Scrub	2	2	0

Results of track plate surveys are shown in Table 3. Four mammal species were detected on track plates. Three species had high frequencies of occurrence on track plates: cats (65%), raccoons (41%) and dogs (29%). Skunk tracks were found on one track plate. Cats were detected by this method in most habitat types. Dogs were generally in close association with their owners. Their occurrence seemed to be related to accessibility (avoiding dense shrub cover or dense, shrubby understory) and distance to hiking trails. I found no evidence suggesting feral dog occurrence in the study area. Raccoons were found in riparian (3 of 7 occurrences), coastal scrub and woodland habitats.

Additional observations of mammal species or sign were made during field work. Valley Pocket Gopher mounds were seen at virtually all locations in the Presidio and in all habitat types, avoiding only waterlogged or extremely compacted soils. Gopher sign seemed to be most abundant in grasslands and open woodlands, less abundant in coastal

and dune scrub. Pits, burrow entrances and runways made by California Voles and possibly Western Harvest Mice were encountered at most sites and were most abundant in grasslands and habitats with a grassy understory. A road-killed Striped Skunk was seen near Fort Point. Raccoon tracks were observed in mud at live-trapping site 5. Cats were seen in several habitats: riparian (3 sightings), Monterey Pine woodland (2 sightings), grassland (1 sighting), coastal scrub (3 sightings) and dune scrub (2 sightings). At least three cats were seen in the immediate proximity of a cat feeding station at Inspiration Point. Two juvenile cats were seen in coastal scrub near Battery Crosby.

A number of records of mammal species were obtained by searching the collections of the California Academy of Sciences and the Museum of Vertebrate Zoology, University of California, Berkeley. These records are detailed in the Species Accounts section below.

Table 3

Site (live-trapping site)	Presence of tracks of mammal species on sooted track plates.				
	Habitat	Cat	Dog	Raccoon	Skunk
1 (6)	Riparian		X	X	
2 (6)	Riparian				X
3 (7)	Mont. Pine	X	X		
4 (8)	Mont. Pine	X		X	
5 (9)	Redwood	X		X	
6 (9)	Eukalyptus		X		
7 (10)	Cypress	X	X	X	
8 (10)	Eukalyptus				
9 (11)	Dune	X			
	Scrub/Mont. Pine				
10 (11)	Dune Scrub	X			
11 (12)	Coastal Scrub	X			
12 (13)	Coastal Scrub			X	
13 (13)	Coastal Scrub	X			
14 (12)	Coastal Scrub/Mont. Pine		X		
15 (1)	Riparian	X			
16 (1)	Riparian			X	
17 (1)	Riparian	X		X	
18 (1)	Riparian	X			

Species Accounts

Vagrant Shrew (*Sorex vagrans vagrans*) and Ornate Shrew (*Sorex ornatus*)

These two similar species of small shrew may co-occur on the Presidio. The distributional and taxonomic status of the two species in the San Francisco Bay area is complex and poorly understood (Findley 1955, Hennings and Hoffmann 1977, Junge and Hoffmann 1981). Both species are represented in the Bay area by several subspecies. The most reliable morphological characteristic for separating the two species is the position and pigmentation pattern of the medial lines of the first pair of incisors (Junge and Hoffmann 1981). Both species prefer moist microhabitats and are likely to be most common in riparian and moist meadow situations. The Ornate Shrew is somewhat more likely to be encountered in drier habitats (e.g. oak woodland) than the Vagrant Shrew. Habitat suitable for either of these species is common on the Presidio. Riparian areas and woodlands with a dense grassy/herb/blackberry understory provide preferred microhabitat for shrews. Presence of downed logs and other woody debris would also favor shrews.

