

Dipodomys stephensi. By Vernon C. Bleich

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Dipodomys stephensi (Merriam, 1907)

Stephens' Kangaroo Rat

Perodipus stephensi Merriam, 1907:78. Type locality San Jacinto Valley, Riverside Co., California. More precisely, a little west of the present town of Winchester, toward Menifee (Grinnell, 1922).

Dipodomys stephensi, Grinnell, 1921:95. First use of current name combination.

Dipodomys cascus Huey, 1962:479. Type locality 1 mi. E Bonsall, 350 ft., San Diego Co., California.

CONTEXT AND CONTENT. Order Rodentia, Family Heteromyidae, Subfamily Dipodominae. *Dipodomys stephensi* is monotypic.

DIAGNOSIS. The size is medium for the genus; five toes are present on the hind foot; the tail is 1.45 times the length of head and body, bicolored, and crested. *D. stephensi* is similar externally to *D. agilis*, the geographic distribution of which partly coincides with that of *stephensi*. *D. stephensi* differs from *agilis* in having: a relatively wider head; broader arietiform markings; dusky rather than dark soles on the hind feet; few rather than many white hairs in the tail tuft; many hairs in the dorsal and ventral tail stripes having white bases (giving the stripes a grizzled appearance); narrow lateral white tail stripes indistinctly demarcated from the dark stripes, rather than broad, sharply demarcated lateral stripes; ear averaging 15 mm rather than 17 mm in length.

Distinguishing cranial (figure 1) characters include: the auditory bullae, which are "elongate globose" when viewed from above, and are as wide as the skull when viewed from behind (see Grinnell, 1922: pls. 4 and 6); the foramen magnum, which has a rounded dorsal perimeter (in most specimens of *agilis* the dorsal perimeter is angular); the broad posterior jugal base, which is craniomedially directed (in *agilis* the jugal base is narrow and cranially directed); and the medially curved extreme caudal portion of the suture between each nasal and premaxilla lateral to it (in *agilis*, this suture is straight in the caudal portion).

GENERAL CHARACTERS. External measurements of adults (in millimeters) are: total length, 277 to 300; length of tail, 164 to 180; length of hind foot, 39 to 43; length of ear (from notch), 13 to 16. Size is medium for a kangaroo rat; adult weight averages 67.26 g (eight males, six females). Grinnell (1922) and Lackey (1967a) provided detailed morphological data.

DISTRIBUTION. The known geographic distribution of *D. stephensi* includes the San Jacinto Valley and adjacent areas of western Riverside, southwestern San Bernardino, and northwestern San Diego counties (figure 2). *D. stephensi* recently was reported from Fallbrook, San Diego County (Bleich and Schwartz, 1974). The altitudinal distribution ranges from 85 m near Fallbrook (Bleich, 1973) to 610 m in Bautista Canyon, Riverside County (Thomas, 1973).

FOSSIL RECORD. Miller (1971) reported specimens of a *Dipodomys* species similar to *stephensi* from the Pleistocene deposits of Costeau Pit, Orange Co., California.

FORM AND FUNCTION. Lackey (1967a) described and discussed cranial morphology of *stephensi*. Best and Schnell (1974) and Lackey (1967a) illustrated the baculum of *stephensi*, and discussed taxonomic implications.

Sork (1973) concluded that *stephensi* was capable of surviving without water, but after 40 days of deprivation mean body weight had dropped 15%. Mean urine osmolarities ranged from 800 to 3300 for field-caught animals; after exposure to various water regimens they ranged from 1100 to 3400. Sork's (1973:191) *ad libitum* water consumption data are difficult to interpret.

Futcher (1974) reported the only electrophoretic data available for the taxon.

ONTOGENY AND REPRODUCTION. Available data suggest a breeding season in late spring and early summer. Pregnant and lactating females, and males having scrotal testes, were reported for June and July (Lackey, 1967b; Bleich, 1973). Average litter size is 2.5, based on Lackey's (1967b) data.

