MAMMALIAN SPECIES No. 330, pp. 1–9, 3 figs.

Neotoma micropus.

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Published 12 May 1989 by The American Society of Mammalogists

Neotoma micropus Baird, 1855

Southern Plains Woodrat

Neotoma micropus Baird, 1855:333. Type locality "Charco Escondido, Tamaulipas, Mexico."

CONTEXT AND CONTENT. Order Rodentia, Superfamily Muroidea, Family Muridae, Subfamily Sigmodontinae, Genus *Neotoma*, Subgenus *Neotoma*. Five subspecies are recognized (Hall, 1981):

N. m. canescens Allen, 1891:285. Type locality "North Beaver River, Indian Territory, near the boundary line between Indian Territory and New Mexico."
N. m. leucophaea Goldman, 1933:472. Type locality "White Sands, 10 mi. W Point of Sands, White Sands National Monument, 4100 ft., Otero Co., New Mexico."
N. m. littoralis Goldman, 1905:31. Type locality "Altamira, 1000 ft., Tamaulipas, Mexico."
N. m. micropus Baird, 1855:333, see above (*surberi* Elliot a synonym).
N. m. planiceps Goldman, 1905:32. Type locality "Rio Verde, 3000 ft., San Luis Potosi, Mexico."

DIAGNOSIS. *Neotoma micropus* is a medium-sized woodrat. The dorsal adult pelage is pale, ashy gray, or steely to slaty gray, sometimes washed with buff and sometimes with blackish hairs along the back (Fig. 1). The belly is gray; throat and pectoral regions are white. The tail is bicolored (blackish or dusky above and grayish or whitish below), relatively short, heavy, and sparsely haired. The cranial characters (Fig. 2) are as follows: skull robust; supraorbital region strongly arched; maxillovomerine notch absent; interpterygoid fossa broad; palatal bridge relatively short, usually with a posterior median spine, but occasionally concave or square; sphenopalatine vacuities large; incisive foramina relatively long; interparietal length almost equal to width between temporal ridges; temporal ridges prominent, present over the orbits, widest on the parietals, converging gradually toward the interparietal; anterointernal re-entrant angle of M1 shallow; upper incisors wide, heavy (Finley, 1958; Hall, 1981).

Neotoma micropus differs from species of the subgenus *Neotoma* that have adjacent or overlapping ranges in coloration and in the absence of a maxillovomerine notch in the septum (also lacking in *N. floridana*). *N. stephensi* is ochraceous or yellowish dorsally and *N. goldmani* is creamy buff dorsally; throat hairs on both are plumbeous basally. *N. angustapalata* is dusky brown dorsally; the anterointernal re-entrant angle of M1 extends more than halfway across the tooth in *N. angustapalata* and in *N. mexicana*. The lateral dentine tract of ml is ≥0.2 mm in height for *N. goldmani*, *N. mexicana*, and *N. stephensi*, whereas, in *N. micropus*, *N. albigula*, and *N. floridana* the height of the lateral dentine tract is ≤0.2 mm (Harris, 1984*b*). *N. floridana* is pale cinnamon to buffy gray dorsally; the tail is not bicolored; the interorbital region is nearly level; and the bony palate has a concave or notched posterior margin and narrower sphenopalatine vacuities. *N. albigula* is brownish, washed with fulvous to ochraceous, mixed with dusky dorsally; its supraorbital region is less arched (Hall, 1981).

GENERAL CHARACTERS. *Neotoma micropus* has dense, soft pelage. Feet are white; ears are large; eyes are prominent. Vibrissae are long and may reach the posterior tips of the ears. The forefoot and hind foot have four subequal digits; the pollex is rudimentary and clawless and the hallux is short and clawed. Mammae (two pairs) are inguinal (Bailey, 1931; Finley, 1958). Coloration is invariant for sexes, ages, and seasons (Allen, 1894).

In *N. m. micropus*, there are no significant differences between character means of males and females, although means for males are larger than those for females in nine characters (Birney, 1973). For *N. m. canescens*, the means of four characters are significantly different; all means for males (except one) are larger than or equal to those of females (Birney, 1973).

Length of the hind foot and length of the ear show little to no correlation with age; alveolar length of the maxillary toothrow does not increase after molars become occlusal and least interorbital constriction increases up to age groups III and IV. Cranial characters of age groups VII and VIII are not significantly different; means for age group VI are generally smaller than those for groups VII and VIII, but the difference is seldom significant, resulting in the combination of the three groups to form the adult group (Birney, 1973). Temporal changes in shape of skull are due to lengthening of preorbital skull segments without corresponding relative increases in postorbital regions (Allen, 1894).

Specimens from coastal Texas and south-central Kansas are larger than specimens from the remainder of the range. Specimens found to the south (in Oklahoma and north-central Texas) and southwest (in southwestern Kansas and the Oklahoma Panhandle) of south-central Kansas show a gradual decrease in size. Size also decreases clinally in specimens to the southwest of south-central Kansas (the Texas Panhandle and southeastern New Mexico). *N. micropus* from Big Bend, Texas, Coahuila, and Tamaulipas are the smallest (Birney, 1973).

Known *N. micropus*/*N. floridana* hybrids show the following characteristics: 60% have a straight anterior palatal spine (characteristic of *N. micropus*); 37% have a posterior palatal spine (characteristic of *N. micropus*); 38% have intermediate and wide sphenopalatine vacuities (characteristic of *N. micropus*); 41% have bacula shaped like *N. micropus*. Means for condylonasal length and least interorbital constriction of known hybrids and *N. floridana* are significantly different. Means for condylonasal length and zygomatic breadth for known hybrids and *N. micropus* are significantly different (Spencer, 1968).

Mean standard external measurements (in mm, with sample size and range in parentheses; Birney, 1973) for males and females, respectively, of *N. m. canescens* are: total length, 370.0 (23, 334 to 411), 355.8 (31, 310 to 382); length of tail, 152.6 (23, 131 to 175), 147.1 (31, 130 to 165); length of hind foot, 39.2 (25, 35 to 45), 38.4 (30, 36 to 41); length of ear, 27.1 (16, 25 to 29), 27.1 (24, 25 to 30). Ranges of mass (in g; Alvarez, 1963; Armstrong, 1972; Baker, 1956; Davis, 1966; Finley, 1958) are: males, 210 to 317; females, 180 to 274.

The dental formula is i 1/1, c 0/0, p 0/0, m 3/3, total 16.

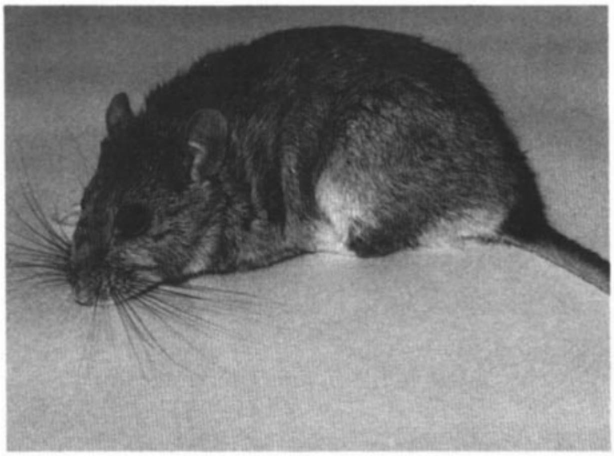

FIG. 1. Adult *Neotoma micropus* from 2.5 mi. W jct. Hwys 281 and 15, Major Co., Oklahoma. Photograph by J. K. Braun.

