Peromyscus eremicus. By Rita Veal and William Caire

Published 8 June 1979 by the American Society of Mammalogists

Peromyscus eremicus (Baird, 1858) Cactus Mouse

Hesperospermum eremicus Baird, 1858:479. Type locality “Fort Yuma, California,” Imperial County, on Colorado River, opposite S. Arizona.

Hesperospermum (Vesperimus) anthonyi Merriam, 1887:5. Type locality Camp Apache, Big Hatcha Mountains, Hidalgo County, New Mexico.

Vesperomys merriami Miller, 1892:261. Type locality Dulzura, San Diego County, California.

Sitomys harrisi Rhoads, 1893:832. Type locality Reche Canyon, San Bernardino County, California.

Peromyscus tiburonensis Means, 1897:270. Type locality Tiburon Island, Gulf of California, Sonora, Mexico.

Peromyscus cedrosensis J. A. Allen, 1898:154. Type locality Cedros (=Cedros) Island, Baja California.

Peromyscus homochroia Elliot, 1903:158. Type locality San Quintin, Baja California.

CONTEXT AND CONTENT. Order Rodentia, Family Muridae, Subfamily Cricetinae, Subgenus Haplorhynychus. Fifteen subspecies of P. eremicus are presently recognized of which eight are known only from their type localities and are indicated below with an asterisk (*). (Hall and Kelso, 1959; Anderson, 1972; Lawlor, 1971:a, b).

P. e. eremicus (Baird, 1858:479), see above (arenarius Means is a synonym).

P. e. anthonyi (Merriam, 1887:5), see above.

P. e. franciscanus (Miller, 1892:261), see above (harrisi Rhoads, nigrellus Rhoads, and homochroia Elliot are synonyms).

*P. e. tiburonensis Means, 1897:270, see above.

*P. e. cedrosensis J. A. Allen, 1898:154, see above.

P. e. phaeus Osgood, 1900:75. Type locality Hacienda la Parada, San Luis Potosi.

*P. e. avitus Osgood, 1909:247. Type locality Cerralbo Island (=Cerralbo Island), Gulf of California, Baja California.

*P. e. insulicola Osgood, 1909:246. Type locality Espiritu Santo Island, Gulf of California, Baja California.

*P. e. polypolius Osgood, 1909:248. Type locality Margarita Island, off the west coast of southern Baja California.

P. e. papagenis Goldman, 1917:110. Type locality Sierra Pina cate, Sonora.

*P. e. cinereus Hall, 1931:87. Type locality SW end San Jose Island, latitude 25°N, Baja California.

*P. e. collartis Burt, 1932:172. Type locality Turners Island, lati tude 28°19′ W, Gulf of California, Sonora.

*P. e. pulius Blossom, 1933:53. Type locality Black Mountain, 10 mi. S Tucson, Pima County, Arizona.

P. e. alcorni Anderson, 1972:341. Type locality 11 mi. NNW San Buenaventura, Chihuahua, Mexico.

P. e. sinaoensis Anderson, 1972:542. Type locality 26 mi. NE Choix, Sinaloa, Mexico.

DIAGNOSIS. Peromyscus eremicus occurs sympatricly with four other species of the subgenus Haplorhynychus (P. californicus, P. crinitus, P. eva, and P. merriami) and with two members of the boyil species group (P. pectoralis and P. boyiil). Because of broad overlap of species ranges and extensive geographic variation in most characters of P. eremicus and other species of Peromyscus, the diagnostic characters at one locality may not be diagnostic at another locality. To insure proper identification a combination of characters are needed.

