Chaetodipus fallax. By James Alden Lackey

Chaetodipus fallax (Merriam, 1889)

San Diego Pocket Mouse

Perognathus fallax Merriam, 1889:19. Type locality "San Bernardino [in San Bernardino County], Cal. [California]" Osgood (1900:55) subsequently described the type locality as "Reche Canyon, 3 miles southeast of Colton, San Bernardino County, Cal." Grinnell (1933:153) added "1250 feet" to Osgood's description of the type locality.

C[haetodipus]. fallax: Hafner and Hafner, 1983:24. Elevation of subgenus to generic status.

CONTEXT AND CONTENT. Order Rodentia, Family Heteromyidae, Subfamily Perognathinae. Six subspecies of *C. fallax* are recognized by Williams et al. (1993):

C. f. anthonyi Osgood (1900:56). Type locality "South Bay, Cerros [Cedros] Island, Lower [Baja] California," Mexico.

C. f. fallax Merriam, 1889:19, see above.

C. f. inopinus Nelson and Goldman, 1929:110. Type locality "Turtle (also known as San Bartolome) Bay, Lower [Baja] California, Mexico."

C. f. majusculus Huey, 1960:418. Type locality "San Quintin, Baja California, Mexico." (30°30′N, 115°59′W—Bond, 1969)

C. f. pallidus Mearns, 1901:135. Type locality "Mountain Spring, half-way up the east slope of the Coast Range Mountains, on the Mexican Boundary Line, in San Diego County, California." (type locality now within Imperial County—Huey, 1960)

C. f. xerotrophicus Huey, 1960:419. Type locality "2 mi. northwest of Chapala, Baja California, Mexico." (29°25′N, 114°20′W—Bond, 1969)

DIAGNOSIS. The following characters singly or collectively distinguish *C. fallax* from other species of pocket mice in the genera *Chaetodipus* and *Perognathus* sympatric with *C. fallax*. The rump has distinct spines or bristles, the lateral line is well marked, and the pelage is not markedly hispid. The interparietal is pentagonal with a conspicuous anterior angle, the cranium is moderately arched, and the rostrum is attenuate and narrow. Total length is >170 mm (Hall, 1981).

GENERAL CHARACTERS. *Chaetodipus fallax* (Fig. 1) is medium in size compared with other species of the genus. The upper parts of the pelage are rich brown, darker over the rump,

FIG. 1. *Chaetodipus fallax* from Anza Borrego State Park, San Diego Co., California. Photograph by John Harris/Mammal Slide Library.

and under parts are white or creamy white. Bristles on the rump are black, whereas those on the flank are white. The lateral line and subterminal portions of hairs of the upper parts are pinkish buff. The tail is long and crested, dark above and white below. The ears are dusky on the inflexed portion, and whitish on the inner surface. The cranium (Fig. 2) is arched, the interparietal is wide
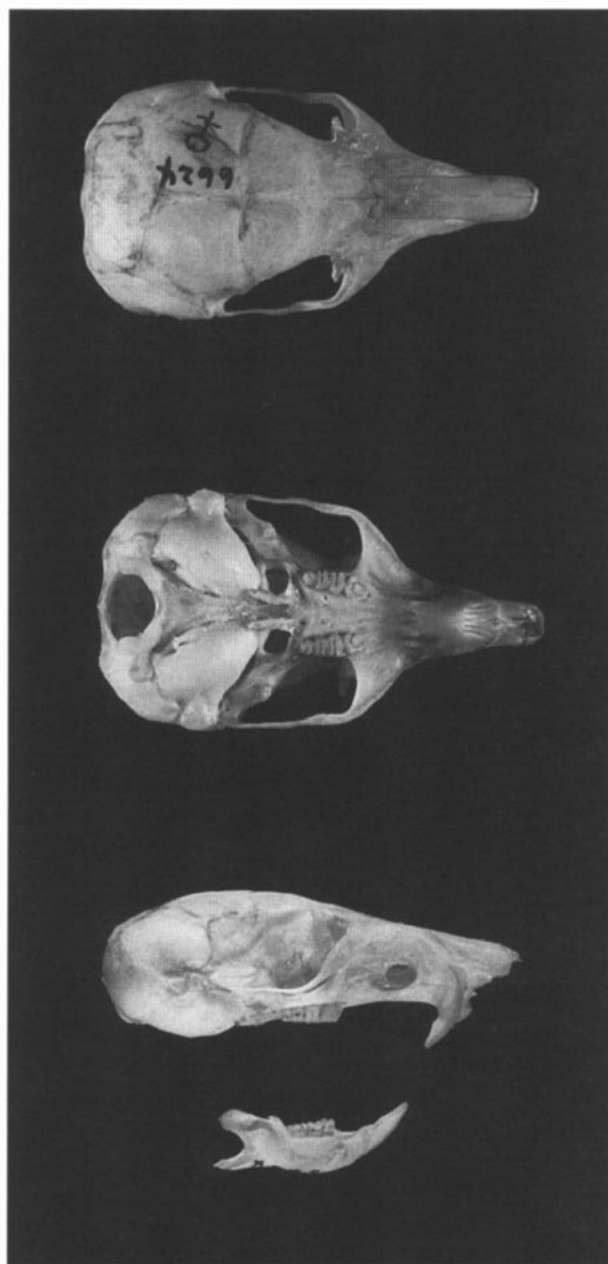