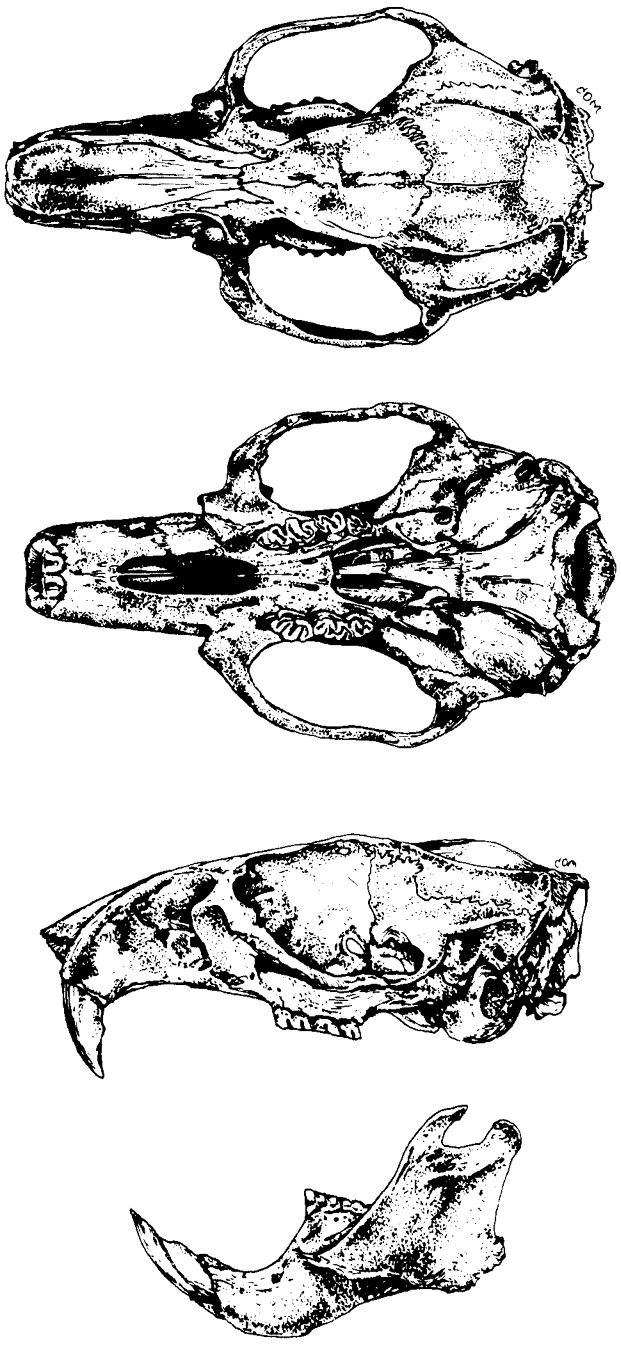

FIG. 2. Dorsal, ventral, and lateral views of the cranium and lateral view of the mandible of an adult female *Neotoma micropus* (Oklahoma Museum of Natural History 4825) from Harmon Co., Oklahoma. Greatest length of cranium is 48.0 mm. Drawing by C. McCallister.

Mean skull measurements (in mm, with sample size and range in parentheses; Birney, 1973) for males and females, respectively, of *N. m. canescens* are: greatest length, 49.5 (25, 46.4 to 52.9), 48.8 (27, 44.2 to 51.8); condylobasilar length, 48.3 (24, 44.6 to 50.9), 47.0 (29, 42.8 to 50.0); zygomatic breadth, 26.7 (26, 25.1 to 28.8), 26.5 (30, 24.7 to 29.1); interorbital constriction, 6.3 (27, 5.8 to 6.9), 6.3 (32, 5.8 to 7.0); nasal length, 19.8 (26, 18.0 to 21.1), 19.2 (16.7 to 21.2); rostral breadth, 8.3 (27, 7.5 to 9.2), 8.3 (32, 7.2 to 9.3); rostral length, 19.4 (26, 17.8 to 20.7), 18.9 (30, 17.2 to 20.2); mastoid breadth, 19.3 (24, 18.0 to 20.8), 19.1 (27, 17.9 to 20.3); length of the palatal bridge, 8.1 (26, 6.8 to 8.9), 7.9 (31, 7.1 to 9.5); alveolar length of the maxillary toothrow, 9.3 (27, 8.7 to 10.1), 9.4 (32, 8.5 to 10.1).

DISTRIBUTION. *Neotoma micropus* inhabits the southern Great Plains of the south-central and southwestern United States and northeastern Mexico (Fig. 3; Armstrong, 1972; Hall, 1981). The eastern range limits abut the western limits of *N. floridana*; only one area of sympatry on the North Canadian River in extreme southwestern Major County, Oklahoma, has been described (Birney, 1973; Spencer, 1968). *N. micropus* and *N. albigula* have overlapping distributions over much of their ranges (Hall, 1981).

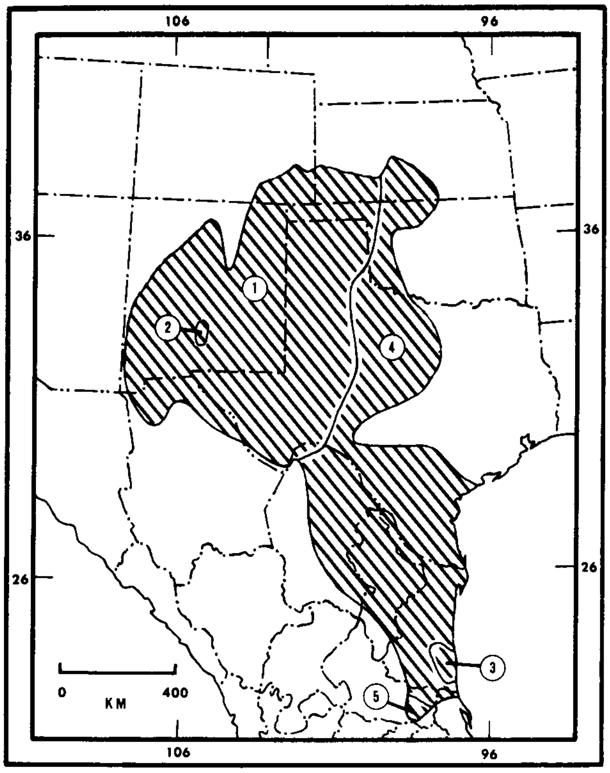

FIG. 3. Geographic distribution of *Neotoma micropus* in North America (Hall, 1981). Numbers correspond to the following subspecies: 1, *N. m. canescens*; 2, *N. m. leucophaea*; 3, *N. m. littoralis*; 4, *N. m. micropus*; 5, *N. m. planiceps*.

FOSSIL RECORD. *Neotoma micropus* is known from the following Rancholabrean (late Pleistocene) faunas: Cragin Quarry, Meade Co., Kansas (Hibbard and Taylor, 1960); Muskox Cave (Logan, 1981) and Dry Cave (Harris, 1984*a*, 1987), Eddy Co., New Mexico; Howard Ranch, Hardeman Co., Texas (Dalquest, 1965); Frio Bat Cave, Uvalde Co., Texas (Reddell, 1970); Upper Sloth Cave (Logan and Black, 1979; Lundelius, 1979) and Fowlkes Cave (Dalquest and Stangl, 1984), Culberson Co., Texas; Schultze Cave, Edwards Co., Texas (Dalquest et al., 1969); Easley Ranch, Foard Co., Texas (Dalquest, 1962); Klein Cave, Kerr Co., Texas (Roth, 1972); Jimenez Cave, Chihuahua (Harris, 1984*b*). *N. m. littoralis* is known as late Pleistocene fossils from extreme southern Tamaulipas, indicating that *N. m. canescens*, which occupies the northern two-thirds of Tamaulipas, did not range farther south than its present range during the late Pleistocene (Dalquest and Roth, 1970). Width of the second lophid of M1 distinguishes most fossils of *N. micropus* (width > 1.94 mm) from *N. albigula* (width < 1.94 mm; Dalquest et al., 1969; Harris, 1984*b*).