The best characters to distinguish males of P. eremicus from males of other sympatric Peromyscus are: baculum relatively short, broad (8.2 x 1.8 mm; Burt, 1960), and dorsally curved; base squarish and very small; cartilaginous tip diffuse; phallus small, broad, and with no lappets on glans; all male accessory reproductive glands present (Lawlor, 1971b).
DISTRIBUTION. The distribution of Peromyscus eremicus is shown in figure 3. Peromyscus eremicus is common in desert shrub and riparian habitats throughout the southwestern United States, north-central Mexico, and Baja California. Insular records of the species include Cedros, Margarita, and Magdalena islands off the western coast of Baja California, and Cerralbo (=Cerralvo), Esiritu Santo, San José, and Tiburón islands, located in the Gulf of California (Caire, 1978; Hall and Kelson, 1959; Lawlor, 1971b). Gennaro (1969) suggested that the lower average annual temperature and/or the lack of mesquite (Prosopis juliflora) might limit the northern expansion of P. eremicus in the Rio Grande Valley of New Mexico. Southern limits of the range of P. eremicus coincide with the terminus of the Mexican highlands in central Mexico. Peromyscus eremicus have been taken from elevations of 35 m (Cockrum, 1960) to elevations of 2130 m (Hall, 1946).

FOSSIL RECORD. According to Tammitt (1957), the subgenus Haplotomys had a much wider distribution during the late Tertiary than at present. Martin (1968) referred one fossil mandible from the late Pleistocene deposits near Friesenhahn Cave, Bexar County, Texas, to P. cf. eremicus because the 3 was notably reduced. A possible close relationship between P. e. eremicus and the Pleistocene P. nesodytes from Santa Rosa Island, Santa Barbara County, California, has been suggested by Wilson (1936).

FORM. The hooved apparatus of P. eremicus has been described by Sprague (1941). The basihyal is flattened and little arched, and resembles that of Onychomys leucogaster. The entoglossal process of the basihyal is weakly developed, but the shoulders are prominent. The thyrohyals have noticeable flares and slightly developed trochanters. The spatulate-shaped ceratohyalys are well developed.

Hooper (1957) described the dental pattern of P. eremicus as being simple and tending to lack accessory styles and lophs. If accessory cusps occur, they are often a mesostyle in the upper molars, and an ectostyloid in the lower molars. The styles and stylos are less prominent than those in the species of the subgenus Peromyscus, which have more complex dental patterns. The second tooth in each jaw is simpler than the first.

Rinker (1963) compared the musculature of P. eremicus, P. leucopus, and Ochrotomys nuttalli. The following muscles of P. eremicus were structurally different from those of P. leucopus and O. nuttalli: pectoralis minor, gracilis anterior, adductor longus, adductor brevis, quadratus femoris, flexor digitorum tibialis, abductor ossis metatarsi V, and flexor hallucis brevis.

Hooper (1938) described the phallicus of P. eremicus as having a vase-shaped glans, the body of which is covered with stubby spines; lappets are lacking; and the terminus of the glans consists of folds of soft nonspiny tissue. Blair (1942) and Hooper (1958) briefly described the baculum of P. eremicus.

Peromyscus eremicus lacks internal cheek pouches and has a mean lens weight of 17.4 mg (King, 1966). Rinker (1960) and Manville (1961) reported the presence of the entepicondylar foramen in the humerus of P. eremicus.
FUNCTION. Ogunsua et al. (1971) studied the adrenal steroid biosynthesis of *P. eremicus*. Peterson (1968) analyzed the blood serum patterns of *P. eremicus* by electrophoresis. The albumin mobility had a value of 0.6 and was monomorphous by serum electrophoresis (Brown and Weber, 1968). King and Vestal (1974) found the minimum visual angle of *P. eremicus* to be 6.6 ± 0.4 minutes of arc at 20 cm distance. Postcaudal cutaneous papillae of *P. eremicus* function in the halting of the estrous cycle and in triggering a functional luteal phase (Dewsbury and Estep, 1975).

Water requirements, body temperature, and metabolism of *P. eremicus* have been studied in relation to adaptations to desert living by Lindborg (1932), Murie (1961), McNab and Morrison (1963), MacMillen (1964, 1965), and Morhardt and Hudson (1966). Murie (1961) reported *P. eremicus* to have a 10 to 20% lower metabolic rate and to resort to salvia spreading for evaporative cooling at high temperatures less readily than *P. maniculatus*. Taste discrimination by *P. eremicus* for different concentrations of glucose has been studied by King (1968). Huestis (1969) described the microscopic hair characters, and Collins (1923) discussed the juvenile and postjuvenile pelage phases of *P. e. fraterculus*.