A single museum specimen (California Academy of Sciences #21491) and one specimen captured during the present study, are the basis for including the Vagrant Shrew on the list of Presidio mammals. The museum specimen, captured in 1979, was obtained on the south edge of the Presidio. No further location or habitat data is available. The specimen found in this study was captured in dense grassy understory of a cypress stand near Inspiration Point (site 10). The California Academy of Sciences specimen is assigned to the subspecies *S. vagrans vagrans*. Both the Museum of Vertebrate Zoology and the California Academy of Sciences have additional specimens assigned to *S. v. vagrans* from San Francisco County. Distributional literature indicates that this subspecies occurs north of San Francisco Bay, while another subspecies (*S. v. paludivagus*) occurs in riparian and wetland habitats in the San Francisco peninsula and Monterey Bay area (Hennings and Hoffmann 1977, Hall 1981, Williams 1986). Specimens assigned to *S. v. paludivagus* from San Francisco (Lake Merced, Suto Forest) are in the Museum of Vertebrate Zoology. Therefore the presence of *S. vagrans* on the Presidio seems reasonably well documented, but the subspecific identity of these shrews is doubtful. Presidio *S. vagrans* may be an isolated southward extension of the range of *S. v. vagrans* or they may represent *S. v. paludivagus*.

A single specimen of the Ornate Shrew is catalogued in the Museum of Vertebrate Zoology (#57245). This specimen, collected in 1933, was captured "3/4 mi. N of Marine Hospital". No further information is available regarding habitat. Unfortunately, this specimen has been missing from the MVZ collection since at least 1979 and is therefore unavailable for further examination. A shrew specimen obtained in this study appears to be *S. ornatus*, but the teeth are somewhat worn. This specimen was collected near site 10, in grassy/blackberry understory of a cypress stand.

To conclude, Ornate and Vagrant shrews are likely to occur on the Presidio. Both species are found in similar moist microhabitats with dense cover of grasses, herbs and/or blackberry thicket. The subspecific identity of shrews found on the Presidio should be investigated by an expert on the taxonomy of this group.

Broad-footed Mole (*Scapanus latimanus*)

The Museum of Vertebrate Zoology has two specimens of this species collected in 1936 (#s 70456, 70457). I observed some sign (mounds) that could be attributed to this species along Lobos Creek and near Inspiration Point. There are many specimens of Broad-footed Moles from other parts of San Francisco (MVZ, CAS), including Golden

Gate Park and Lake Merced. This common species prefers moist, friable soils and is most common in moist meadow and riparian situations. It is less tolerant of dry, compact soils than the Valley Pocket Gopher. Moles also frequent residential areas, especially lawns and gardens. Moles are likely to be found on the Presidio wherever there is moist, uncompacted soil.. Riparian, grassland and open woodland habitats with grassy understory are the most likely habitat types.

Fox Squirrel (*Sciurus niger*)

The Fox Squirrel is included here based on sighting reports obtained from National Park Service personnel. Squirrels matching the description of this species have been observed in the vicinity of Inspiration Point, where a number of forest types occur in close proximity. Fox squirrels were not observed during field work, and appear to be uncommon on the Presidio. Both Fox Squirrels and Eastern Gray Squirrels (*S. carolinensis*) are known from Golden Gate Park. A potential dispersal corridor exists along Park Presidio Blvd. between Golden Gate Park and the Presidio, a distance of about one mile.

Fox Squirrels are an introduced eastern species which is primarily found in and near urban areas in California. A variety of forest types and park lands are used. Acorns are known to be a preferred food source where available, but a variety of fruits and nuts may be used. In Ventura County, Fox Squirrels used Eucalyptus nuts as a winter food source, moving to orchards and native woodlands at other times of year (Wolf and Roest 1971). Although Fox Squirrels are not a conifer forest species in their native range, they may be expected to occupy mixed forest stands on the Presidio if sufficient understory food sources are available (e.g. blackberry, toyon, oaks, etc.). Fox squirrels are unlikely to be permanent occupants of conifer or eucalyptus groves that are composed of large trees lacking any understory or having only grasses as an understory component.

