

Microtus breweri. By Robert H. Tamarin and Thomas H. Kunz

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Microtus breweri (Baird, 1857)

Beach Vole

Arvicola breweri Baird, 1857. Type from Muskeget Island, west of Nantucket Island, Massachusetts.

Microtus breweri Miller, 1896.

CONTEXT AND CONTENT. Order Rodentia, Suborder Myomorpha, Family Muridae, Subfamily Microtinae. The genus *Microtus* now includes approximately 47 species distributed in the Northern Hemisphere throughout the northern two-thirds of Eurasia, and in North America south to Guatemala (Ellerman and Morrison-Scott, 1951). *Microtus breweri* is an insular species and no known subspecies are recognized.

DIAGNOSIS. In comparison to *Microtus pennsylvanicus*, the most closely related insular and mainland species, *Microtus breweri* is distinguished by having a larger skull and, when

viewed from above; the braincase is longer and narrower, the occiput is depressed and widened, and the zygomatic arches are more abruptly flaring. The interparietal is longer and its antero-posterior diameter is shorter than its transverse diameter (figure 1). The body is larger and the pelage is paler and coarser in *M. breweri* than in *M. pennsylvanicus* (Miller, 1896). The posterior upper molar (figure 2) has a reduced number of closed triangles as compared to *M. pennsylvanicus* (Starrett, 1958).

GENERAL CHARACTERS. External measurements are, for males (N = 28): total length, 192.9 (169 to 215); tail, 51.9 (45 to 60); hind foot, 23.8 (22 to 25); for females (N = 44): total length, 181.2 (165 to 201); tail, 48.6 (35 to 55); hind foot, 23.4 (22 to 25). Cranial measurements are: condylo-basal length (N = 62), 29.8 (28.5 to 31.7); zygomatic breadth (N = 72), 17.2 (15.6 to 18.4); cranial length (N = 67), 13.1 (11.6 to 14.3); cranial breadth (N = 66), 11.2 (10.6 to 11.8); diastema length (N = 81), 8.7 (7.6 to 9.5); length of nasals (N = 70), 8.8 (7.7 to 9.9); least orbital breadth (N = 79), 3.4 (3.0 to 3.8); interparietal length (N = 66), 5.2 (3.6 to 6.8); interparietal breadth (N = 67), 8.8 (6.1 to 10.0). The above external and cranial measurements of the species are from Starrett (personal communication). For additional measurements of the species, see Miller (1896).

DISTRIBUTION. *Microtus breweri* is restricted to Muskeget Island, off the west coast of Nantucket, Massachusetts (figure 3). The glacial and recent history of the Cape area was summarized by Starrett (1958), and the recent history of Muskeget Island was summarized by Wetherbee *et al.* (1972). In essence, Muskeget lies just within the terminal moraine of the last glaciation. Due to tidal buildup and erosion, the island has moved eastwardly about 1.6 km (one mile) in the last 200 years. The island separated from its neighbors as recently as perhaps 2000 to 3000 years ago. In this time the taxonomic distinction of *Microtus breweri* has developed. There is no fossil record of *M. breweri*.

FORM AND FUNCTION. In *Microtus pennsylvanicus* and its near relatives, the pelage is of two types of hairs, excluding the vibrissae. There are short underhairs and longer, stiffer guard hairs. Most guard hairs are on the dorsal surface of the body and have gray bases and longer, dark brown apical portions. The underhairs are usually tricolored. In addition to a gray base and brown apex, the underhairs generally have a long central orange band. The dark brown tips may be absent from dorsal underhairs and are usually absent ventrally. The general color pattern of a vole is modified in *M. breweri* by a striking paleness due to a reduced number of dorsal guard hairs and a total lack of them on the sides, a high proportion of dorsal underhairs without the dark tip and with the orange band lightened to a yellow brown. Pigment is reduced in some hairs, and a high proportion of all white underhairs on the venter give it a nearly white appearance.