FIG. 2. Dorsal, ventral, and lateral views of cranium, and lateral view of mandible of *Chaetodipus fallax* from 4 mi. SW Perris, Riverside Co., California (female, San Diego Natural History Museum 6624). Greatest length of cranium is 25.3 mm. Photographs by James Ford.
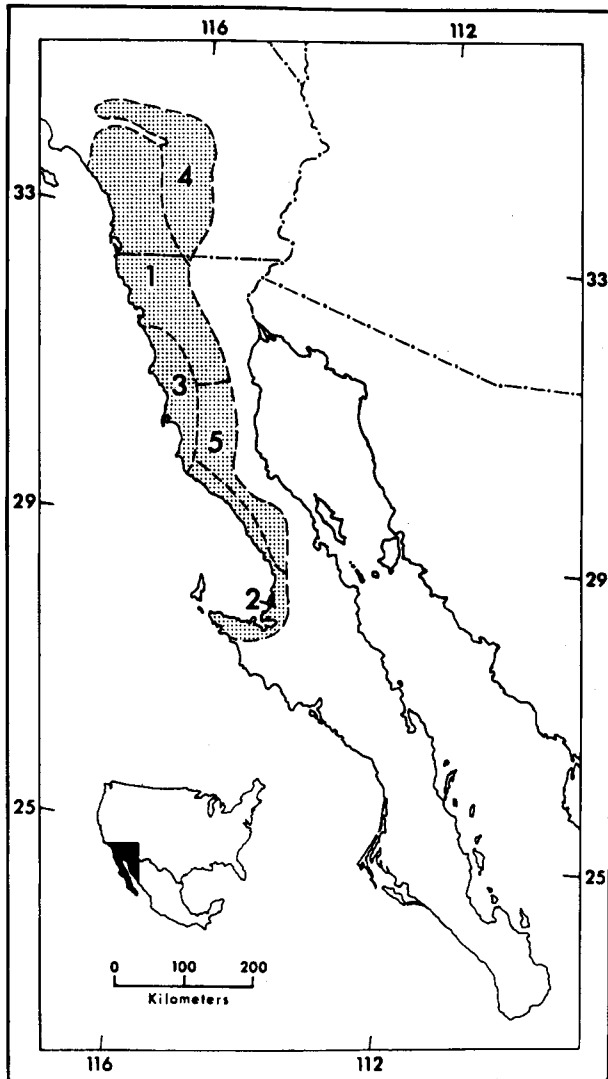
FIG. 3. Distribution of *Chaetodipus fallax* in California and Baja California, Mexico (Hall, 1981). 1, *C. f. fallax*; 2, *C. f. inopinus*; 3, *C. f. majusculus*; 4, *C. f. pallidus*; 5, *C. f. xerotrophicus*.
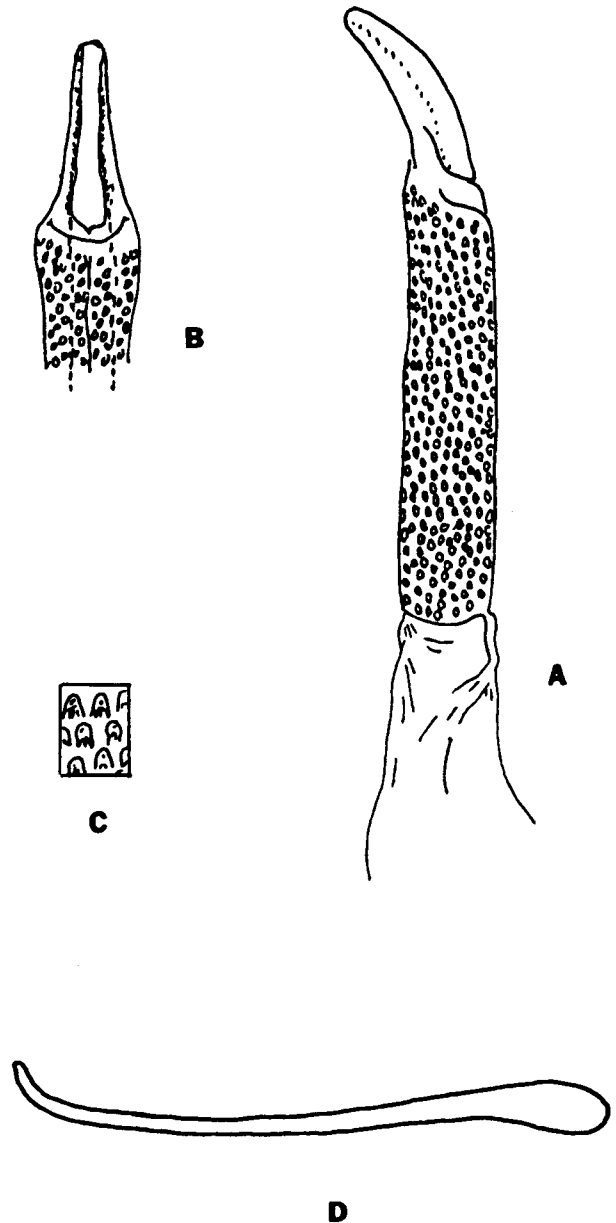

FIG. 4. Glans penis and baculum of *Chaetodipus fallax*: A, lateral view of glans; B, ventral view of glans, illustrating the urethral lappets and position of urethra (dashed lines); C, enlarged view of spines; D, lateral view of baculum (after Kelly, 1969).

with the anterior angle obsolete, the mastoids are large, and the nasofrontal suture is slightly or not at all emarginate (Hall, 1981; Osgood, 1900; Ryan, 1968).

Means of measurements (in mm) for samples of 20 males and 20 females from throughout the range of the species were, respectively: total length, 191, 187; length of body, 85, 82; length of tail, 106, 105; length of hind foot, 24, 23; length of ear, 10, 10; basal length of cranium, 16.3, 16.3; greatest length of cranium, 26.6, 26.4; spread of maxillary arches, 12.4, 12.3; interorbital width, 6.4, 6.5; nasal length, 10.3, 10.4; intermaxillary width, 4.9, 4.9; alveolar length, 4.0, 4.1; lacrimal length, 1.9, 2.0; maxillary arch width, 1.6, 1.6; basioccipital length, 4.0, 3.9; greatest depth of cranium, 8.9, 8.7; greatest width of cranium, 13.8, 13.9; zygomatic width, 13.4, 13.5; and nasal width, 2.7, 2.7. The only instance of sexual dimorphism among 19 characters was alveolar length, in which males were larger; other species of *Chaetodipus* exhibit from 0 to 12 instances of sexual dimorphism (Best, 1993).