Valley Pocket Gopher (*Thomomys bottae*)

Sign of the Valley Pocket Gopher was encountered everywhere during this study. Twenty-eight specimens captured on the Presidio are in the collection of the Museum of Vertebrate Zoology. These specimens were collected in 1935 and 1936. Pocket Gophers are tolerant of a wide variety of soils, avoiding only waterlogged soil. They may occur in grasslands, shrublands, woodlands and residential areas. Pocket Gopher sign was observed in every habitat type investigated during this study, including serpentine grassland, annual grassland, dune scrub, coastal scrub, riparian, Monterey Pine, Cypress, Eucalyptus, mixed woodlands, and residential areas. Thus they are certainly one of the most common small mammals on the Presidio.

Western Harvest Mouse (*Reithrodontomys megalotis*)

The Western Harvest Mouse was the frequently captured small mammal and live-trapping sites. There were 21 captures at 6 sites in four habitats: riparian (1 capture), dune scrub (9 captures), coastal scrub (5 captures) and cypress woodland (6 captures). The feature linking these sites is the dense herbaceous/shrubby understory, composed of grasses, blackberry, ferns and other herbaceous plants. Grassland and other open woodland types with these characteristics are also within the expected habitat range for Western Harvest Mice and probably harbor populations of this species.

Deer Mouse (*Peromyscus maniculatus*)

This widespread and abundant small mammal is found throughout the San Francisco Bay area and occurs in a wide variety of habitats, especially shrub and woodland habitats. The lack of captures of deer mice is the most surprising result of the live-trapping survey. A series of three specimens (#9869-9871) collected in 1950 is in the museum of the California Academy of Sciences. Other San Francisco locations include Cliff House (CAS), Suto Forest (CAS), Lake Merced (CAS), Alcatraz Island (MVZ) and "San Francisco" (MVZ). Given the ubiquity and abundance of this species in North America (Ingles 1965, Hall 1981, Zeiner et al. 1990) and the presence of many other records in the Bay area, it seems likely that deer mice are currently living on the Presidio. Compared to voles and harvest mice, deer mice are less abundant in more grassy or mesic microhabitats and more abundant in drier, more open habitats. The widespread occurrence of voles and harvest mice on the Presidio may indicate that the habitat is not optimal for deer mice. Alternatively, deer mouse populations may have been experiencing a low density and be more abundant in other years. Deer mouse population density may change dramatically between seasons or years (King 1968, Kirkland 1989). The presence of deer mice on the Presidio seems certain, but their abundance and habitat occurrence are not well documented at this point.

California Vole (*Microtus californicus*)

The California Vole was the second most frequently captured small mammal during this study. There were 20 captures at 6 sites in five habitats: riparian (1 capture), dune scrub (8), coastal scrub (4), cypress woodland (3) and annual grassland (4). Probable sign of voles was observed at two additional riparian live-trapping sites and two open Monterey Pine woodland sites. All sites at which voles were captured had a dense understory of grasses or a mixture of grass, blackberry and other herbaceous plants. Generally, grasslands and meadows are considered the optimum habitat for California Voles (Ingles 1965, Zeiner et al. 1990), but in this survey there were more captures in dune scrub than in annual grassland. The widespread occurrence of this species, and its co-occurrence with the Western Harvest Mouse, is undoubtedly related to the mesic nature of most Presidio habitats and the presence of dense cover.

Roof Rat (*Rattus rattus*)

Three roof rats were captured in a riparian blackberry thicket between Inspiration Point and El Polin Spring. Although this is the only available record for this species, roof rats are likely to be closely associated with buildings, especially where brushy thickets and ivy are close to buildings.

Striped Skunk (*Mephitis mephitis*)

A road-killed Striped Skunk was seen near Fort Point, and I found the tracks of a skunk near El Polin spring on a track plate placed in a riparian thicket. Several individuals reported having smelled skunks at various places on the Presidio. Brushy sites in woodlands and riparian habitats are likely to be important den and foraging sites on the Presidio, although Striped Skunks are likely to be seen in most habitats on the site.