The following descriptions of growth and development are based on Lackey's (1967b) observations. Average tail length of

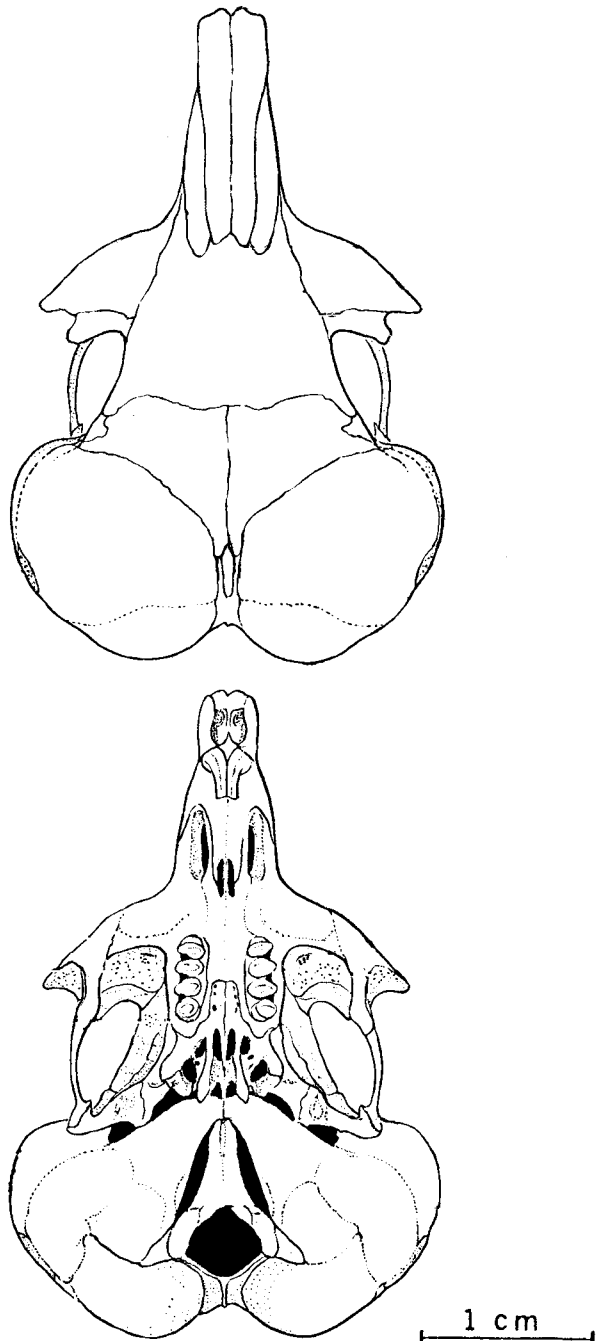


FIGURE 1. Dorsal and ventral views of the cranium of *Dipodomys stephensi*. Modified from Lackey (1967a).

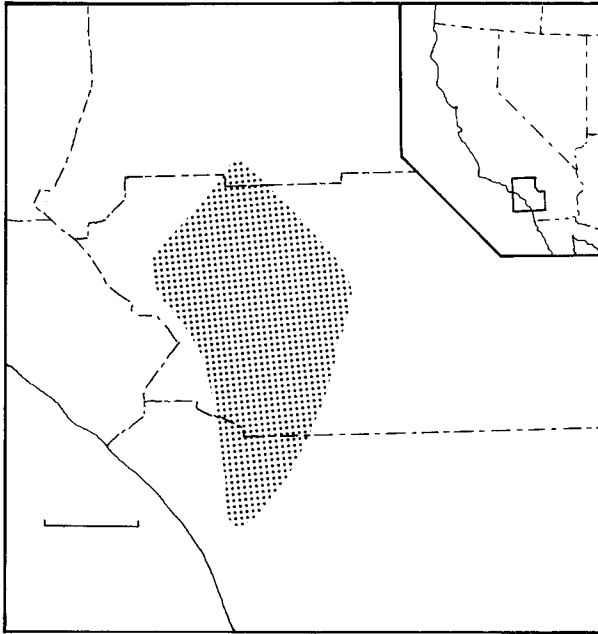


FIGURE 2. Geographic distribution of *Dipodomys stephensi* in southern California. Scale at lower left represents 25 km. Inset shows California and surrounding regions with the location of larger-scale distribution.