DISTRIBUTION. In the United States, the border of the geographic range of the San Diego pocket mouse (Fig. 3) extends from the U.S.-Mexican boundary at San Diego, California, northwesterly along the Pacific coast to San Onofre, thence northward to the southern edge of the Mohave Desert in Riverside County (34°30′N), eastward to Twentynine Palms, thence southward to the U.S.-Mexican boundary near Mountain Springs, Imperial County. In Baja California, Mexico, the geographic range encompasses the

western two-thirds of the peninsula from the U.S.-Mexican boundary southward to Bajia Tortolo (= Turtle Bay or San Bartolome Bay) in west-central Baja California, 27°41′N. *C. fallax* has been collected in California at elevations from 138 m at Palm Springs, Riverside Co., to 1,835 m on the northern slopes of the San Bernardino Mountains in San Bernardino Co. (Grinnell, 1933). Its elevational range in Baja California is not clearly described in the literature. Huey (1960:415) stated there were no records of this species "from the eastern slopes of the Sierra Juarez or the Sierra San Pedro Martir in northern Baja California nor from above the 5,000-foot level along the western slopes of the mountains." However, in the same publication in the section devoted to *C. f. fallax*, which occurs on the western slopes, no data on the elevational range of this subspecies in Baja California were provided. Presumably, some populations of *C. fallax* occur at elevations up to 1,530 m (5,000 feet) in Baja California. There is no fossil record for this species.

FORM. The baculum of *C. fallax* (Fig. 4) resembles that of close relatives such as *C. spinatus*, *C. californicus*, and *C. arenarius* in having a large base, a thin tapering shaft, and a sharply

upturned tip. Means of measurements (in mm) from a sample of five *C. fallax* bacula are as follows: total length, 12.3; lateral diameter of the shaft at midpoint, 0.50; dorsoventral diameter of base, 1.6; lateral diameter of base, 1.3; and angle of curvature of the tip, 124°. The glans penis of *C. fallax* has a slender, elongated form, and no urethral lappets. There are numerous small diamond-shaped spines on the main body of the glans and the bacular projection; each spine includes a flat structure having five to seven projections pointed posteriorly. Means of measurements (in mm) of five specimens are as follows: total length of glans, 6.6; proximal glans length, 5.5; distal glans diameter, 1.3; proximal glans diameter, 1.5; and bacular projection diameter, 0.7 (Kelly, 1969).

The molars are hypsodont and lophodont, with cusps in unworn dentition reduced to small rugosities on the occlusal surface; the cusps soon disappear with wear, leaving only two transverse lophs. The p4 is quadritubercular, with a connection beteen the two lophs, the m1 and m2 are sextitubercular, and the m3 is quinquetubercular. The P4 has a small unicuspular protoloph and a tricuspid metaloph. M1 and M2 have essentially the structure of m1 and m2. M3 consists of the four primitive cusps and a protostyle continuing posteriorly as an internal cingulum with the same height as the two lophs (Wood, 1931).

The jugular (posterior lacerate) foramen, situated between the tympanic bulla and the basioccipital, is large and slit-like in the San Diego pocket mouse and in the several other representatives of the family Heteromyidae examined, whereas this foramen is small in most rodents. The canal for the internal carotid artery is not separable from the jugular foramen in heteromyids including *C. fallax*, but in various other rodents the canal is merely a groove on the tympanic bulla, or a small opening between the basisphenoid and petrotympanic bones anterior to the tympanic bulla (Hill, 1935).

The middle ears in *Chaetodipus* and *Perognathus* have a theoretical transmission of incident acoustical energy of 94–100%. Middle ear volume (0.05 cm³), length and width of stapes footplate (in mm—0.66, 0.34), length of malleus (1.63), and length of incus (0.73) were close to the mean for the 14 species of *Perognathus* and *Chaetodipus* examined. The structure of the cochlea of *C. fallax* is similar to that of other species of *Chaetodipus*, *Perognathus*, and *Liomys* in being broad and squat, and having a sharply tapering apex. There are three turns in the cochlea of *Chaetodipus* and *Perognathus*, compared with three and one-half turns in *Dipodomys*, *Microdipodops*, and *Liomys* (Webster and Webster, 1975; 1977).

When held by the tail, individuals of the San Diego pocket mouse sometimes twist violently, often breaking the tail off; subsequent locomotion, however, seems unimpaired by this loss (MacMillen, 1964). The break occurs across one of the caudal vertebrae, usually near its center. Regrowth of the stump of the tail amounted to only a few mm in several captive specimens examined a year later. The terminal end of the stump was slightly enlarged and had grown a dense tuft of hairs (Sumner and Collins, 1918).

FUNCTION. Red cell and blood electrolyte metabolism during "hibernation" was studied in *C. fallax* in the laboratory by exposing the animals to an ambient temperature of 15°C and restricting their food supply. The resulting torpidity was irregular in duration. Blood samples were taken from five individuals torpid for 3 days, from two individuals torpid for 4 days, and from three torpid for 5 days. Body temperature at the time blood samples were taken averaged 17.7°C (range 15.9–19.2°C); body temperature of active animals at room temperature averaged 34.9°C (range 33.3–36.7°C). This regime caused a decrease in red blood cell potassium, but increases in cell sodium and plasma potassium. When estivation was induced by constant exposure to an ambient temperature of 25°C, a dim red light, and restricted food, torpidity was irregular in duration. Body temperature was 26.0°C (25.5–26.5°C) at the time blood samples were taken. Cell sodium and plasma levels increased slightly, but possibly not significantly. The investigators concluded that changes in electrolyte levels probably were the direct results of changes in blood temperature, rather than representing physiological adaptations in blood cell metabolism and membrane characteristics. Electrolyte levels in animals experiencing hibernation reverted at least partially to normal within 10 days after being returned to room temperatures and an adequate food supply (Andrus et al., 1965).

Unlike any other rodent associate tested, the San Diego pocket

mouse gained weight on a diet of seeds and no free water; when free water was available only two of nine animals drank significant amounts (other species tested were the dusky-footed woodrat, *Neotoma fuscipes*; desert woodrat, *N. lepida*; California mouse, *Peromyscus californicus*; cactus mouse, *P. eremicus*; deer mouse, *P. maniculatus*; and the Pacific kangaroo rat, *Dipodomys agilis*). *C. fallax* appears capable of a normal existence with no access to free water (MacMillen, 1964). One individual of *C. f. fallax* lived eight years in captivity without access to free water, and with bird seed as the only food (Huey, 1959).