In addition to pallor, *M. breweri* has a grizzled appearance caused by the reduced number of guard hairs and increased numbers of bicolored underhairs dorsally. The feet are pale

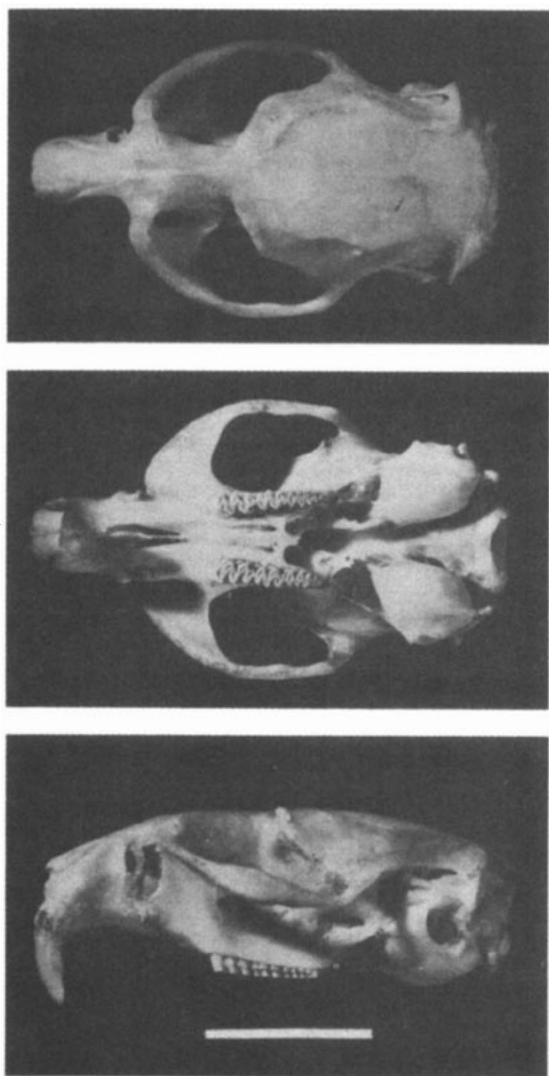


FIGURE 1. Photograph of dorsal, ventral and lateral views of skull of a female *Microtus breweri*. Line at bottom represents 10 mm.

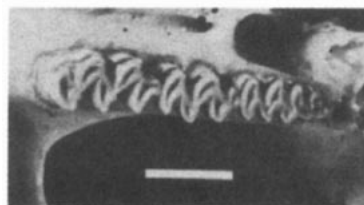


FIGURE 2. Photograph of occlusal view of right upper tooth-row of *Microtus breweri*. Line at bottom represents 2 mm.

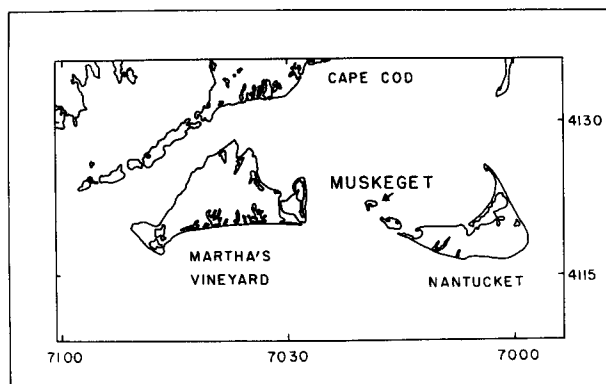


FIGURE 3. Map showing geographical location of Muskeget Island, Massachusetts.

due to silvery-colored hairs. The tail ranges from off-white to dark brown and from bicolor to uniform brown or white. In addition, the beach vole has a light-colored patch on each shoulder resulting from an absence of guard hairs, a dorsal extension of paler ventral underfur, and a reduction of the tricolor underfur that is more common on the dorsum (Starrett, 1958).

A distinctive characteristic of the beach vole is a blaze or white patch of fur observed in varying frequencies in samples taken from the island after 1893. The blaze varies in position and size, but is usually on the forehead, and less often on the chin or throat. The blaze may result from one or several white guard hairs or from a mixture of white guard hairs and white underfur (Starrett, 1958).

There are no sexual or seasonal differences in pelage color but in summer a grizzled appearance results from sparseness of fur. Another striking feature is that young voles have the same pallor as do adults (Starrett, 1958), although there is some variation among the young. In contrast, young of *M. pennsylvanicus* are much darker than adults.

A voluminous literature exists for *M. pennsylvanicus* but little is known of the functional aspects of *M. breweri*. Starrett (1958) found that cranial differences between species were accentuated in older *Microtus*, and young of *M. breweri* and *M. pennsylvanicus* are more difficult to distinguish than the adults of the two species. Miller (1896) reported breeding probably throughout the warm season and litters of four or five. No studies of reproduction or development have been published.

ECOLOGY. Muskeget Island is a small, low sandy island 1.9 by 0.8 km. The dominant plants in the major habitat of *M. breweri* are beach grass (*Ammophila breviligulata*), and poison ivy (*Rhus radicans*). There are also areas of fresh water, salt water marsh, and areas of bare sand. The vegetation was mapped by Wetherbee *et al.* (1972). The only other terrestrial mammal known to occur on the island is *Peromyscus leucopus*. The island serves as a major breeding ground for herring gulls (*Larus argentatus*) and great black-backed gulls (*Larus marinus*).