16 neonates was 17.7 mm (15 to 20 mm); body length averaged 40 mm (37 to 44 mm); mean hind foot length was 10.8 mm (10 to 12 mm), and ear length was 2 mm for all animals. The mean weight at birth was 4.4 g (3.8 to 4.7 g).

Neonates were naked and pink. A gray pigmentation developed on the dorsal surfaces of the head, body, and tail by day 2 or 3, obscuring skull sutures by day 4 or 5. The pelage was dark olive brown on the dorsal and lateral surfaces of the body by day 9. Molt commenced at approximately month 3.

The eyes generally opened on day 14, and the auditory meatus opened on day 10 or 11. Incisors erupted on day 8 or 9. Vibrissae were 5 mm long at birth. No measurable development of the cheek pouch had occurred by day 10. Adult size of the cheek pouch was attained by day 40. At day 63, the following percentages of the adult values were reached: tail length, 87; body length, 90; hind foot, 96; ear, 96; weight, 70.

ECOLOGY. The close association between *Dipodomys stephensi* and sparsely vegetated habitats has been well documented (Grinnell, 1933; Lackey, 1967a; Bleich, 1973; Bontrager, 1973; Thomas, 1973; Bleich and Schwartz, 1974; Thomas, 1975). Pequegnat (1951) found *stephensi* in a mixture of sagebrush and annual grasslands in the Santa Ana Mountains. Bleich (1973) captured *stephensi* in the Annual Grassland Community, and in the *Haplopappus* Association of the Coastal Sage Scrub Community; these habitats are characterized by sparse perennial vegetation. Bontrager (1973) reported *stephensi* from the annual grassland plant formation on the Santa Rosa Plateau, Riverside County. Lackey (1967a) found *stephensi* in open types of habitat, taking only a few specimens in light chaparral immediately adjacent to a field in which that species was abundant. Bleich (1973), Bontrager (1973) and Thomas (1975) in particular provide quantitative habitat descriptions in terms of vegetative analysis.

Stephens' kangaroo rat is restricted to gravelly soils in the Santa Ana Mountains (Pequegnat, 1951). Near Fallbrook, *stephensi* was found on soils containing high percentages of granule gravel (Bleich, 1973). Lackey (1967a) reported *stephensi* from habitats having soils neither extremely dense nor largely sand. Bontrager (1973) found *stephensi* most abundantly in areas having extremely sandy soil. Bleich (1973) and Thomas (1975) hypothesized that soil types or vegetation density, or a combination of the two, may be ecological factors limiting the distribution of *stephensi*.

Few population data are available. During summer, population density in the Annual Grassland Community and the *Haplopappus* Association of the Coastal Sage Scrub Community was 7.5 and 33.8 per hectare (ha), respectively (Bleich, 1973; Bleich and Schwartz, 1974). Sork (1973) reported a mean monthly density from October to May of approximately 11 per ha. Thomas (1975) obtained summertime estimates of 40.4 and 57.5 per ha for two localities in Riverside County.

Individual home ranges of *stephensi* varied from about 420 m² to nearly 1600 m² (Thomas, 1975). Mean home range sizes for two populations in Riverside County were 570 m² and 970 m². Thomas (1975) noted an inverse relationship between population density and mean home range size.

Bleich (1973) found *Peromyscus maniculatus* to be the only rodent occurring microsympatrically with *stephensi*, although other rodent species do so (Bontrager, 1973; Sork, 1973). Grinnell (1922), Lackey (1967a), and Thomas (1973, 1975) occasionally took both *stephensi* and *agilis* in the same trapline; however, when taken together on open ground, *stephensi* was more numerous.