At an ambient temperature of 10°C, and while subsisting solely on hulled barley, the urine concentration of osmotically active particles of *C. fallax* averaged 502 mOsm/l; at 23°C, urine concentration was 1,241 mOsm/l; and at 30°C, urine concentration was 4,617 mOsm/l. In contrast, urine concentrations of the Merriam kangaroo rat *Dipodomys merriami*, a desert species, at the same temperatures were 1,512; 2,726; and 5,020 mOsm/l; respectively. Water turnover for *C. fallax* fed hulled barley was 17.5, 10.9, and 6.5%/day, at ambient temperatures of 10°, 23°, and 30°C, respectively. At the same temperatures, water turnover for *D. merriami* was 10.8, 7.3, and 4.2%/day, respectively (MacMillen and Hinds, 1983).

The average mean resting oxygen consumption (ml O_2 $g^{-1}h^{-1}$) at thermoneutrality (T_A = 25–35°C) was 1.518. The T_A at which the lowest mean resting oxygen consumption occurred (1.370) was 25°C. Mean evaporative water loss (mg H_2O $g^{-1}h^{-1}$) at T_A of 5–25°C, was 1.904; at T_A = 35°C, evaporative water loss was 2.735 (included water used for cooling). The mean body temperature of *C. fallax* at T_A <30°C was 32.5°C; at T_A = 35°C, mean body temperature was 36.4°C (Hinds and MacMillen, 1985).

Minimal metabolic rates (ml $O_2g^{-1}h^{-1}$, T_A = 32°C, resting animals), were 1.21, 1.31, and 1.45, for *C. fallax* from desert, intermediate, and coastal habitats, respectively. Summit metabolic rates (oxygen consumption in an atmosphere of 79% helium and 21% oxygen), at 15, 10, and 5°C, were 8.64, 7.68, and 8.38 ml $O_2g^{-1}h^{-1}$, in animals from desert, intermediate, and coastal habitats, respectively. Plasma thyroxine levels (n mol/l), in animals from those habitats were 38, 40 and 32, respectively. As a group, the heteromyid rodents (includes *C. fallax*) exhibited significantly lower levels of plasma thyroxine than did the two murid rodents (deer mice, *Peromyscus*) used in the study (Hulbert et al., 1985).

In a sample of nine *C. fallax* from southern California, average dry weight biomass was 5.41 g. Average ether-extractable fat as a percent of dry weight biomass was 8.27%, and ash content, calculated similarly, was 15.80%. Average caloric value for dry weight biomass was 4.78 Kcal/g, and for ash-free dry weight biomass was 5.67 Kcal/g. The six species of heteromyids studied had an average caloric value for dry weight biomass of 4.87 Kcal/g, significantly less than that of eight species in the family Muridae (average = 5.13 Kcal/g; P < 0.01). The range of caloric density of live weight biomass for all heteromyids in the study was 1.3–1.4 Kcal/g, less than the values reported for most rodents inhabiting mesic habitats (Kaufman et al., 1975).

The chemical composition of *C. fallax*, based on whole-body analysis, was (in mg/g mean dry weight): nitrogen, 225.3; calcium, 41.1; sulfur, 40.1; phosphorus, 21.1; potassium, 10.9; sodium, 3.15; and magnesium, 1.13. Other elements were (in ug/g mean dry weight): iron, 238; aluminum, 499; zinc, 88.6; strontium, 63.6; manganese, 9.0; barium, 6.0; boron, 5.6; and molybdenum, 3.1 (Weiner et al., 1977).

Locomotion in several species of pocket mice (*Perognathus longimembris*, *Chaetodipus fallax*, *C. formosus*, and *C. californicus*) is quadrupedal at low speeds, with limbs moving alternately. At slightly higher speeds, locomotion shifts to a trot, then to a quadrupedal hop in which the hind limbs move together, as do the front limbs; this pattern is common among rodents, including slowly moving kangaroo rats (*Dipodomys*). When travelling at high speeds in a straight line, pocket mice use a gallop in which the front limbs strike the ground together, after which the hind limbs make contact with the ground at a point ahead of the front limbs. When disturbed, pocket mice leap erratically in unpredictable directions, carrying the animals more than 0.5 m vertically, and 1 m horizontally, a behavior also observed in kangaroo rats. The tail is used as a balancing organ, as in kangaroo rats. When sifting through soil for seeds, the long axis of the body of pocket mice is almost horizontal, and the head is near the ground; other rodents typically sit more nearly vertical, with the head raised. The horizontal position adopt-

ed by pocket mice possibly facilitates foraging and food item manipulation by the front limbs; enlarged hind limbs and a long tail apparently facilitate that style of foraging. The initial stages of bipedalism (such as somewhat enlarged hind limbs and feet, and use of the hind limbs as possibly the sole source of propulsion during high-speed locomotion) are present in pocket mice, and these initial stages may represent adaptations having greater value in facilitating foraging than in enhancing locomotor capabilities. Presumbably, advanced bipedalism as observed in saltatorial rodents such as kangaroo rats represents an adaptation conferring advantages beyond that simply of foraging (Bartholomew and Cary, 1954).

Maximal running speed of *C. fallax* under laboratory conditions averaged 12.8 km/h (range 11.4–14.2) for individuals having body masses of 15.0–21.6 g ($\bar{x} = 18.0$ g). In field tests, maximal running speed averaged 11.4 km/h (range 6.9–15.0 km/h). Speeds of *C. fallax* measured under laboratory conditions did not differ significantly from those of the Bailey pocket mouse (*C. baileyi*, 39.1 g), Great Basin pocket mouse (*Perognathus parvus*, 24.4 g), dark kangaroo mouse (*Microdipodops megacephalus*, 12.3 g), and canyon mouse (*Peromyscus crinitus*, 13.7 g—Djawdan and Garland, 1988).

One lactating and two gravid females were trapped in the San Gabriel Mountains, southern California, in early October (Vaughan, 1954). On an alluvial fan near the base of the San Gabriel Mountains, fecund males were noted in January and February, pregnant and lactating females in April and May, and juveniles were trapped in May, June, and July (MacMillen, 1964). Three lactating females, a gravid female, and two juveniles, were caught in early May. Later, six subadults were trapped between early May and mid-July in Deep Canyon, Riverside County, California. Males having enlarged testes were recorded from February to May (Ryan, 1968).