REPRODUCTION AND ONTOGENY. Fertilization and implantation in *P. eremicus* have not been investigated. The recorded gestation time for a non-lactating female is 21 days (Svihla, 1923). Ossification of the embryo occurs in a cranio-caudal sequence, and the skeletal growth indices of the embryos are similar to those of the adult (Van de Graaff, 1973). The calcaneus and the bony elements of the pes do not ossify prematurely (Van de Graaff, 1973).

Average litter size has been reported to vary from 2.2 (N = 14, Brand and Ryckman, 1968) to 2.8 (N = 372, Drickamer and Vestal, 1973). Davis and Davis (1947) found a mean litter size of 2.4 (N = 404), and noted that the number of young increased with each successive litter, up to the fifth or sixth, and then decreased. Drickamer and Vestal (1973), however, found no significant change in litter size in successive litters of females. Hall (1946), Lewis (1972), and Svihla (1932) have also presented data on litter size. Davis and Davis (1947) gave a sex ratio of 64 males to 57 females (41 litters), while Brand and Ryckman (1968) reported 13 males to 17 females from 14 litters. Moor (1968) suggested that *P. eremicus* is probably reproductively active throughout the year in the lower desert areas but that reproduction is curtailed during the hot dry periods of summer. Lewis (1972) trapped males and females in breeding condition throughout the year with March through April appearing to be the peak breeding season. Under laboratory conditions, Drickamer and Vestal (1973) noted a seasonal breeding pattern of spring through autumn with a peak occurring during the months of increased day length. MacMillen (1964) proposed a seasonal reproductive cycle for males of *P. eremicus*. He trapped only males with atrophied testes in October and November, but caught males with increasing testicular size from December through February, and found males with the most fully developed gonads from March through September. MacMillen (1964) suggested that females that become pregnant to lactating have a parturient estrus and a prolongation of gestation; this would explain the occurrence of pregnant and lactating females during the nonreproductive period of males.

Svihla (1932) reported a mean neonate weight of 2.5 g (range, 2.1 to 2.9) which was 13% of the adult weight, and Brand and Ryckman (1968) gave a mean neonate weight taken within 24 hours of birth as 2.23 g (range, 1.85 to 2.60) which was 11.1% of the mean adult weight. The naked young are pink except for a pigmented dorsal and usually have complete gray and black pelage after 14 days (Eisenberg, 1968). Collins (1923) and Dice (1939) discussed pelage phases of *P. eremicus*. According to Brand and Ryckman (1968), the postjuvenile molt begins between the 34th and 35th day. Neonates of *P. eremicus* move very little until about six days of age and emit an abandoned cry which is scarcely audible and which disappears after the eyes are open and the young gain coordinated locomotion (Eisenberg, 1968). Svihla (1932), Layne (1968), and Brand and Ryckman (1968) reported that the eyes opened on the average at 15.5 (15 to 17), 12.8 (10 to 15), and 11 to 15 days, respectively. Svihla (1932) stated that the pinnar elevated in less than one day. Brand and Ryckman (1968) reported that the external auditory meatus opened between 9 and 11 days, and found the upper and lower incisors to erupt through the gums at an average of 2.7 days (three litters). Brand and Ryckman (1968) and Eisenberg (1968) noted that the young of *P. eremicus* were weaned at 20 to 22 days, but King (1963) reported a weaning age of 44 days.

Lewis (1972) trapped lactating and pregnant females of subadult age. In laboratory colonies, Clark (1938) reported the average age at first estrus to be 39.2 ± 1.3 days, the earliest age at first estrus to be 28 days, and the earliest age for conception to be 58 days. Davis and Davis (1947) listed the average age at first conception as 10 months, with 50 days (average) between litters. Several females showed an interval of only 28 to 30 days between litters which was followed by a rest of several months (Davis and Davis, 1947). This suggested a parturient estrus to Brand and Ryckman (1968), who found similar results. Dewsbury et al. (1977) discuss the estrous cycle of *P. eremicus*.