Neotoma albigula, *N. micropus*, and *N. floridana* are taxa in intermediate stages of speciation (Birney, 1973). Between 200,000 years BP (Birney, 1973) and 155,000 years BP (Spencer, 1968; Zimmerman and Nejtek, 1977), *N. albigula* and related species diverged from the ancestral stock. About 100,000 (Birney, 1973) or 112,000 years BP (Spencer, 1968; Zimmerman and Nejtek, 1977), the ancestral stock of *N. floridana* retreated south into Florida, while what was to become *N. micropus* retreated to coastal Texas and Tamaulipas. *N. micropus* and *N. floridana* may have re-established contact in postglacial times before significant reproductive isolating mechanisms could evolve (Spencer, 1968), although evidence suggests that *N. micropus* and *N. albigula* may have been in contact during the late Pleistocene in New Mexico and southern Chihuahua (Harris, 1984*b*).

FORM. Laboratory-raised animals generally are larger than wild-caught individuals. Captive animals show decreased tooth wear and tooth growth; incisors of captives frequently are broken, resulting in abnormal occlusion (Birney, 1973).

The dorsal pelage of *N. micropus* gives the following reflectance values: reflected red, 13.0 to 17.1%; reflected blue, 6.8 to 12.2%; reflected green, 7.2 to 15.0%. Specimens from New Mexico and West Texas are palest; paler on average than specimens of *N. m. leucophaea* known only from White Sands National Monument, New Mexico. Darkest specimens occur in the eastern parts of the range (Birney, 1973).

The hyoid complex is similar to *N. floridana*; the basihyal has a prominent entoglossal process with prominent shoulders and well-developed arch; hypohyals are triangular (fused to the basihyal in old adults) and more flattened than in *N. floridana*; ceratohyals vary in shape; thyrohyals usually are long and pointed, lateral flares and medial trochanters are prominent. Average measurements (in mm) of *N. m. micropus* and *N. m. canescens*, respectively, are: width of basihyal, 7.5, 7.2; length of thyrohyal, 5.5, 5.0; length of ceratohyal, 2.6, 3.0; arch of the basihyal and thyrohyals, 5.9, 5.0; width of thyrohyals, 11.4, 11.6; thickness of basihyal through entoglossal process, 1.9, 2.2. Except for hypohyal shape and general size, the hyoid is similar to that of the subgenus *Peromyscus* (Sprague, 1941).

In immature specimens, the tympanohyal (partly ossified) is distinct and protrematic in position. With age, the tympanohyal ossifies and becomes fused to the mastoid process. The stylohyal is well developed and cartilaginous. The stylohyoid and jugulohyoid are present. The jugulohyoideus and stylohyoideus are incompletely separated (Sprague, 1942).

Characteristics of the baculum and glans penis are intermediate between *N. floridana* and *N. albigula* in many respects (Burt and Barkalow, 1942; Hooper, 1960). The baculum resembles *N. albigula* in the shallow U-shaped cross-section of the proximal end and the rounded shaft, which is longer (> one-half the total length) than the expanded basal portion. The thick shaft, deeper U-shape of the proximal end and reduced knob on the distal end resemble that of *N. floridana* (Burt and Barkalow, 1942). Ranges of bacular measurements (in mm; Burt and Barkalow, 1942) for *N. m. micropus* and *N. m. canescens*, respectively, are: total length, 6.25 to 6.99, 5.95 to 7.61; dorso-ventral diameter of base, 1.61 to 1.70, 1.64 to 1.65; lateral diameter of base, 3.21, 3.29 to 3.35; dorso-ventral diameter of shaft near middle, 0.70 to 0.89, 0.80 to 0.90; lateral diameter of shaft near middle, 0.80 to 0.83, 0.80 to 0.91. Mean bacular measurements (in mm; Spencer, 1968) for known *N. micropus/N. floridana* hybrids are: length, 7.63; lateral width, 2.93; dorso-ventral width, 1.58; shaft diameter, 0.77.

The glans penis is similar to that of *N. albigula*, except that it is larger and the terminal hood relatively smaller and slightly cleft distally. The phallus is also similar to that of *N. floridana*, except the urethral processes are longer and narrower, the crater deeper (occupies the terminal one-third rather than one-fourth of the glans), and a longer segment of the baculum (head of the os penis and all of the cartilaginous spine) is free of the crater walls (Hooper, 1960).

FUNCTION. Hearing and vision with respect to movement are acute. Woodrats are alerted by the slightest sound or movement (Raun, 1966*a*).

At least two and frequently three molts occur during the first year, and thereafter one annual molt is the rule (Birney, 1973; Finley, 1958; Wiley, 1972). Individuals born in late summer or early fall spend the first winter in subadult or first autumn pelage (Birney, 1973). Molts begin on the venter, progress up the sides, and move forward from the dorsal rump to the head (Finley, 1958; Wiley, 1972). The pattern resembles that of *N. floridana* and *N. albigula*. The smooth, sleek juvenile pelage becomes soft and fluffy as hair shafts lengthen and bases become wavy. The postjuvenile molt is in progress or complete between 2 and 4 months of age. Hairs of the subadult pelage are straighter and coarser than juvenile hairs. The second molt occurs after 4 months of age. The resulting first autumn pelage appears in late summer or fall. The third molt begins in fall or early winter. The first winter pelage is similar to the first autumn pelage, but may be longer and thicker, and is retained until the annual molt in the following summer or autumn (Finley, 1958). Birney (1973) found that adults in northern populations acquire the winter pelage by late November or early December. By late winter or early spring, as the pelage begins to deteriorate, it is replaced where thinnest and most worn; there is no symmetry of pattern and it may be complete, absent, or abbreviated. In late summer and autumn, all individuals molt into a new winter pelage. In southern populations, time and pattern of molting is less defined. The annual molt is weakly synchronized within populations, usually occuring between June and October, and is complete by November (Goldman, 1910). Reproductive hormones may influence molt; some pregnant females show arrested molt (Birney, 1973).

Mean body temperature (T_b) in southern Texas in January and August is 36.0 and 38.8°C, respectively, and ranges from 14.8 to 40.4°C (both are probably near the extremes). Low ambient temperatures (T_a) reduce T_b that can result in increases in juvenile mortality. High and low T_a can be tolerated only for short periods of time. High T_a seems to be more detrimental than low T_a; mean T_b is closer to the lethal maximum than minimum. Survival at high or low T_a depends on avoidance rather than physiological regulation. Effects of high T_a are avoided by nocturnal habits and insulated dens; effects of low T_a are avoided with decreased activity outside the den. T_a extremes may cause high mortality when the number of individuals exceeds the number of adequate dens (Raun, 1966*b*).

Initial consumption of water by captive *N. micropus* is directly related to its availability in the habitat; this trend is reversed by day 20 (Boice, 1969; Boice and Boice, 1968). Increased consumption occurs when access is easy; when water is scarce, water intake is reduced (Boice, 1969). Increased amounts of NaCl increase the rate at which *N. micropus* consumes water until animals die. Survivors (nondrinkers) show decreased water consumption. Because *N. micropus* feeds on and stores cactus stems and fruits all year, it has reduced its need to withstand dessication (Birney and Twomey, 1970).