ECOLOGY. In Deep Canyon, Riverside Co., California, populations of *C. fallax* occurred in a variety of habitats ranging from rocky areas in the Deep Canyon flood plain, to an elevation of approximately 1,000 m on desert slopes of the Santa Rosa Mountains. The highest population densities of *C. fallax* were recorded in two habitats on mountain slopes—the rocky slopes habitat, and the agave-ocotillo (*Agave deserti-Fouquieria splendens*) habitat. The rocky slopes habitat is characterized by a large number of rocks ranging in size from pebbles to boulders, a sandy or gravelly soil, creosote bush (*Larrea divaricata*), indigo bush (*Dalea schottii*), a few barrel cactus (*Echinocactus acanthodes*), and annuals during wet periods. Population density of *C. fallax* in a sample quadrat in this habitat ranged from 36 to 52 mice/ha. Seven species of rodents occurred in this habitat, which exhibited the highest rodent population density, up to 188 rodents/ha, of any habitat in Deep Canyon. In this habitat, populations of *C. fallax* were larger than those of any of the four other species of pocket mice occurring in Deep Canyon—the desert pocket mouse (*C. penicillatus*), the long-tailed pocket mouse (*C. formosus*), the spiny pocket mouse (*C. spinatus*), and the little pocket mouse (*Perognathus longimembris*). In the agave-ocotillo habitat, other plants included creosote bush, cholla (*Opuntia bigelovii*), and at the upper elevational limits, yucca (*Yucca schidigera*), juniper (*Juniperus californica*), and other shrubs. *C. fallax* was second to the desert woodrat in population density in this habitat; other abundant rodents include the canyon mouse, cactus mouse, Merriam kangaroo rat, and white-tailed antelope squirrel (*Ammospermophilus leucurus*). A few *C. fallax* were recorded in the creosote-palo verde (*Larrea divaricata-Cercidium floridum*) habitat on the flood plain of Deep Canyon, and in the pinon-juniper (*Pinus quadrifolia-Juniperus californica*) habitat on slopes immediately above the agave-ocotillo habitat (Ryan, 1968). In accordance with observations on habitat use in Deep Canyon, *C. fallax* was more abundant in rocky situations at a study site in the coastal sage scrub vegetation near Riverside, California than in three other habitats at that site (Price and Kramer, 1984; Price and Waser, 1984).

The abundance of *C. fallax* in a given habitat may be determined in part by the availabiliy of shelter from visually orienting predators. When artificial shelters were placed between shrubs at a site near Joshua Tree, San Bernardino County, California, the abundance of *C. fallax* at that site increased dramatically, as indicated by the increase in number of captures from one capture prior to introduction of the shelters, to 34 afterward. This increase was attributed to the reduced time required by *C. fallax* to move between shelters while foraging, thereby presumably reducing ex-

posure to predation (Thompson, 1982). The abundance of this species in rocky habitats in Deep Canyon, but scarcity in other habitats having fewer rocks, was attributed to the cover provided by rocks even though the quantity of vegetation (and, presumably, food supply) were lower in the rocky habitats (Ryan, 1968).

In the San Gabriel Mountains in eastern Los Angeles County, California, *C. f. fallax* was common only in the coastal sage scrub association. This form was the most common rodent in eroded adobe banks of the foothills, where white sage (*Salvia apiana*) and coastal sagebrush (*Artemisia californica*) were dominant. Other common species of plants in this habitat were black sage (*Salvia mellifera*), California buckwheat (*Eriogonum fasciculatum*), lemonadeberry (*Rhus integrifolia*), prickly pear cactus (*Opuntia occidentalis*), and a composite (*Happlopappus squarosus*). Within this habitat, rodent associates of *C. f. fallax* included the Pacific kangaroo rat, deer mouse, California mouse, cactus mouse, desert woodrat, dusky-footed woodrat, western harvest mouse (*Reithrodontomys megalotis*), and California vole (*Microtus californicus*). Habitats occupied by a different subspecies, *C. fallax pallidus*, on the eastern, desert-facing slopes of the San Gabriel Mountains, include the pinyon-juniper (*Pinus monophylla-Juniperus californica*) woodland association, at an elevation of 1,200 to 1,800 m. Other dominant species of plants in this habitat include scrub oak (*Quercus dumosa*), antelope-brush (*Purshia glandulosa*), California slippery elm (*Fremontia californica*), mountain mahogany (*Cercocarpus ledifolius*), and Spanish bayonet (*Yucca whipplei*). Rodent associates in this habitat include the Pacific kangaroo rat, pinon mouse (*Peromyscus truei*), and dusky-footed woodrat. In the juniper belt (similar to the preceding habitat, but located on the desert slopes and not including pinyon pines), rodent associates of *C. f. pallidus* included Merriam's kangaroo rat, Panamint kangaroo rat (*D. panamintinus*), pinon mouse, deer mouse, desert woodrat, dusky-footed woodrat, and southern grasshopper mouse (*Onychomys torridus*). There was a close correlation between the distribution of *C. f. pallidus* and yucca on the desert slopes of the San Gabriel Mountains, especially on dry rocky southern slopes, whereas there were no *C. fallax* found on adjacent flats, and on north-facing slopes having antelope-brush and scrub oak. This species was almost the only rodent collected on steep rocky southern exposures supporting burro weed (*Franseria dumosa*) and yucca (Vaughan, 1954).

On an alluvial fan near the San Gabriel Mountains, the San Diego pocket mouse was present in low but stable numbers throughout the year, with population densities varying from 0.6 to 3.7 individuals/ha; highest densities occurred from November to March. Males constituted 64% of the individuals captured, and females 36%. Common plants at this site were coastal sagebrush, white sage, California buckwheat, yerba santa (*Eriodictyon californicum*), prickly pear cactus, lemonadeberry, and laurel sumac (*Rhus laurina*). Rodent associates included the desert woodrat, dusky-footed woodrat, California mouse, deer mouse, cactus mouse and Pacific kangaroo rat (MacMillen, 1964).