Thomas (1975) noted that *stephensi* commonly inhabited previously disturbed areas, and offered explanations for this observation. He also speculated that *stephensi* utilizes old pocket gopher (*Thomomys bottae*) burrows. Pellet analyses suggest that barn owls (*Tyto alba*) and long-eared owls (*Asio otus*) are important predators of *stephensi* (Bleich and Schwartz, unpublished data; D. T. Wright, unpublished data).

Agricultural development of the low-lying lands of the San Jacinto Valley and vicinity has destroyed much of the preferred habitat of *stephensi*. For this reason, the California Fish and Game Commission declared *stephensi* a "rare" species, thereby authorizing complete protection. Thomas (1975) supported this classification: "The extensive habitat loss throughout the range of *D. stephensi* . . . has resulted in only isolated populations of the animal. These populations occupy small areas and are vulnerable to habitat loss."

BEHAVIOR. In captivity, pregnant females built elaborate nests up to a week before parturition (Lackey, 1967b). The following descriptions of behavioral development are also from Lackey (1967b). When disturbed, young *stephensi* up to day 10 made a rapid, high-pitched squeaking sound. At day 9, before the eyes opened, they crawled about outside the nest. Scratching behind the ear with the hind foot occurred as early as day 9; however, this usually did not occur until day 13. Face washing attempts were concurrent. Cheek pouches were first observed in use on day 19; most individuals used them on day 21 or 22. Lettuce was first eaten on day 15; dry food was eaten on day 22. Weaning occurred between day 18 and 22. "Boxing" behavior was first observed between siblings at day 30.

There is little information on the behavior of *stephensi* under field conditions. They are nocturnal, preferring "open" types of habitat as noted above. Stock (1974) noted that male *stephensi* were attacked by estrous female *agilis* when placed together.

GENETICS. *D. stephensi* has a diploid chromosome number of 70 (Stock, 1974; Futcher, 1974). Stock (1974) considered five autosome pairs to be submetacentric, five subtelocentric, and 24 acrocentric. Futcher (1974) considered 10 autosomes to be metacentric, 26 acrocentric, and 32 subjective as to classification. The X-chromosome is submetacentric according to Stock (1974), and metacentric according to Futcher (1974). Stock (1974) considered the Y-chromosome acrocentric, whereas Futcher (1974) considered it metacentric. Discrepancies between the findings of Futcher (1974) and Stock (1974) possibly reflect the presence of minute or small arms ("rabbit ears") on many chromosomes (Futcher, 1974), making karyotypes difficult to interpret.

REMARKS. The relationship of *stephensi* to other kangaroo rats has been discussed by several authors. Grinnell (1922) placed *stephensi* in the *heermanni* group together with *heermanni*, *panamintinus*, and *ingens*. Utilizing bacular form, Burt (1936) grouped *stephensi* with *heermanni*, *panamintinus*, *ingens*, *agilis*, and *ordii*. Setzer (1949) placed *stephensi* with *panamintinus* in the *panamintinus* group. Lidicker (1960) placed *stephensi* in a newly created subgroup A of the *heermanni* group, along with *heermanni*, *ingens*, *panamintinus*, and *gravipes*.

On the basis of cranial measurements, bacular morphology, and various ecological similarities, Lackey (1967a) allied *stephensi* with *heermanni*; characteristics of the baculum of *stephensi* suggested a closer relationship to *gravipes* than to *panamintinus*.

Using sophisticated clustering techniques, Best and Schnell (1974) estimated phenetic similarities among the bacula of various kangaroo rats. On this basis, they included *stephensi* in "cluster 1" along with *ordii*, *ingens*, *gravipes*, *heermanni*, *elator*, and *ornatus*.

Stock's (1974) recent karyological study suggested that *stephensi* and *gravipes* are closely related. Utilizing similar methods, Futcher (1974) concluded that "*Dipodomys stephensi* is a distinct, well differentiated species, and is not immediately related to *D. heermanni* or *D. panamintinus*, as has been suggested by several authors."

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