Thyroid hormone production increases in *N. micropus* exposed to long photoperiods. Thiourea-treated animals have significantly greater mean thyroid mass and show thyroidal hypertrophy and hyperplasia. There are no differences between combinations of photoperiod and temperature groups of thiourea-treated animals; photoperiod duration significantly affects thyroid mass. Mean thyroid mass of cold stressed (10°C) animals is greater than that of individuals kept at 20°C (Capehart and Burns, 1976).

ONTOGENY AND REPRODUCTION. Twenty-one (Feldman, 1935) to 24% (Birney, 1973) of laboratory matings produce progeny. Preimplantation and early postimplantation ovum losses (10.2%) and postimplantation losses (5.1%) are common (Wiley, 1984). Ova transmigration occurs in 20% of pregnant females; monozygotic twinning or polyovuly is rare (two occurences; Wiley, 1984). *N. m. canescens* from eastern localities are less successful breeders than those from western localities (Birney, 1973).

The gestation period generally is 33 to 35 days, but can vary from 30 to 39 days (Bee et al., 1981; Birney, 1973; Davis, 1966; Feldman, 1935; Hall, 1955; Raun, 1966*a*; Spencer, 1968; Wiley, 1984). During late pregnancy, mammae are enlarged and inflamed, the abdomen is swollen, and there is a tendency toward abdominal hair loss (Raun, 1966*a*). The mammary area of lactating females is naked. Evidence of lactation persists until after weaning (Raun, 1966*a*). Post-partum estrus and prolonged gestation are uncommon (Birney, 1973; Spencer, 1968).

No direct observations of parturition have been recorded for *N. micropus*, although a female has been observed just after giving birth. One young was attached to a nipple and a second, wet young was lying nearby with the placenta attached to the umbilical cord. Thirty minutes later, both were attached to nipples and sucking; the umbilical cord had been bitten off close to the body and eaten along with the placenta. A third young was born later. The placenta is similar in structure to that of *N. floridana* (Wiley, 1984).

Litter size based on number of embryos, placental scars, young captured with a female, and young born to females that were pregnant when captured is two or three (Alvarez, 1963; Bailey, 1931; Baker, 1956; Bee et al., 1981; Birney, 1973; Davis, 1966; Dice, 1937; Feldman, 1935; Finley, 1958; Hall, 1955; Johnson, 1952; Raun, 1966*a*; Schmidly, 1977; Spencer, 1968; Wiley, 1984). Litters of one or four are rare (Bailey, 1931; Birney, 1973; Hall, 1955; Schmidly, 1977; Spencer, 1968; Wiley, 1984). Northern populations of *N. m. canescens* generally have larger litters (three young) than southern populations (two young/litter; Birney, 1973). Laboratory-born young have sex ratios of 2:1 (males : females; Birney, 1973; Feldman, 1935) and 1:1 (Wiley, 1984). Litters may consist entirely of males (Birney, 1973; Feldman, 1935) or females (Feldman, 1935).

Neotoma micropus may breed in early spring and produce one litter/year (Bee et al., 1981; Davis, 1966; Feldman, 1935; Schmidly, 1977) or may have a more continuous breeding season (producing two or more litters; Bailey, 1931; Finley, 1958; Johnson, 1952; Raun, 1966*a*; Spencer, 1968; Wiley, 1984), especially in southern populations (Birney, 1973). Peaks occur in early spring and late fall with a low point in late summer (Johnson, 1952; Raun, 1966*a*; Spencer, 1968; Wiley, 1984).

A thick growth of hair covers the mammary region of virgin females; on reproductively active females, this region is bare (Raun, 1966*a*). Sexually inactive females have an imperforate vagina; small, hard teats; and a small, white or pinkish clitoris (Birney, 1973; Raun, 1966*a*; Wiley, 1984). Sexually active females have a perforate vagina and swollen clitoris (Birney, 1973; Raun, 1966*a*). The condition of the vaginal orifice may be unreliable for assessing reproductive activity. Nipple condition and milk-gland development give accurate indices of the length of the breeding season. Thirty percent of ovaries examined during October to March contained active corpora lutea, indicating a capability to breed. Vaginal plugs completely fill the vagina, the body of the uterus, and the uterine horns. Lactating, postlactating, and nonlactating females have plugs (Wiley, 1984).

Males have viable sperm in the testes (Spencer, 1968; Wiley, 1984) and epididymides all year even when testes are abdominal (Birney, 1973; Wiley, 1984). There is no difference among monthly testes mass, although there is a trend toward reduced mass from October to January (Wiley, 1984). Testes position does not give an accurate indication of the individual breeding condition (Raun, 1966*a*); scrotal animals can quickly retract the testes from the scrotum to the abdomen (Wiley, 1984). At death, males become scrotal (Wiley, 1984). The percentage of scrotal males in a population reflects the reproductive trends in females in the population (Raun, 1966*a*; Spencer, 1968; Wiley, 1984). Mass of seminal vesicles increases from March to April, is greatest from June to August, and decreases between September and October (Wiley, 1984). Once maturity is reached, there is no period of sexual quiescence (Raun, 1966*a*).

In adult males, the ventral abdominal gland ranges from 3 to 9 mm in width and from 40 to 65 mm in length (Spencer, 1968; Wiley, 1984). When large and well developed, it is not covered by hair (Wiley, 1984). In females, the gland is smaller, less developed (2 to 5 mm in width, 20 to 55 mm in length) or absent, and has hair (Wiley, 1984). In males, exudate stains the pelage along the gland's lateral edges. Size of the ventral abdominal gland does not seem to be correlated with time of staining or season of breeding. Sebaceous glands, which empty into the hair follicles, are larger and more numerous in May and September than in December. Females and subadult males possess poorly-developed sebaceous glands (Wiley, 1984).

Apparently, breeding season coincides with phenological changes in vegetation. Two major food items, mesquite (*Prosopis*) and catclaw acacia (*Acacia greggi*), leaf in April and lose leaves by November (Wiley, 1984).

Mass of neonates ranges from 10 to 13.4 g (Davis, 1966; Feldman, 1935; Johnson, 1952; Wiley, 1972). Mean measurements (in mm) for 1-day-old male ($n = 2$) and female ($n = 2$) *N. micropus/N. floridana* hybrids, respectively, are: total length, 96.5, 93.5; length of tail, 27.5, 25.5; length of hind foot, 14.5, 14.0; length of ear, 6.0, 6.0 (Spencer, 1968). Neonates have the following characteristics (Spencer, 1968): eyes, external auditory canal, urogenital orifice, and anus closed; pinnae folded or unfolded and erect; if folded, pinnae are erect by day 2; vibrissae pronounced; toes fused to tip; claws well developed; tail naked, annuli pronounced; sparse, light gray hair prominent on the dorsum and sides; venter and appendages nearly naked; skin of dorsum and sides is dark gray to black, that of the venter and appendages pink to red; upper and lower recurved incisors separated at the base. Eyes are open by day 15 (Spencer, 1968; 12 according to Feldman, 1935). The auditory meatus opens at day 3 (Feldman, 1935); the external auditory canal, which first forms as a depression, deepens at least through day 14 (Spencer, 1968). The urogenital orifice opens by day 2 and defecation occurs by day 6 or 7. By the second week, sparse hair covers the tail. The juvenile pelage by day 3 consists of short juvenile hairs (Spencer, 1968) and is well developed at 2 weeks (Feldman, 1935).