Although the population at several times has been small, and founder effects and genetic drift may have occurred, the distinctive features of size and color probably are advantageous even though the exact selective pressures may be unknown. Predation could cause a pale population by removing melanistic voles, which would be more visible on the pale (sandy) substrate. Starrett (1958) reported predation by marsh hawks (*Circus cyaneus*) and short-eared owls (*Asio flammeus*), and concluded that Muskeget has high effective predation, primarily by the owls. This predation may account for the change in color and also act as a check on population size. Large mice seem to occur commonly on islands (Tomich *et al.*, 1968; Berry, 1964), although the nature of any selective pressure here is open to speculation.

In habits, the beach vole closely resembles the meadow vole, *M. pennsylvanicus*. Runways are constructed above ground through the beach grass. In open areas, runways are less distinct. The runways often contain grass cuttings. Nests are constructed both above and below ground. Tunnels seem more common in winter. Nests containing young resemble those of *M. pennsylvanicus* and may be constructed at the base of golden rod (*Solidago*) or beneath fragments of wreckage. If no such shelter is available, these voles construct short bur-

rows (from 30 to 60 cm long) at a steep slope of 45 degrees, presumably to reach more rapidly the moist, compact sand below. The end of the tunnel is filled with a bulky nest. Apparently the beach vole prefers the lower, wetter, grassy areas and during periods of low abundance they are restricted to this habitat (Miller, 1896).

Microtine rodents are well known for their cyclic changes in population densities (Elton, 1942) and *M. pennsylvanicus* in the northeastern United States is no exception (Hamilton, 1941). After trapping in July of 1953 and 1954, Starrett (1958) suggested that 1954 was a low year for densities of voles on Muskeget as well as other islands in the area. J. Clinton Andrews, a naturalist on Nantucket, reported (personal communication) changes in *M. breweri* density in synchrony with changes of *M. pennsylvanicus* on Nantucket, but neither population has been adequately studied. Population cycles on small islands are interesting theoretically, as enclosed populations in areas of up to 0.8 hectare (two acres) do not cycle as they do in unrestricted areas (Krebs *et al.*, 1969).

Miller (1896) reported that beach voles eat the tender bases of beach grass stalks. In autumn, they store much grass for winter food by burying it in the sand where it stays damp and fresh. These caches of grass consist of entire stalks and parts are later selected for food. There are no other comparable herbivores on the island.

GENETICS. The karyotype of *Microtus breweri* has not been published. Maurer (1967) reported a polymorphism in the plasma transferrins and (1969) a cline in transferrin gene frequency from North Dakota to Massachusetts for *M. pennsylvanicus* and included data of *M. breweri*. In general, the Massachusetts islands showed considerable variability, and *M. breweri* did not fit the clinal model. *M. breweri* was almost fixed for an allele that was generally in low frequency at the Massachusetts end of the cline (*Trj^h*).

Coat color was studied by Starrett (1958) but the genetics of coat color is unknown. The distinctive white blaze is attributed to a "founder effect" of the small population in the 1890's. According to Miller (1896), *M. breweri* became extinct on Muskeget in 1891, presumably due to feral cat predation. Samples taken prior to this time had no blaze. Miller subsequently re-introduced 26 animals in 1893 from a small population on the now extinct Southwest Point Island.

REMARKS. *M. breweri* has gone through several taxonomic revisions, and its species status today is still questioned by some. The specific name *breweri* is commemorative, proposed to honor Dr. T. M. Brewer, its discoverer (Baird, 1857:525). Allen (1869) reduced *A. breweri* to a race of the meadow vole, *A. riparius* [= *pennsylvanicus*], because some beach voles were of the ordinary color, and some meadow voles, living on the sand dunes at Ipswich, Massachusetts, had a light color similar to that of the beach vole. Merriam in 1888 elevated the beach vole again to species status. Starrett (1958), on the basis of pelage color and cranial characteristics supported a specific status for *M. breweri*. Wetherbee *et al.* (1972), however, reported that they have cross bred beach and meadow voles in the laboratory. They give no further details, and it is doubtful whether this fact will change the species status of this insular taxon.

Muskeget Island, with its endemic species *M. breweri*, provides an excellent natural laboratory and the population ecology, genetics, and behavior of this interesting species are currently under study (by Tamarin).

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