In the course of a two-year mark-recapture study of *C. fallax* in extreme southern California, population density was highest in spring (March–May), reaching a maximum of 11.2 mice/ha the first spring, and 39 mice/ha in the second spring of the study. Lowest population density was in summer and fall, with a low point of 6 mice/ha in the first year, and 2 mice/ha in the second year. The average population density of the trappable population was 7.4 mice/ha over the two-year period. Reproductive activity was highest in spring, but varied in intensity between the two years: spring of the first year was preceded by a long, cool, and wet winter, and only 17% of males exhibited signs of breeding activity that spring, whereas spring of the second year was preceded by a normal winter, and 71% of males were in breeding condition that spring. Mortality (disappearance from the population) was highest in spring each year; a higher rate of emigration may have contributed significantly to that disappearance rate, as may have increased predation. There was no significant difference in average monthly survival rates between sexes; the average monthly survival rate for both sexes over the entire 24-month study was 0.77. Average longevity (period of residence of an individual on the study area) was 5.4 months for males and 5.0 months for females, and was not significantly different. The greatest longevity (residence) of an individual was 18 months. There was no significant departure from an equal sex ratio; males averaged 0.54 of the trappable population over the course of the study (McClenaghan, 1983).

Although the diet of the San Diego pocket mouse, like that of

most heteromyids, consists largely of seeds, this species may be an effective herbivore under some conditions. In northern Baja California, *C. fallax* and *C. baileyi* were believed to be the cause of extensive cropping of leaves and shoots of *Polygala deserticum*, an herbaceous perennial. The cheek pouches of a hand-captured individual of *C. fallax* contained 86 mg dry weight of material, 14 mg of which were stems and leaves of *Polygala deserticum*. Except for *C. baileyi* no other vertebrates in the area were likely to be the cause of characteristic cropping of this plant. Damage was sufficent to prevent flowering by most plants, and might cause selection among plants for defensive adaptations. Mice may have eaten these plants to obtain amino acids to supplement those obtained in the usual diet of seeds; leaf tissue of *Polygala deserticum* is 3.6% nitrogen, an unusually high concentration (Meehan et al., 1977).

Vaughan (1954) believed the pads of the prickly pear, *Opuntia*, were eaten by this and other rodent species. MacMillen (1964), however, concluded that *C. fallax* did not eat these pads, but that other rodents did.

In La Puerta Valley, San Diego County, California, *C. fallax* was collected with six other species of pocket mice, perhaps the the most extensive sympatry yet reported for pocket mice. The other species were Bailey's pocket mouse (*C. baileyi*), California pocket mouse (*C. californicus*), *C. penicillatus*, *C. formosus*, *C. spinatus*, and *Perognathus longimembris* (von Bloeker, 1932).

This species was not trapped in the San Gabriel Mountains when night temperatures fell below about 5°C. Mice apparently remain underground for weeks at a time during cold weather in December and January in that region (Vaughan, 1954).

The San Diego pocket mouse was trapped in nearly equal numbers by Sherman live traps and Museum Special snap traps (13 and 12 captures, respectively). There was no significant difference in trapping success when Museum Special snap traps were compared with Victor mouse traps, but the sample size was small ($n = 7$—Weiner and Smith, 1972).

Remains of two *C. fallax* were found in the regurgitated pellets of a barn owl, *Tyto alba*, on the northernmost of the Islas Los Coronados, Baja California. *C. fallax* is not resident on those islands, suggesting the owl captured the mice on the mainland, approximately 15 km distant, then flew out to the island (Banks, 1965).

Ectoparasites of *C. fallax* include a mite, *Androlaelaps sinuosa* (= *frontalis*—Furman, 1954, cited in Bassols de B., 1981). There usually is a heavy infestation of mites near the base of the tail (MacMillen, 1964; Vaughan, 1954). Chiggers include *Dermadelema furmani*, *D. mojavense* (Pomeroy and Loomis, 1984), *Euschoengastia ambocalis* (Wrenn and Loomis, 1973), *E. criceticola*, *E. multisetosa* (Loomis and Somerby, 1966), *E. marginalis* (Wrenn and Somerby, 1974), *E. obscura*, *E. simulans* (Wrenn and Loomis, 1974), *Euschoengastoides neotomae*, *E. webbi* (Loomis, 1971), *Hexidionis deserti* (Loomis and Lucas, 1970), *Hyponeocula fovea* (Tanigoshi and Loomis, 1974), *Otorhinophila desertorum*, *O. parvisola*, *O. xerophila* (Loomis and Wrenn, 1973), and a flea *Meringis dipodomys* (Casebeer, 1965).

BEHAVIOR. Individuals of the San Diego pocket mouse from a population near the San Gabriel Mountains in California displayed intraspecific incompatibility, and interspecific intolerance toward sympatric species of rodents when subjected to arena tests; species tested against *C. fallax* were *Neotoma lepida*, *Peromyscus californicus*, *P. eremicus*, *P. maniculatus*, and *Dipodomys agilis*. *C. fallax* was the most subordinate of all rodent species in that community, as indicated by avoidance during the arena tests (MacMillen, 1964).

In laboratory experiments, *C. fallax* preferred seeds of *Salvia columbariae* (Labiatae) and *Lolium* sp. (Graminae) over all other kinds of seeds tested. Seeds of *Cercidium floridum* (Leguminosae) were next in preference, followed by the seeds of a group of three species: *Plantago insularis* (Plantaginaceae), *Hymenoclea salsola* (Compositae), and *Datura meteloides* (Solanaceae). Seeds of *Datura discolor* were least preferred (Hay and Fuller, 1981).

When presented in the laboratory with eight different substrates differing in soil texture, soil-bulk density, and seed dispersion, *C. fallax* selected substrates characterized by coarse, light soil similar to that encountered in its natural environment. The study, which included nine species of heteromyid rodents, indicated a nonrandom use of seed patches by most of the species tested (Price and Longland, 1989).