ECOLOGY. *Peromyscus eremicus* inhabits a number of ecological associations. For example, individuals have been taken from the mesquite-grass, malpais lava, and desert mountain range associations of New Mexico (Blair, 1943; Findley et al., 1975); the rock hill, *Tamias*, and desert plain associations of Arizona (Lewis, 1972; Cahalane, 1939); the coastal sage scrub association and desert slopes of the San Gabriel Mountains in California (Vaughn, 1954); the creosote and desert shrub associations of southern Nevada (Bradley and Maurer, 1973); the thorn forest, short tree forest, and desert shrub associations of Sonora, Mexico (Caire, 1978); the desert shrub association of the Pecos Texas area (Davis, 1966); riparian associations of Utah (Long, 1940); and the desert shrub associations of Durango and San Luis Potosí, Mexico (Baker and Greer, 1962; Dalquest, 1953). Caloric mice inhabit many situations at some localities (Davis, 1966; Vaughn, 1954; Blair, 1943; Lewis, 1972; MacMillen, 1964; Cahalane, 1959), but show a preference for sandy substrates (Dalquest, 1953; Cahalane, 1939; Baker and Greer, 1962; MacMillen, 1964) and loamy soils (Lewis, 1972; Long, 1940) at others. Findley et al. (1975) found *P. eremicus* to be restricted in varying degrees to the south-facing slopes of mountains during the winter months in New Mexico.

Cactus mice have been trapped along brush fences at Fort Lowell, Arizona, in open fields at Fairbank, Arizona, and Opoponax, Mexico, around buildings at San Bernardino Ranch, Arizona (Allen, 1899), in stone walls near Bledos, Mexico (Dalquest, 1953), in brush and brush fencelines in the Papago Indian reservation, in Polygonum alternativo near Sonoyta and Quitobaquito, Sonora (Caire, 1978), and in the stick nests of *Neotoma fasciata mexicana* in California (Gander, 1929). Cactus mice have been found nesting in rock heaps and subterranean cavities (Woods, 1972) and stone walls (Dalquest, 1953) adjacent to the base of mesquites (Cahalane, 1939), and in the abandoned burrows of gophers and kangaroo rats (Caire, 1978). The nests of *P. eremicus* were found in the brush fences near Sonoyta and Quitobaquito were of grass, stems, and feathers. Adult males have been observed foraging in mesquite and hackberry trees (Davis, 1966).

Meserve (1976) described the diet of *P. eremicus* as consist-
ing primarily of fruit and flowers of shrubs. Seeds, insects, and
green vegetation are consumed in varying amounts depending
on seasonal abundance (Bradley and Man 1973; Meserve 1975).
Most of its diet consists of seeds of various desert annuals
(Dalquest 1953; Davis 1963), with mesquite beans, hickory
nuts, insects, and green vegetation comprising the remainder
(Davis 1963). Insects were found to be important in the diet of
P. eremicus by Reichman (1975) and Reichman and Van de Graaf
(1973a).

Two skulls of P. eremicus were recovered from pellets of
barn owls (Tyto alba) from Sonora, Mexico (Bradshaw and Hay-
ward, 1960), and the screech owl (Otus asio) was observed preying
upon cactus mice by Miller and Stebbins (1964). Dice and Bloss-
som (1937) reported a king snake killing and swallowing a cactus
mice.

Peromyscus eremicus is parasitized by the nematode Gony-
lonema peromysci, 15 species of mites, 9 species of chiggers,
4 species of ticks, 17 species of fleas, and 2 species of biting
lice (Anoplura) (Whitaker, 1968; Wrenn and Loomis, 1974). Over
half of the cactus mice trapped by Dalquest (1953) in San Luis
Potosi, Mexico, had large hot fly larvae under the skin of their
sides, backs, or between their shoulders.