Physical development occurs rapidly from birth to 21 days of age; except for length of ear, growth is most rapid from day 3 to 6 (Wiley, 1972). Weaning occurs 30 days after parturition (Bee et al., 1981; Davis, 1966; Feldman, 1935; Raun, 1966*a*) or 20 to 28 days after parturition and a marked decrease in growth follows (Wiley, 1972). By 7, 8, and 14 weeks, respectively, the hind foot, ear, and tail reach adult size (Wiley, 1972). Growth of males and females is not significantly different (Feldman, 1935), although the tendency for males to be heavier than females appears at about 6 months (Raun, 1966*a*). Mean mass (in g) for wild-caught and lab-raised individuals at 15, 30, 60, 90, 150, and 300 days of age, respectively, is (Feldman, 1935; Raun, 1966*a*): 30.0, 37.6; 88.1, 91.2; 144.8, 178.1; 168.4, 254.0; 235.0, 340.9; 263.3, 403.5.

Neotoma micropus attain 85% of their adult mass at 3 months of age (Davis, 1966) and 92% of their adult mass and 98% of their adult body length by 9 months (Wiley, 1972). Ovarian follicles are well developed by 6 months of age, but females may (Raun, 1966*a*) or may not (Spencer, 1968) enter estrus until the spring. Young males have smaller testes and less protruding cauda epididymides than adults, although both contain sperm (Birney, 1973). Ten-week-old males are sexually mature based on sperm production, but for behaviorial reasons (Wiley, 1972), may not breed as early as females (Raun, 1966*a*). Testis size is 16 by 12 mm for sexually-active males and 9 by 5 mm for 6-month-old males (Spencer, 1968). One-year-old individuals of both sexes produced offspring (Feldman, 1935). Birney (1973) and Finley (1958) suggested that young born early in the year are capable of having litters by the summer of the same year; those born late in the year breed the following spring. Attempts at breeding first-year males and females with adult females and males were unsuccessful (Birney, 1973; Spencer, 1968).

Neotoma micropus and *N. micropus/N. floridana* hybrids have a 4- to 6-day estrous cycle. The cycle is similar to that reported for *N. floridana* (Birney, 1973).

ECOLOGY. *Neotoma micropus* inhabits rocky outcrops and shrubby grasslands in southwestern Kansas (Bee et al., 1981; Hill and Hibbard, 1943). Open areas dominated by short-grass and cholla (*Opuntia arborescens*) are selected most often by *N. micropus* in Colorado (Armstrong, 1972). In Oklahoma, *N. micropus* occupies rocky hillsides, ledges, or bluffs (Jackson and Warfel, 1933). In Texas, *N. micropus* lives in areas supporting cactus or thorny desert shrubs (August et al., 1979; Bailey, 1905; Box, 1959; Cornely, 1979; Davis, 1966; Davis and Robertson, 1944; Johnson, 1952; Raun, 1966*a*; Schmidly, 1977); this species is rarely found in rocks (Bailey, 1905; Davis and Robertson, 1944; Schmidly, 1977). *N. m. canescens* is common in cane (*Arundinaria*) and mesquite thickets along the Rio Grande in Big Bend National Park (Schmidly, 1977). *N. micropus* is a grassland species in New Mexico and often is found far from rocky habitats (Bailey, 1931; Bradt, 1932; Findley et al., 1975; Hooper, 1941). *N. m. canescens* is common in the mesquite community of the desert plain in the Tularosa Basin and less common in the creosotebush (*Larrea*) association and the grassy-wash association (Blair, 1941; Bradt, 1932; Dice, 1930). They occur in brushy areas in Tamaulipas (Alvarez, 1963). In Chihuahua, *N. micropus* is found in habitats of scattered creosotebush, mesquite, and cactus (*Opuntia*) on sandy soil (Bogan and Williams, 1975). In Coahuila, *N. micropus* usually avoids rocky areas and thick cover along arroyos; near Nava, woodrats occur in oak thickets and at La Rosa they are present in low-growing vegetation on desert flats (Baker, 1956).

Vegetation (leaves, berries, roots, nuts, and seeds) constitutes the major part of the diet of *N. micropus* in Kansas (Bee et al., 1981). In Texas, *N. micropus* forages on green vegetation, prickly pear, cactus fruits, beans and pods of mesquite, and acorns (Bailey, 1905; Box, 1959; Davis, 1966; Johnson, 1952; Raun, 1966*a*; Schmidly, 1977). Joints and spiny fruits of tree cactus (*Opuntia arborescens*) are the food items that were selected in Colorado (Finley, 1958); when tree cacti are unavailable, leaf blades, fruit capsules, and seeds of yucca (*Yucca glauca*) and prickly pear (*Opuntia polyacantha*) are eaten. In New Mexico, *N. micropus* selects the flesh and fruit of cactus, but will eat green vegetation, fruits, and seeds (Bailey, 1931). During periods of drought, *N. micropus* seems to depend on cactus pulp for food and moisture (Bailey, 1931; Finley, 1958).

Hawks (*Buteo albicaudatus, Parabuteo unicinctus*), owls (*Bubo virginianus, Tyto alba*), roadrunners (*Geococcyx californianus*), raccoons (*Procyon lotor*), foxes, coyotes (*Canis latrans*), bobcats (*Felis rufus*), and snakes (*Crotalus atrox, Elaphe obsoleta*) are the main predators of *N. micropus* (Bailey, 1905, 1931; Bee et al., 1981; Raun, 1966*a*). Pellets from barn owls (*Tyto alba*) indicate that *N. micropus* is an infrequent prey item (4%, Stickel and Stickel, 1948; 1.6 and 0.7%, Raun, 1960) and may be at about the maximum prey-size for barn owls (Raun, 1960). In southern Texas, *N. micropus* is the most common food item of *Crotalus atrox* (Cottam et al., 1959). *N. micropus* is resistant to large quantities of rattlesnake venom (Perez et al., 1979; Huang and Perez, 1980). Native fire ants (*Solenopsis*) may attack and kill trapped animals and nestlings (Raun, 1966*a*).

Fleas are the most common parasite in Zavala Co., Texas. *Orchopeas sexdentatus* is present all year, with the highest occurrences during the cool, dry months (maximum in January) and the lowest during warm, wet months (minimum in August; Johnson, 1966*a*). *O. sexdentatus* occurs on *N. micropus* in Colorado (Finley, 1958), New Mexico (Holdenried and Morlan, 1956), and Texas (Eads and Menzies, 1949; Miles et al., 1952). *O. leucopus* (a common parasite of *Peromyscus leucopus* and *Sigmodon hispidus*) is found on *N. micropus* (Eads and Menzies, 1949; Johnson, 1966*a*), an association that may be explained by cohabitation with *P. leucopus* and *S. hispidus* in brush piles. The following fleas are found in smaller numbers on *N. micropus*, or are host specific on other mammals: *Foxella ignota* and *Malaraeus* (Eads and Menzies, 1949; Finley, 1958), *Hoplopsyllus affinis*, *Thrassis fotus* (Eads and Menzies, 1949; Johnson, 1966*a*; Miles et al., 1952), *T. campestris* (Eads and Menzies, 1949; Miles et al., 1952), *Xenopsylla cheopsis* (Johnson, 1966*a*), *Pulex irritans* (Eads and Menzies, 1949; Johnson, 1966*a*; Miles et al., 1952), *Echidnophaga gallinacea* (Hightower et al., 1953; Johnson, 1966*a*; Miles et al., 1952), *Anomiopsyllus hiemalis* (Eads and Menzies, 1948; Miles et al., 1952), *Meringis arachis*, *M. bilsingi* (Eads and Menzies, 1949), *M. parkeri* (Eads and Menzies, 1949; Miles et al., 1952). Three species of lice occur on *N. micropus*: *Neohaematopinus neotomae* (Finley, 1958; Johnson, 1966*a*; Menzies et al., 1951), *Hoplopleura hirsuta* (Johnson, 1966*a*), and *Anomiopsyllus* (Finley, 1958). Bot-fly larvae (*Cuterebra*) are parasitic on *N. micropus* (Johnson, 1966*a*).