Estimated home range size was 0.3 ha, based on seven individuals captured an average of 13 times each, and calculated by the exclusive boundary-strip method. There was no difference between sexes in home range size, and little overlap between sexes in home ranges, possibly the result of territoriality. In this study, however, population density of *C. fallax* was low (MacMillen, 1964).

GENETICS. Biochemical variation at 26 loci in 16 individuals of *C. fallax* from five populations in California was as follows: mean number of alleles per locus, 1.346; mean proportion of polymorphic loci per population, 0.105; and mean proportion of loci heterozygous per individual, 0.059. The range of mean values for these three measures for 12 other species of *Chaetodipus* were, respectively, 1.107 to 2.808, 0.071 to 0.276, and 0.022 to 0.096 (data for *C. hispidis*, represented by one individual, are not included here). Estimates of interspecific relationships based on three different analytical techniques indicated the closest relatives of *C. fallax* were *C. californicus* and *C. spinatus*; *C. fallax* was close to *C. arenarius* according to one technique (Patton et al., 1981).

The diploid chromosome number of *C. fallax* is 44, and the fundamental number is 56. There are five pairs of large metacentrics and submetacentrics, one pair of medium metacentrics, one pair of small submetacentrics, and 14 pairs of acrocentrics ranging in size from medium to and including one pair of minute chromosomes. The X chromosome is a medium metacentric, and the Y is a small acrocentric (Patton, 1970).

REMARKS. A phenetic study of the relationships among species of *Chaetodipus* placed *C. fallax* in a group whose other members included *C. nelsoni*, *C. arenarius*, *C. penicillatus*, *C. intermedius*, and *C. anthonyi* (Caire, 1976). Williams et al. (1993) considered *C. anthonyi* Osgood, inhabiting Cedros Island, Baja California, to be a subspecies of *C. fallax*, and their opinion is followed herein. *Chaetodipus* is derived from the Greek *chaeta* meaning long hair or mane; *di* meaning two; and *podos*, meaning feet. The specific epithet is from the Latin *fallax*, meaning deceitful or false (Brown, 1954). I thank Leroy R. McClenaghan, Jr., for reviewing the manuscript. The map was drawn by M. C. Blake.

LITERATURE CITED

ANDRUS, W. D., S. E. STARR, AND R. R. STRATHMANN. 1965. Red cell and plasma sodium and potassium changes in the San Diego pocket mouse during hibernation. Journal of Cellular and Comparative Physiology, 65:415–418.

BANKS, R. C. 1965. Some information from barn owl pellets. Auk, 82:506.

BARTHOLOMEW, G. A., JR., AND G. R. CARY. 1954. Locomotion in pocket mice. Journal of Mammalogy, 35:386–392.

BASSOLS DE B., I. 1981. Catalogo de los acaros Mesostigmata de mamiferos de Mexico. Anales de la Escuela Nacional de Ciencias Biologicas (Mexico), 24:9–49.

BEST, T. L. 1993. Patterns of morphologic and morphometric variation in heteromyid rodents. Pp. 197–235, *in* Biology of the Heteromyidae (H. H. Genoways and J. H. Brown, eds.). Special Publication, The American Society of Mammalogists, 10: 1–719.

BOND, S. I. 1969. Type specimens of mammals in the San Diego Natural History Museum. Transactions of the San Diego Society of Natural History, 15:252–263.

BROWN, R. W. 1954. Composition of scientific words. Smithsonian Institution Press, Washington, D.C., 882 pp.

CAIRE, W. 1976. Phenetic relationships of pocket mice in the subgenus *Chaetodipus* (Rodentia: Heteromyidae). Journal of Mammalogy, 57:375–378.

CASEBEER, R. S. 1965. Seasonal fluctuations in ectoparasite populations of desert rodents. I. Siphonaptera. Bulletin of the Southern California Academy of Sciences, 64:75–88.

DJAWDAN, M., AND T. GARLAND, JR. 1988. Maximal running speeds of bipedal and quadrupedal rodents. Journal of Mammalogy, 69:765–772.

FURMAN, D. P. 1954. A new species of *Androlaelaps* from *Perognathus* in southern California (Acarina: Laelaptidae). Pan-Pacific Entomologist, 30:119–124. (not seen, cited in Bassols de B., 1981)

GRINNELL, J. 1933. Review of the recent mammal fauna of California. University of California Publications in Zoology, 40: 71–234.

HAFNER, J. C., AND M. S. HAFNER. 1983. Evolutionary relationships of heteromyid rodents. Great Basin Naturalist Memoirs, 7:3–29.

HALL, E. R. 1981. The mammals of North America. Second ed. John Wiley & Sons, New York, 1:1–600 + 90.

HAY, M. E., AND P. J. FULLER. 1981. Seed escape from heteromyid rodents: the importance of microhabitat and seed preference. Ecology, 62:1395–1399.

HILL, J. E. 1935. The cranial foramina in rodents. Journal of Mammalogy, 16:121–129.

HINDS, D. S., AND R. E. MACMILLEN. 1985. Scaling of energy metabolism and evaporative water loss in heteromyid rodents. Physiological Zoology, 58:282–298.

HUEY, L. M. 1959. Longevity notes on captive Perognathus. Journal of Mammalogy, 40:412–415.

———. 1960. Comments on the pocket mouse, Perognathus fallax, with descriptions of two new races from Baja California, Mexico. Transactions of the San Diego Society of Natural History, 12:413–420.

HULBERT, A. J., D. S. HINDS, AND R. E. MACMILLEN. 1985. Minimal metabolism, summit metabolism and plasma thyroxine in rodents from different environments. Comparative Biochemistry and Physiology, 81A:687–693.

KAUFMAN, D. W., G. A. KAUFMAN, AND J. G. WIENER. 1975. Energy equivalents for sixteen species of xeric rodents. Journal of Mammalogy, 56:946–949.

KELLY, T. S. 1969. The comparative morphology of the male phallus in the genus Dipodomys. M. S. thesis, San Fernando Valley State College, Northridge, California, 133 pp.

LOOMIS, R. B. 1971. The genus Euschoengastoides (Acarina: Trombiculidae) from North America. Journal of Parasitology, 57:689–707.