Duran and Sanz (1973) found P. eremicus more susceptible
to being trapped than Perognathus amplus, Neotoma albigena, and
Peromyscus maniuscalus, and noted that males were cap-
tured more frequently than females. Snap traps captured more
individuals than live traps. Lewis (1965) suggested that mice
generally tend to wander, thus making them more suscepti-
ble to trapping. Cactus mice have been trapped using these
baits: rolled oats, sunflower seeds, whole grains, and a peanut
bread mixture (Davis, 1966; Lewis, 1972). MacMillen (1964) and
Reichman and Van de Graaf (1973a) found the fre-
cuency of capture to be greater in areas of dense vegetation
than in areas of sparse vegetation. Bradley and Mauer (1973)
suggested that the food density and density of P. eremicus in desert
scrub communities increases with an increase in the cover area
density of vegetation.

In a California rodent community, M'Closkey (1972) found
P. eremicus to have a low and relatively stable population. In
Arizona, Lewis (1972) reported a rather stable population, and
Chew and Chew (1970) found P. eremicus to be the resident
species with the least stable and lowest density. Meserve (1973)
and Reichman and Van de Graaf (1975a) observed that population
numbers dropped in fall and early winter and increased in spring.
However, MacMillen (1964) and Lewis (1972) found high winter
populations and low summer populations of P. eremicus. Chew
and Chew (1970) discussed the role of P. eremicus in the ener-
genic and food ecosystem. Ogston (1974) found that home
ranges averaged 0.3 hectares. The home ranges of males over-
lapped considerably while those of the females showed almost no
overlap (MacMillen, 1964).

P. crinitus and P. eremicus occur sympatrically. P. crinitus
generally inhabits rocky areas, while P. eremicus generally inhabits
brushy, flat desert floors (Eisenberg, 1963).

BEHAVIOR. Peromyscus eremicus was described as quiet
and docile in captivity by Siviglia (1932) and as excitable and shy
by Brand and Ryckman (1968), who also noted that they seldom
attempt to bite when handled. Murie (1961) reported P. eremicus
to be generally more passive than P. maniculatus. Peromyscus
eremicus is dominant over Perognathus fallax, is mutually intoler-
erant with Peromyscus maniculatus, and is subordinate to Neo-
toma lepida, Peromyscus californicus, and Dipodomys agilis
(MacMillen, 1964). MacMillen (1964) found individuals of P. er-
icus to be mutually incompatible in the wild. In laboratory sit-
uations at low densities, individuals were considerably tolerant
of each other, with a mated pair often remaining together through
But fighting and subsequent wounding of the rump and tail
increased at higher densities (Eisenberg, 1963). Eisenberg (1963)
described the social structure of P. eremicus as loose, with
transient pairing, and described the ‘‘modified’’ fighting tech-
nique usually employed. Smith (1965) discussed the behavioral
discrimination shown by allopatric and sympatric males of P. er-
icus between females of P. eremicus and P. californicus. The
copulatory behavior of P. eremicus was described by Dew-
bury (1974). Patterning (rapid movement of forepaw up and
down against the substrate, producing a soft, whirring sound) was
frequently exhibited when adults of P. eremicus were disturbed
(Siviglia, 1932; Eisenberg, 1963). In another study, mice
produced during aggressive arousal, squalls were produced in
response to bites or injury, and single chits were produced during
nest defense (Eisenberg, 1968). The ability of the neonates to
attach themselves tightly to the teats and thus be transported by
the mother was well developed in P. eremicus (Siviglia, 1932; Eisen-
berg, 1968).

In the laboratory, P. eremicus built fluffy, globular, cotton
nests (Brand and Ryckman, 1968).