Ixodes woodi is found all year in Zavala Co., Texas; highest densities occur in November and lowest in August (Johnson, 1966*a*). *Dermacenter variabilis* rarely occurs on *N. micropus* and primarily is found as seed ticks in November and December. Nymphal *Ornithodorus talaje* are present from May to November, with highest densities in July. Additional occurrences of *O. talaje* (Eads et al., 1956), *O. turicata*, *O. woodi* (Eads et al., 1952), *Amblyomma inornatum* (Eads et al., 1956), and *D. parumapertus* (Eads et al., 1952) have been reported. The following mites are present on *N. micropus*: *Bdellonyssus bacoti* (Eads et al., 1952; Hightower et al., 1953; Johnson, 1966*a*), *Haemolaelaps glasgowi* (Eads et al., 1952; Finley, 1958; Johnson, 1966*a*), *Euschongastia criceticola* (Finley, 1958), *Ischyropoda armatus*, *Uropoda*, *Brevisterna utahensis* (Eads et al., 1952), *Neoichoronyssus neotomae* (Eads and Hightower, 1951*a*), *Androlaelaps johnstoni* (Eads and Hightower, 1951*b*), and *B. morlani* (Strandtmann and Allred, 1956).

Internal parasites of *N. micropus* include the nematodes *Litomosoides carinii* and *Trichuris muris*, the tapeworm *Taenia taeniaeformis*, and the flagellate protozoan *Trypanosoma* (Johnson, 1966*a*). Of 88 animals examined, 27% were infested with up to five *L. carinii*. *Trichuris muris* was found in the caecum of most specimens. In 26% of the animals examined, *Taenia taeniaeformis* was found encysted in the liver. Cysts were found from December through April; none was found in May. *Trypanosoma* had been found in the blood of woodrats (Johnson, 1966*a*). *Trypanosoma cruzi* was found in *N. micropus* from Texas (Packchanian, 1942, 1949).

Population density of *N. micropus* has been estimated using den counts and capture-recapture methods. The highest densities of *N. micropus* were in mesquite-cactus habitat (74.1 dens/ha) and prickly pear–short grass habitat (30.6 dens/ha; Box, 1959; Johnson, 1952). In one study (Raun, 1966*a*), density increased from 14.8 to 31.1 woodrats/ha in 8 months, remained stable at 24.7/ha for 10 months, decreased to 9.1/ha 6 months later, and 6 months after that, the density was 0/ha. This decline in population density was due to the elimination of 90% of the cacti by excessive rainfall (Raun, 1966*a*). Percent overhead cover (Box, 1959) and cactus density were correlated with rodent density (Raun, 1966*a*). Woodrat density may be directly proportional to plant cover only in suitable habitats where plants that provide essential food and water are found (Wright, 1973). In desert-scrub habitat in the Guadalupe Mountains National Park, there were 18.5 woodrats/ha (August et al., 1979) and in Winkler Co., Texas, 75% of the dens were occupied, with 29.7 woodrats/ha (Wiley, 1984).

Sixty-five percent of males and 38% of females disperse from their natal area. Nondispersers may displace the mother and siblings and retain their natal areas. Males disperse an average of 61.4 m and females 61.2 m; dispersal direction is controlled by the configuration of cactus growth (Raun, 1966*a*).

The adult sex ratio fluctuates as the population structure changes; although initially biased toward females, the sex ratio equalizes as the population expands (Raun, 1966*a*). In a wild population, the adult sex ratio was 1:1, although significantly more non-adult females than males were present (Johnson, 1952). Laboratory-born young had a ratio of 1:1; in the natural population, the ratio was 1:2 (Wiley, 1984). Adults composed the bulk of the population at all times (Raun, 1966*a*).

In southwestern Texas, males and females have home ranges of 971.3 m^2 and 1,335.5 m^2, respectively (boundary strip method; Johnson, 1952). Minimum home range sizes for males (232.4 m^2) and females (157.8 m^2) in southern Texas are not significantly different, although the home range is absolutely larger for males. Home ranges are similar to the area of the cactus patch or patches utilized (Raun, 1966*a*). In the Guadalupe Mountains National Park, *N. micropus* has a home range of 258 m^2 (August et al., 1979). Frequent and often complete overlap of home ranges of individuals may occur (Raun, 1966*a*). Range shifts are uncommon; most are due to alteration (destruction) of the resident cactus patch (Raun, 1966*a*).

Normal daily movements are short and confined to the resident cactus clump or to a neighboring cactus clump. *N. micropus* seldom crosses stretches (>15.2 m) of habitat devoid of vegetation. The mean average distance of movement from the center of activity for females is 6.9 m and for males is 14.1 m. Only 4% of females and 40% of males move outside their home range. The movements of males are associated with breeding activity. Females tend to move <30.5 m; males tended to move distances >30.5 m. Mean average distance and mean maximum distance moved by males and females are significantly different. Immigration and emigration are of little consequence. In this study, no marked woodrats were taken more than 15.2 m from the plot boundary; those captured <15.2 m from the boundary had home ranges that included the boundary (Raun, 1966*a*).

Adult females tend to live longer than adult males in a natural population (Raun, 1966*a*); males survive an average of 5.6 months after being marked and females 7.6 months. Males and females marked as young have nearly equal survival values until the fifth month after marking, after which males disappear at a much faster rate. Dispersal occurred at about 6 months of age. The percentage of marked young surviving to maturity is highest during population expansion and after the peak (vacant houses are available); the percentage is lowest during the population peak (fewer houses available for occupancy) and the population decline (flooding increased mortality). Maximum known survival is 27 months. Individuals that survive at least 12 months occupy areas of large, dense, closely-grouped cactus clumps. In the laboratory, animals captured as adults live as long as 40 additional months (Feldman, 1935).

Individuals of *Notiosorex crawfordi* occur in *N. micropus* houses (Davis, 1941; Preston and Martin, 1963). The assassin bugs *Triatoma lenticularis*, *T. sanguisuga*, and *T. gerstackeri* (Johnson, 1966*a*) and *T. neotomae*, *T. occulta*, and *T. protracta* (Ryckman, 1962; Thurman, 1944) are associated with *N. micropus* dens. In the Guadalupe Mountains National Park, Texas, *N. micropus* occurs with *Chaetodipus penicillatus*, *C. intermedius*, *Dipodomys merriami*, *D. spectabilis*, *D. ordii*, *Peromyscus maniculatus*, *P. eremicus*, *Onychomys torridus*, *Spermophilus spilosoma*, and *S. mexicanus* (August et al., 1979). In southern Texas, the following species are commonly associated with *N. micropus* (Raun, 1966*a*; Raun and Wilks, 1964): *Lepus californicus*, *Sylvilagus floridanus*, *Oryzomys palustris*, *Reithrodontomys fulvescens*, *Peromyscus leucopus*, *Baiomys taylori*, *Sigmodon hispidus*, *Cryptotis parva*, *Dasypus novemcinctus*. In Chihuahua, Mexico, *D. merriami*, *D. ordii*, *Perognathus apache*, *O. torridus*, and *Mus musculus* are associated with *N. micropus* (Bogan and Williams, 1975) whereas in Coahuila, Mexico, *N. micropus* is found in association with *S. floridanus*, *S. mexicanus*, *Chaetodipus hispidus*, *Perognathus merriami*, *R. fulvescens*, *Onychomys leucogaster*, *P. leucopus*, and *B. taylori* (Baker, 1956).