Raccoon (*Procyon lotor*)

This widespread, adaptable omnivore is common on the Presidio. Raccoon tracks were found on seven (41% of the track plates established during this study. These plates were located in riparian, Monterey Pine, redwood and cypress stands, and coastal scrub. I also observed tracks in a riparian thicket adjacent to grassland and dune scrub and along

the beach below Battery Crosby. Although raccoons are closely associated with riparian habitats, they may occur in virtually any habitat. Cavities in trees, snags, logs, rocky areas and abandoned buildings may serve as den sites. Raccoons are very tolerant of human activity and are often found in residential and urban areas. On the Presidio, riparian and woodland habitats are probably important as den and foraging sites, though raccoons could be expected to forage and explore virtually anywhere on the site.

Cat (*Felis domesticus*)

Domestic and feral cats are very common throughout the Presidio. Individuals were seen in all habitat types and tracks were obtained in most habitat types. Cats left tracks on 65% of the tracking plates. Feeding stations for cats are being maintained by the public. Some feral cats have been captured and neutered, and others placed in homes, by people maintaining feeding stations. Despite such efforts, it is likely that some feral cats are reproducing, given the widespread occurrence of cats on the Presidio and the likelihood that more cats enter (or are abandoned) from nearby residential areas. I observed two juvenile cats near Battery Crosby.

Species Thought to be Extirpated or of Doubtful Occurrence

Salt Marsh Vagrant Shrew (*Sorex vagrans halicoetes*)

The Salt Marsh Vagrant Shrew is restricted to salt marsh habitats in the south and central San Francisco Bay region. It is rare and is a Category 2 candidate for federal listing and a California Species of Special Concern (Williams 1986). A single specimen of this shrew from the Presidio is in the collection of the California Academy of Sciences (# 8153). The specimen was collected in 1940, and no specific location or habitat information is available. It seems likely that this shrew may have existed in salt marsh habitat located between Fort Point and Crissy Field. No suitable habitat for this shrew is currently found on the Presidio, thus there is no reason to believe that it occurs there.

Trowbridge Shrew (*Sorex trowbridgii*)

The Trowbridge Shrew is listed by Kurz (1983) as occurring on the Presidio, but no specific information is provided to document the occurrence of this species. No specimens were found in the California Academy of Sciences or the Museum of Vertebrate Zoology, although other *Sorex* species were represented. The Trowbridge shrew is generally associated with conifer forests, although it may also be found in woodlands.

California Ground Squirrel (*Spermophilus beecheyi*)

A single specimen collected in 1938 (California Academy of Sciences #7763) is the only record of occurrence for this species on the Presidio. This conspicuous species prefers open areas and is a common to abundant resident of grasslands, agricultural areas and open developed regions of lowland California. There appear to be no recent sightings of this ground squirrel on the Presidio, and I did not observe the species during my field work. California Ground Squirrels and their burrow systems are generally very easy to observe, thus I believe that this species is no longer present on the Presidio.

Long-tailed Weasel (*Mustela frenata*)

Kurz (1983) listed the Long-tailed Weasel as occurring on the Presidio, but provided no source or documentation for the observation. There are no additional records

for this species. A specimen from Golden Gate Park is in the collection of the California Academy of Sciences. Open woodlands with shrubby understory and coarse woody debris would provide suitable habitat for weasels. Although suitable habitat exists on the Presidio, habitat fragmentation could be a problem for this predator.

Gray Fox (*Urocyon cinereoargenteus*)

Kurz (1983) includes the Presidio as a location for this species, but the specific sighting is not described and there is no date. No other definite records were found for this species. No tracks of a suitable size were detected on track plates (all tracks were much too large). Suitable habitat that could be permanently occupied on the Presidio would include coastal scrub and woodlands with dense shrub cover (Ingles 1965, Zeiner et al. 1990). Most of the woodland patches on the Presidio are highly fragmented and disturbed. Coastal scrub is less accessible to disturbance by people and dogs, contains areas with rugged terrain and includes some fairly large blocks of habitat, although this habitat forms a very narrow strip along the coastline. Gray foxes foraging along beaches might use coastal habitats on the Presidio for foraging. The coastal edge of the Presidio, with its blocks of coastal scrub habitat and beaches, would be suitable habitat for transient and perhaps resident Gray Fox.