Light reinforcement in P. eremicus was studied by King
(1970). Owings and Lockard (1971) found P. eremicus to be most
active on moonlit nights and P. californicus to be most active on
moonless nights, and discussed these results in terms of a tem-
poral dimension of competitive exclusion for these sympatric
species. Of five taxa of Peromyscus, P. eremicus was found to
exhibit the highest level of food hoarding. The amount of food
hoarded apparently was not affected by temperature or photo-
period (Barry, 1976). In cactus mice, torpor is mainly circadian
(torpid by day, active by night; MacMillen, 1972) and can be
employed anytime their energy supplies become limited (Mor-
between winter (circadian) torpor, induced only by food restric-
tion, and summer torpor, which may be circadian or may last two
or three months. Summer torpor was induced by food restriction
or by imposing a negative water balance. According to MacMillen
(1964, 1965), cactus mice hibernate during the summer to con-
serve water and prolong food reserves.

King et al. (1968) conducted five behavior tests (running,
swimming, climbing, digging, and gnawing) on eight taxa of Pero-
my scus, including P. eremicus. Cactus mice were good runners,
but were slow to perform in most other tests.

GENETICS. Cross (1938) reported 58 chromosomes for P.
eremicus but more recent studies (Clark et al., 1973; Hsu and
Arrighi, 1968; Lawlor, 1971a; Tein Kao et al., 1974) showed that
the diploid number was 48. The autosomes of P. eremicus are all
biarmed, with the larger ones being subtelocentric or submeta-
centric, and with many being morphologically similar. The small-

est pair is nearly metacentric. The X chromosome is large with
nearly equal arms, while the Y chromosome is usually a medium-
sized submetacentric. According to Hsu and Arrighi (1966), P.
californicus has a small acrocentric Y, but Lawlor (1971a) consid-
ered it to be submetacentric, with the centromere very near the
end of the long arm. Cactus mice have 96 chromosome arms,
consisting of 46 euchromatic acrocentric arms and 48 het-
erochromatic short arms with the centromeric regions also being
heterochromatic (Clark et al., 1973). Pathak et al. (1973) dis-
cussed the role of heterochromatin in karyotypic evolution,
and Jalal et al. (1974) discussed cytological differentiation of con-
stitutive heterochromatin.

Rasmussen and Koehn (1966) reported polymorphism for
two serum transferrin components in P. eremicus, which are similar
to those of P. maniculatus and P. boylii, but which are slower
in migration. Avise et al. (1973) discussed the potential poly-
orphism of P. eremicus and demonstrated potential geographic dif-
ferences in allelomorph properties.

Dice (1935) studied the inheritance of walking behavior and
epilepsy, and Clark (1936b) studied pectoral hair. Clark (1939)
and Dice (1939) discussed pectoral spotting and inheritance
of pelage color. Huestis (1923) discussed the inheritance of
hair characters of P. eremicus. The occurrence of a silver-
white pelage variation in P. eremicus was reported by Reichman
and Van de Graaf (1973b).

Brand and Ryckman (1969) and Lawlor (1971a) found that
crosses between individuals of P. eremicus and P. interparietalis
produced viable offspring. Dice (1933) noted that crosses between
individuals of the subspecies P. e. anthonyi, eremicus, fratercu-
lus, and pullus produced fertile young. Attempted matings be-
 tween mainland P. eremicus and P. e. ibertoniensis produced no
offspring (Lawlor, 1971a). Crosses between P. eremicus and P.
maniculatus, P. leucopus, and P. californicus were infertile
(Dice, 1933).

REMARKS. Drs. K. N. Geluso and T. E. Lawlor, and an
anonymous reviewer provided valuable criticism of the manu-
script for which we are grateful.

LITERATURE CITED
Allen, J. A. 1895. On a collection of mammals from Arizona
and Mexico, made by Mr. W. W. Price, with field notes by
—. 1903. Descriptions of new mammals from West Texas,
Mexico and Lower California. Bull. Amer. Mus. Nat. Hist. 10:143-
158.


Miller, G. S., Jr. 1892. Description of a new mouse from southern California. Amer. Nat. 26:261–263.


Editors for the account were S. Anderson and D. F. Williams.

Rita A. Veal and William Caile, Biology Department, Central State University, Edmond, Oklahoma 73034.