The ranges of *N. micropus* and *N. floridana* are conterminous from southeastern Colorado through southwestern Kansas, western Oklahoma, and eastern Texas to the Gulf. In southwestern Kansas, the ranges of *N. micropus* and *N. floridana* do not overlap, but are separated by the Arkansas River (Bee et al., 1981). *N. micropus* prefers grassland-cactus associations and *N. floridana* prefers mesic, woodland habitats. The ranges of *N. micropus* and *N. albigula* overlap greatly. Although hybridization has been reported over the northern extreme of sympatry (Birney, 1973; Finley, 1958; Huheey, 1972) and in northern Mexico (Anderson, 1969), habitat separation is usually maintained. *N. micropus* prefers flat, semiarid plains of yucca-shortgrass or cactus-shortgrass; *N. albigula* may occur in similar habitats, but is usually found in rocky habitats or canyons in association with junipers (*Juniperus*) and yucca (Bailey, 1905, 1931; Blair, 1941; Cornely, 1979; Davis and Robertson, 1944; Dice, 1930, 1942; Findley et al., 1975; Finley, 1958; Hooper, 1941; Schmidly, 1977). In the Guadalupe Mountains, *N. albigula* shifts to a secondary diet and habitat when *N. micropus* and *N. albigula* come in close proximity (Cornely, 1979). In southeastern Colorado, *N. micropus* retreats to rocky terrain and into contact with *N. albigula* when natural open-plains habitat is disturbed by domestic grazing and agriculture (Huheey, 1972). In Colorado, *N. micropus* and *N. albigula* compete for houses where they come into contact; they can coexist at low population levels (Finley, 1958). The range of *N. albigula* is expanding and that of *N. micropus* decreasing in the Mesilla Valley, New Mexico, in response to changes in vegetational composition as a result of human activity (Wright, 1973). In northwestern Texas, *N. albigula* and *N. micropus* occur together with no apparent ecological separation (Cutter, 1959). In the western part of the range of *N. micropus*, *N. albigula* increasingly has occupied what is considered habitat of *N. micropus*, while *N. micropus* has become less common (Ederhoff, 1971; Findley et al., 1975).

Woodrats may be caught in snap traps or live traps. Snap traps baited with moistened oatmeal are twice as effective as snap traps baited with peanut butter and three times as effective as unbaited traps. Live traps are 42% effective when unbaited, but 70% effective when baited with either oatmeal or peanut butter. There is no significant difference between sex and age groups captured by any type of trap or bait. In a 6-day trapping period, 48% of adults were trapped in the first 2 nights; 48% of juveniles were trapped on the third and fourth nights; 45% of subadults were captured on the second and third nights (Carley and Knowlton, 1971).

Woodrats can be used as biological indicators to detect habitat change in the Guadalupe Mountains National Park. Population densities reflect vegetation changes. Density of *N. micropus* and *N. albigula* is inversely related to the quality and quantity of grassland. Range extensions and increasing densities may indicate habitat degradation due to human use, climatic changes, or wildlife activity (Cornely, 1979).

Neotoma micropus may be maintained for long periods of time in captivity (Birney, 1973; Feldman, 1935; Spencer, 1968). Captive animals eat uncooked commercial dog foods, wheat, corn, sunflower seeds, rolled oats, lettuce leaves, and cod-liver oil, but select cereals and green food over dog food (Feldman, 1935).

BEHAVIOR. *Neotoma micropus* tends to fight if two unfamiliar adults are caged together (Feldman, 1935; Raun, 1966*a*); fights usually begin within 1 h (Feldman, 1935). Although most are of short duration and result in no injuries (Raun, 1966*a*), serious injuries and death can occur (Feldman, 1935; Raun, 1966*a*). The conflict is usually initiated by the female when the male comes too close or is persistent in approaching. Juveniles and subadults (irrespective of litter) show no aggression when caged together (Raun, 1966*a*). Captive males placed in a new cage drag their venters over any object even after estrous or nonestrous females are placed in the cage; this behavior may be involved with sex recognition or territorial marking (Spencer, 1968). In the field, interactions usually occur between residents and transients; a decrease in available unoccupied dens and habitat deterioration increases the number of intraspecific interactions (Raun, 1966*a*).

Females are attracted to urine and ventral gland sebum odors of males. Males are attracted to the combined odor of urine and feces of females and less attracted to them individually. Odors may be important in sex recognition (August, 1978).

Mating behaviors of male and female hybrids of *N. micropus*/*N. floridana* are not different from that of *N. micropus*. Sexually active males and estrous females follow a sterotyped mating pattern. Males and females approach each other cautiously in a crouched position with partially flexed legs. Touching of vibrissae is followed by mutual smelling of the face. Audible tooth chattering accompanies sparring or boxing encounters in which both woodrats stand on their hind feet and touch the forefeet of the other. Both exhibit side to side and forward and back headbobbing. This bout is repeated four to five times. The female, in a crouched position, then passes back and forth rapidly in front of the male, moving in short hops with rapid drumming of the hind feet. The female directs the posterior region toward the male dragging the vaginal-anal area on the ground and emitting low-pitched raspy squeaks. The male approaches from the rear, mounts and penetrates with rapid, vigorous thrusts of the hind quarters. The female remains crouched with the tail flexed to one side and emits raspy, squeaky sounds. After a short time the female attempts to move away, dragging the male along. The ability to remain mounted is due in part to the recurved spines on the surface of the glans penis. Frequency and duration of mating varies. Some individuals copulate at 2 to 10 min intervals; the female displays before each copulation. Intervals between copulations increase with mating frequency. The highest observed frequency was six copulations in 19 min. Copulation duration ranges from 2 to 90 s, but most last 10 to 20 s. There seems to be no correlation between duration and impregnation success; increased copulations seem to result in increased pregnancies. Females become pregnant with as few as two copulations, but success increases with four or five (Spencer, 1968).

Most activity occurs between dusk and midnight (Raun, 1966*a*). Foraging begins at twilight, or earlier if the sky is overcast (Bee et al., 1981). There is no correlation between trapping success and weather conditions or moonlight, nor any seasonal variation (Raun, 1966*a*).

The tendency of young to hold tightly to nipples persists until weaning. Individuals born and reared in captivity are no tamer than individuals caught in the wild (Feldman, 1935).

Woodrats thump or drum their hind feet (Bee et al., 1981; Feldman, 1935; Johnson, 1952). When disturbed, captive woodrats retreat to the rear of the cage and thump the floor (Feldman, 1935; Johnson, 1952). Both sexes of subadults and adults exhibited this behavior (Johnson, 1952). Approaching an occupied den or live trap also elicits this behavior (Johnson, 1952). Foot drumming may be a means of communicating territorial ownership (Bee et al., 1981).

Neotoma micropus are confused and disoriented if they are released away from the runway. Upon reorienting themselves, they become calm and groom themselves or proceed to the den (Raun, 1966*a*).

Territorial tendencies are confined to the den, which is vigorously defended. The availability of a den in close proximity to a den occupied by either sex does not influence its occupation (Raun, 1966*a*).