Black-tailed Deer (*Odocoileus hemionus*)

No recent deer sightings exist for the Presidio. I found no sign of deer during my field work, and in my opinion there is insufficient undisturbed cover to support a deer population on the Presidio. According to Kurz (1983), deer have not been seen on the Presidio since the mid 1970's

Species Likely to Occur but Undocumented by This Study

Opossum (*Didelphis virginiana*)

The introduced opossum is a highly opportunistic animal that is found in moist woodlands and brushy areas, agricultural and residential areas. Because it can also use urban areas, and is known to occur in San Francisco, it is likely to be found on the Presidio. Most likely habitats would include riparian areas and brushy, moist thickets.

Brush Rabbit (*Sylvilagus bachmani*)

This species is a resident of dense, brushy areas, feeding on a variety of herbs, grasses and portions of a variety of shrubs. It would be expected to occur in coastal scrub habitat and possibly in dune scrub habitat. Although no records or sightings of this conspicuous animal were found, the abundance and distribution of Brush Rabbits in the San Francisco Bay area suggests that it is likely to be found on the Presidio.

House Mouse (*Mus musculus*)

This common introduced mammal is closely associated with human activity, particularly dwellings and other structures. During my surveys, I avoided trapping near any buildings in order to avoid disturbance of traps. House mice are very likely to occur in association with houses and other buildings on the Presidio.

Discussion

At the tip of the San Francisco peninsula, the Presidio lies within a region inhabited by mammal species typical of the southern and inner coast ranges (Hooper 1944, Ingles 1965, Hall 1981). The Presidio could be a northern range limit for mammalian species or subspecies, since number of species have range limits which coincide with some portion of the San Francisco Bay - Delta system (Hooper 1944, Hall 1981). Examples of species occurring only north of the Bay include Douglas Squirrel, Mountain Beaver and Pacific Jumping Mouse. Examples of species only occurring south of the Bay include California Mouse and Merriam's Chipmunk. All of the species found in this survey occur both north and south of the Bay, but some have subspecies whose range limits coincide with the Bay. Among the species occurring or formerly occurring on the Presidio, this group would include Vagrant Shrew, Broad-footed Mole, Valley Pocket Gopher, California Ground Squirrel, and California Vole.

The species diversity of mammals on the Presidio is low, considering the range of possible species within the San Francisco peninsula. Several factors clearly contribute to this situation. Some of the historically present habitats have been greatly reduced or eliminated, such as dune, dune scrub, and salt marsh. Dune scrub, riparian, grassland, and oak woodland occupy very small fragments of land. Other habitats are entirely artificial, dominated by introduced trees such as eucalyptus, Monterey Pine, cypress. Some of these woodland patches lack a well-developed understory or are even-aged stands with little coarse woody debris. Most woodland stands are occupy small fragments of land. Much of the Presidio is residential or developed land, with lawns, buildings, roads, etc. Human activity is evident everywhere. In addition to the activities of people working and living on the Presidio, there are large numbers of people hiking, running, biking, walking dogs or driving through the Presidio. In summary, from the perspective of native mammal habitat relationships, habitats on the Presidio are somewhat isolated, fragmentary, disturbed and dominated by exotic species.