LOOMIS, R. B., AND J. L. LUCAS. 1970. A new subgenus and two new species of Hexidionis (Acarina, Trombiculidae) from North America. Bulletin of the Southern California Academy of Sciences, 69:52–59.

LOOMIS, R. B., AND R. E. SOMERBY. 1966. New species and new records of Euschoengastia (Acarina, Trombiculidae) from western Mexico. Bulletin of the Southern California Academy of Sciences, 65:211–224.

LOOMIS, R. B., AND W. J. WRENN. 1973. The North American genus Otorhinophila Wrenn and Loomis (Acarina: Trombiculidae), with the descriptions of three new species. Journal of Parasitology, 59:175–182.

MACMILLEN, R. E. 1964. Population ecology, water relations, and social behavior of a southern California semidesert rodent fauna. University of California Publications in Zoology, 71:1–59.

MACMILLEN, R. E., AND D. S. HINDS. 1983. Water regulatory efficiency in the heteromyid rodents: a model and its application. Ecology, 64:152–164.

McCLENAGHAN, L. R., JR. 1983. Notes on the population ecology of Perognathus fallax (Rodentia: Heteromyidae) in southern California. The Southwestern Naturalist, 28:429–436.

MEARNS, E. A. 1901. A new pocket mouse from southern California. Proceedings of the Biological Society of Washington, 14:135–136.

MEEHAN, T. E., P. W. RUNDEL, R. AMBROSE, G. BAKER, AND A. RAPPAPORT. 1977. The influence of intense selective browsing by pocket mice (Perognathus) on the spatial distribution of Polygala deserticum in Baja California. The American Midland Naturalist, 97:489–495.

MERRIAM, C. H. 1889. Preliminary revision of the North American pocket mice (Genera Perognathus et Cricetodipus auct.) with descriptions of new species and subspecies and a key to the known forms. North American Fauna, 1:1–29.

NELSON, E. W., AND E. A. GOLDMAN. 1929. Six new pocket mice from Lower California and notes on the status of several described species. Proceedings of the Biological Society of Washington, 42:103–112.

OSGOOD, W. H. 1900. Revision of the pocket mice of the genus Perognathus. North American Fauna, 18:1–73.

PATTON, J. L. 1970. Karyotypes of five species of pocket mice, genus Perognathus (Rodentia: Heteromyidae), and a summary of chromosome data for the genus. Mammalian Chromosomes Newsletter, 11:3–8.

PATTON, J. L., S. W. SHERWOOD, AND S. Y. YANG. 1981. Biochemical systematics of chaetodipine pocket mice, genus Perognathus. Journal of Mammalogy, 62:477–492.

POMEROY, L. V., AND R. B. LOOMIS. 1984. A new genus of trombiculine chiggers (Acari:.Trombiculidae) from western North America. Journal of Medical Entomology, 21:268–273.

PRICE, M. V., AND K. A. KRAMER. 1984. On measuring microhabitat affinities with special reference to small mammals. Oikos, 42:349–354.

PRICE, M. V., AND W. S. LONGLAND. 1989. Use of artificial seed patches by heteromyid rodents. Journal of Mammalogy, 70:316–322.

PRICE, M. V., AND N. M. WASER. 1984. On the relative abundance of species: postfire changes in a coastal sage scrub rodent community. Ecology, 65:1161–1169.

RYAN, R. M. 1968. Mammals of Deep Canyon, Colorado Desert, California. The Desert Museum, Palm Springs, California, 138 pp.

SUMNER, F. B., AND H. H. COLLINS. 1918. Autotomy of the tail in rodents. Biological Bulletin, 34:1–6.

TANIGOSHI, L. K., AND R. B. LOOMIS. 1974. The genus Hyponeocula (Acarina, Trombiculidae) of western North America. Melanderia, 17:1–27.

THOMPSON, S. D. 1982. Structure and species composition of desert heteromyid rodent species assemblages: effects of a simple habitat manipulation. Ecology, 63:1313–1321.

VAUGHAN, T. A. 1954. Mammals of the San Gabriel Mountains of California. University of Kansas Publications, Museum of Natural History, 7:513–582.

VON BLOEKER, J. C., JR. 1932. New locality records for Perognathus baileyi from California. Journal of Mammalogy, 13:279–280.

WEBSTER, D. B., AND M. WEBSTER. 1975. Auditory systems of Heteromyidae: functional morphology and evolution of the middle ear. Journal of Morphology, 146:343–376.

———. 1977. Auditory systems of Heteromyidae: cochlear diversity. Journal of Morphology, 152:153–170.

WEINER, J. G., AND M. H. SMITH. 1972. Relative efficiencies of four small mammal traps. Journal of Mammalogy, 53:868–873.

WEINER, J. G., D. W. KAUFMAN, G. A. KAUFMAN, J. B. GENTRY, M. H. SMITH, AND P. R. RAMSEY. 1977. Chemical composition of rodents: use of whole body concentrations for estimation of standing crops of elements. The Southwestern Naturalist, 22:77–88.

WILLIAMS, D. F., H. H. GENOWAYS, AND J. K. BRAUN. 1993. Taxonomy. Pp. 38–196, in Biology of the Heteromyidae (H. H. Genoways and J. H. Brown, eds.). Special Publication, The American Society of Mammalogists, 10:1–719.

WOOD, A. E. 1931. Phylogeny of the heteromyid rodents. American Museum Novitates, 501:1–19.

WRENN, W. J., AND R. B. LOOMIS. 1973. A new species of Euschoengastia (Acarina: Trombiculidae) from western North America, and the status of E. californica (Ewing). Journal of Medical Entomology, 10:97–100.

———. 1974. The Euschoengastia radfordi species complex (Acarina: Trombiculidae) from western North America, with descriptions of five new species. Annals of the Entomological Society of America, 67:241–256.

WRENN, W. J., AND R. E. SOMERBY. 1974. Descriptions of two new species of Euschoengastia (Acarina: Trombiculidae) from California and Baja California Norte, Mexico. Bulletin of the Southern California Academy of Sciences, 73:5–8.

J. A. LACKEY, DEPARTMENT OF BIOLOGY, STATE UNIVERSITY OF NEW YORK, OSWEGO, NEW YORK 13126.