Individuals, generally females, occupy one den more or less permanently throughout adult life; shifts to another den usually coincide with the destruction of the original den or the maturation of a litter (Raun, 1966*a*). Dens are built under mesquite, acacia, allthorn (*Koeberlinia*), yucca, and cactus; prickly-pear patches are selected most often (Armstrong, 1972; Bailey, 1905, 1931; Baker, 1956; Cornely, 1979; Davis, 1966; Dice, 1930; Findley et al., 1975; Finley, 1958; Johnson, 1966*b*; Raun, 1966*a*). They may be built over abandoned kangaroo rat (*Dipodomys*) burrows, in sand dunes or coarse grass, under rock ledges, or on rock outcrops (Bailey, 1931; Bee et al., 1981; Finley, 1958). Some dens are placed in holes in sides of gullies (Findley et al., 1975; Hill and Hibbard, 1943). Dimensions (in cm) of *N. micropus* dens are: mean height, 29, mean diameter, 84 (Cornely, 1979; Johnson, 1966*b*). Sticks ($\bar{X}$ = 2.1 kg), cholla ($\bar{X}$ = 1.96 kg), manure ($\bar{X}$ = 0.21 kg), and prickly pear ($\bar{X}$ = 0.05 kg) contribute the most mass and occur in the greatest number of dens (Cornely, 1979). Den height and diameter varies with the season; dens built in early fall are larger (Johnson, 1966*b*). Den size and mass of materials used in construction are more dependent on the availability of materials than collecting instinct (Cornely, 1979). Size and configuration of a den varies with the supporting plant; dens under cactus generally are taller (Johnson, 1966*b*).

Dens usually have three entrances, some up to five, around which thorny twigs and cactus are placed (Bailey, 1931; Bee et al., 1981; Johnson, 1966*b*). The entrances lead to a large chamber in the center of the den off of which are situated several side chambers that serve for food storage and one of which is a nest (Bee et al., 1981; Johnson, 1966*b*). The nest is a ball of fine grasses and is kept free of food remains and excrement (Bailey, 1905; Bee et al., 1981; Johnson, 1966*b*). The rest of the den generally is not kept clean, although in spring and fall remains of food and other material may be pushed out the entrances (Johnson, 1966*b*). Some dens have a burrow that leads from the center and opens away from the den edge (Bee et al., 1981; Johnson, 1966*b*). Trails may lead between dens and to feeding areas (Bailey, 1905). A system of radial runways leading from dens usually connects with a peripheral run encircling the cactus patch (Raun, 1966*a*).

GENETICS. The diploid number of chromosomes in *N. micropus* is 52; the fundamental number is 50 to 56 (Baker and Mascarello, 1969). The X chromosome is a large submetacentric or acrocentric (Baker and Mascarello, 1969; Baker et al., 1970; Hsu and Benirschke, 1968) and has one heterochromatic arm (Mascarello and Warner, 1974). The Y chromosome is a medium-sized subtelocentric (Baker and Mascarello, 1969; Baker et al., 1970); it is entirely heterochromatic (Mascarello and Warner, 1974). In males, the number of large biarmed elements varies from one to three and in females from one to four (Baker et al., 1970). The most common male karyotype consists of three large and four small biarmed chromosomes, a medium-sized subtelocentric, and a graded series of 44 acrocentric elements. The most common female karyotype consists of four large and four small biarmed chromosomes and a graded series of 44 acrocentric elements. The polymorphic system, which exists within and among populations, involves reciprocal variation between the number of biarmed and acrocentric chromosomes. The polymorphism results in no phenotypic differences and no obvious reproductive differences (Baker et al., 1970).

In the two largest autosomes, the short arm of the biarmed form and the proximal one-fourth of the acrocentric form are heterochromatic. Four forms exist: two submetacentric chromosomes; one submetacentric and one acrocentric chromosome; two acrocentric chromosomes; one submetacentric and one subtelocentric chromosome. The subtelocentric is the result of a partial deletion of the heterochromatin found in the submetacentric form. G-banding shows distinct homologies between the two largest autosomes in all four forms. The chromosomal variation was produced by at least two events (pericentric inversion and deletion) occurring in the same block of heterochromatin (Mascarello and Warner, 1974). Mascarello and Warner (1974) concluded that the submetacentric form is the ancestral form, and the subtelocentric and acrocentric forms are recent derivatives, because the number of individuals homozygous for the submetacentric form was 20% greater than the number of heterozygous individuals and more than three times as great as the number of individuals homozygous for the acrocentric form. There is no evidence of abnormal meiosis in male *N. micropus* (Warner, 1976).

Hemoglobin of *N. micropus* and laboratory-bred *N. micropus*/*N. floridana* hybrids has been studied using starch gel electrophoresis (Birney and Perez, 1971). Of the seven observed phenotypes, one was common to both species, three were present only in *N. floridana*, two were present only in *N. micropus*, and one was unique to the hybrids. The variation resulted from differences in the beta chain; at least three beta loci are involved in genetic control of hemoglobin. Proteins and hemoglobin of *N. micropus*, *N. albigula*, and *N. floridana* were also studied using electrophoresis (Birney, 1973; Zimmerman and Nejtek, 1977). Mascarello et al. (1974) compared the G-banding pattern of *N. micropus* to that of seven other species of rodents and suggested that the Muridae and Cricetidae should be combined. *N. micropus* has the probable primitive G-band karyotype for the genus; most sequences may be primitive for the Cricetidae (Koop et al., 1984; Koop et al., 1985). The karyotype of *N. floridana* is identical to that of *N. micropus* with two large submetacentric autosomes (Baker and Mascarello, 1969). The banding patterns of *N. micropus* and *N. albigula* differ only in *N. albigula* having additional amounts of heterochromatin (Mascarello and Hsu, 1976).

Neotoma micropus and *N. floridana* hybridize in Oklahoma (Spencer, 1968). Ecological factors may be the primary isolating mechanisms preventing interbreeding of the two species. The area of hybridization is characterized by typical woodland habitat (habitat preferred by *N. floridana*) bordering a grassland-yucca-cactus habitat (habitat preferred by *N. micropus*; Birney, 1973, 1976). Both species maintain high levels of specific integrity with little or no introgression (Birney, 1973). F_1, F_2, and intergrade offspring are fertile; there are no obvious behavioral isolating mechanisms (Spencer, 1968).

Hybridization between *N. micropus* and *N. albigula* is or has been widespread, extending throughout the range of *N. a. warreni*. A high proportion of individuals in southeastern Colorado, the Oklahoma Panhandle, and part of northern Texas are not typical of either species, but tend to be morphologically intermediate. Other specimens from this area can easily be assigned to one of the species (Birney, 1976). Hybridization primarily is limited to two arroyos in Baca Co., Colorado, and little introgression is occurring (Huheey, 1972). These two species intergrade in Chihuahua and possibly Coahuila (Anderson, 1969), although *N. micropus* from the interior of Chihuahua are distinct (Bogan and Williams, 1975). The areas of hybridization are at the extremes of the geographic zones of contact or overlap. Suitable habitat at these two sites may be limited.

REMARKS. The generic name, from the Greek *neos* meaning new and *tomos* meaning cut or cutting is an allusion to the teeth. The specific name is also from the Greek, *mikros* meaning small and *pous* meaning foot. Common names include: hoary woodrat, Baird wood rat, black wood rat, plains wood rat, southern plains woodrat, gray wood rat, and rata de campo.

The high coefficients of genetic similarity between *N. micropus*, *N. albigula*, and *N. floridana* indicate that there is little genetic differentiation with speciation and reflect the close relationship of the three species. These three species are semispecies (Zimmerman and Nejtek, 1977), conspecific, or sibling species (Hooper, 1960). The most recent revision (Birney, 1973) suggests that three subspecies be recognized: *N. m. planiceps*, restricted to the type locality; *N. m. micropus* (including *N. m. micropus* and *N. m. littoralis*), inhabiting the coastal plain of Tamaulipas; and *N. m. canescens* (including *N. m. canescens* and *N. m. leucophea*), inhabiting the remainder of the known range.

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Editors of this account were TROY L. BEST and SYDNEY ANDERSON. Managing editor was DON E. WILSON.

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