Despite all of these negative factors, the quality of habitat for the mammal species present is good to excellent in many habitat patches. One could divide the mammal species of the Presidio into two general groupings: species which are habitat generalists tolerant of human disturbance or living in association with humans and species which are dependent on dense cover in the herb/grass layer and are associated with mesic habitats. Members of the former group would include Broad-footed Mole, Fox Squirrel, Valley Pocket Gopher, Deer Mouse, Roof Rat, Striped Skunk, Raccoon, and Cat. Three of these species are introduced (Fox Squirrel, Roof Rat, Cat) and an additional introduced species (Opossum) is probably found at least occasionally on the Presidio. Most of these species can be found regularly in urban areas as well as in undeveloped lands. Members of the second group include Vagrant Shrew, Ornate Shrew, Broad-footed Mole, Western Harvest Mouse, and California Vole. There were no dramatic differences in mammal species composition or diversity between Presidio habitats. The most important habitats for small mammals on the Presidio are riparian, grassland, coastal scrub, dune scrub, and open woodland types with dense understory of grasses, herbs and other understory plants. A more important factor appears to be the quality of understory vegetation within habitat types.

Conclusions

1. Twelve mammal species were shown to occur on the Presidio during this study. This low diversity relative to the possible species composition, reflects the complex history of habitat modification, human disturbance and isolation of habitat fragments.
2. Most of the species could be characterized as habitat generalists tolerant of human presence and disturbed habitats. This group includes Broad-footed Mole, Fox Squirrel, Valley Pocket Gopher, Deer Mouse, Roof Rat, Striped Skunk, Raccoon, and Cat.
3. Three of the species in this group are introduced (Fox Squirrel, Roof Rat, Cat). Of these three species, only cats were widespread and abundant.
4. A second group of species are associated with dense cover in the herb/grass stratum. This group includes Vagrant Shrew, Ornate Shrew, Broad-footed Mole, Western Harvest Mouse, and California Vole.
5. Habitat types did not differ greatly in mammal species composition or species diversity. The density of understory habitat components (i.e. grasses, herbs, blackberry thickets, ferns) appears to be the key habitat feature for mammals on the Presidio.

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Appendix 1. Wildlife of the Presidio of San Francisco
Mammals

Species	Scientific Name	Status	Abund	Water	Shore	Grass	Scrub	Woodland	Developed	Source
Vagrant Shrew	<i>Sorex vagrans vagrans</i>		U				ag	all with ag,bl		CAS
Omate Shrew	<i>Sorex ornatus</i>		C			ag		all with ag,bl		CAS, JH
Broad-footed Mole	<i>Scapanus latimanus</i>		C			ag		all with agla		MVZ
Fox Squirrel	<i>Sciurus niger</i>	#	U					mc,mp,lo,mx		NPS
Valley Pocket Gopher	<i>Thomomys bottae</i>		A			ag,sg	cs,ds	all	la	JH,MVZ
Western Harvest Mouse	<i>Reithrodontomys megalotis</i>		A			ag	cs,ds	all with ag,bl		JH
Deer Mouse	<i>Peromyscus maniculatus</i>		U				cs,ds	all with ag,bl		CAS
California Vole	<i>Microtus californicus</i>		A			ag,sg	cs,ds	all with ag,bl		JH
Roof Rat	<i>Rattus rattus</i>	#	U					bl	bu	JH
Striped Skunk	<i>Mephitis mephitis</i>		C			ag	cs,ds	all with ag,bl	bu,la	JH
Raccoon	<i>Procyon lotor</i>		A		ur,tr	ag	cs,ds	all with ag,bl	bu,la	JH
Cat	<i>Felis domesticus</i>	#	A			ag,sg	cs,ds	all with ag,bl	bu,la	JH

Wildlife of the Presidio of San Francisco
Mammals

Notes:

Status

Same as codes on other wildlife tables

Abundance

A = abundant, nearly always observed in appropriate habitat
C = common, frequently observed in appropriate habitat
U = uncommon, observed only occasionally
R = rare, few records available
? = current status questionable
E = probably extinct

Habitat Associations

Same as codes on other wildlife tables

Sources

CAS = California Academy of Sciences
MVZ = Museum of Vertebrate Zoology, University of California, Berkeley
JH = John Harris field notes compiled during 1994
NPS = National Park Service personnel
Kurz = A. Kurz, checklist of San Francisco's inland native wildlife, 1983