Meadow Vole

Microtus pennsylvanicus (Ord, 1815)

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CONTENT AND TAXONOMIC COMMENTS

There are currently 27 subspecies of the meadow vole (*Microtus pennsylvanicus*) recognized (Hall 1981, Reich 1981, Hoffman and Koeppl 1985, Woods et al. 1982); three occur in the South: *M. p. dukecampbelli*, *M. p. nigrans*, and *M. p. pennsylvanicus*. The literature was reviewed by Reich (1981) and Johnson and Johnson (1982).

DISTINGUISHING CHARACTERISTICS

The meadow vole is a large vole with a moderately long tail. The measurements are: total length 140–198 mm; tail 33–56 mm; hind foot 16–25 mm; ear 11–18 mm; weight 25–65 g. The pelage is yellowish chestnut to dull brown dorsally and silver-gray ventrally with a slightly bicolor tail. The dental formula is: I 1/1, C 0/0, P 0/0, M 3/3 = 16 (Figure 1). The skull is distinctive with the third upper molar having three closed triangles, the first lower molar five (sometimes six) closed triangles, and the third lower molar three transverse loops and no closed triangles. See keys for details.

CONSERVATION STATUS

The Florida salt marsh vole (*M. p. dukecampbelli*) is listed as Endangered by the U. S. Fish and Wildlife Service (U. S. Department of the Interior 1997, 2007). The meadow vole has a global rank of Secure (NatureServe 2007). The species is also considered Secure in those states where it occurs within the region, except for Georgia where it is listed as Vulnerable. It is unranked in Florida and South Carolina; however, South Carolina monitors *M. p. pennsylvanicus* as a Species of Concern.

DISTRIBUTION

The meadow vole is the most widely-distributed North American *Microtus*, ranging from the Alaskan and trans-Canadian Arctic south across much of the northern United States (Figure 2). Regionally, the meadow vole occurs throughout Virginia from the Delmarva Peninsula and coastal islands to the Appalachians (Jackson et al. 1976, Dueser et al. 1979, Handley 1979, Carter and Merritt 1981, Cranford and Maly 1986, Cranford and Maly 1990, Rose et al. 1990, Pagels et al. 1992). It also is widely distributed in

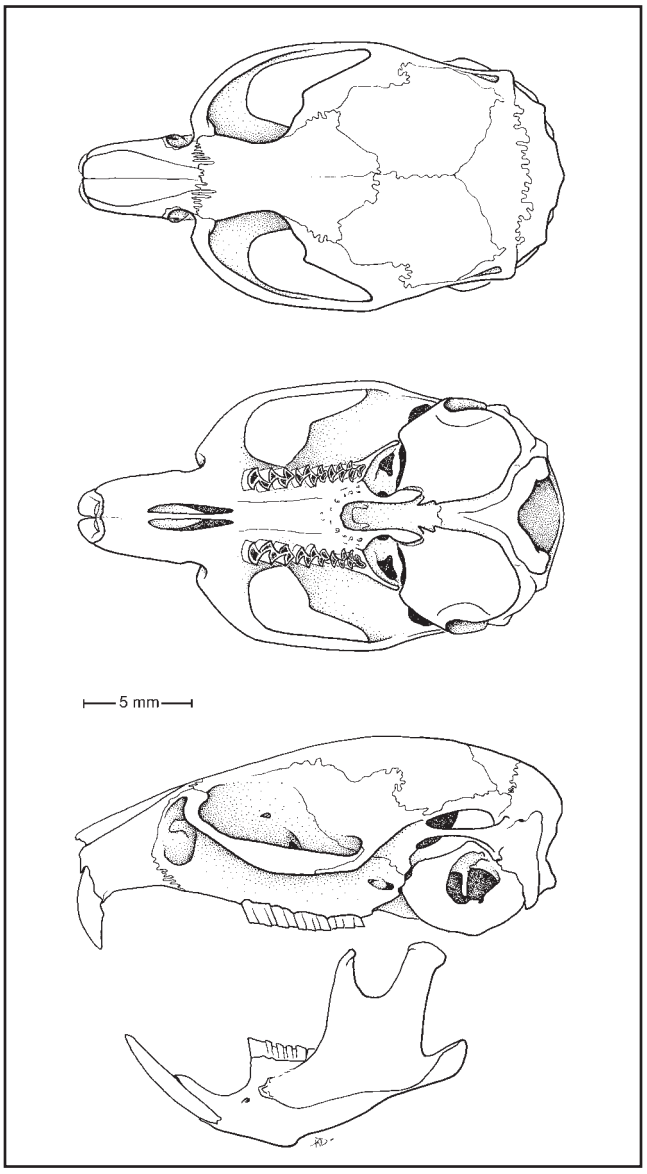

Figure 1. Dorsal, ventral, and lateral view of cranium and lateral view of mandible of *Microtus pennsylvanicus* from Grafton County, New Hampshire (USNM 294792, female).

North Carolina, except the Coastal Plain south of the Pamlico River (Linzey and Linzey 1967, Lee et al. 1982, Clark et al. 1985, Webster et al. 1985, Adams et al. 1987). Most of Virginia and North Carolina are occupied by *M. p. pennsylvanicus*; however, specimens from southeastern Virginia and northeastern North

Carolina in and around the Great Dismal Swamp are referable to *M. p. nigrans*. In South Carolina, the meadow vole has been reported from the western Piedmont and Blue Ridge, the Upper Coastal Plain at the Savannah River Site, and from coastal areas of Charleston County including several barrier islands (Cottam and Nelson 1937, Golley 1966, Sanders 1978, Chamberlain 1979, Webster et al. 1985, Feldhamer et al. 1987, Hart 2000). Georgia populations are restricted to the upper Piedmont and scattered localities in the Blue Ridge in the northeastern part of the state (Odum 1948, Golley 1962, Laerm et al. 1982). Tennessee records occur mainly in the northeast portion of the state in the Blue Ridge and Ridge and Valley (Smith et al. 1974), although the species probably is present throughout much of eastern Tennessee along the Virginia and Kentucky borders. In Kentucky, it is present in the Bluegrass Region (Barbour and Davis 1974), and recent records indicate presence throughout the Cumberland Plateau and Mountains to the south and east (S. Thomas, National Park Service, personal communication), perhaps attributed in part to the abundance of reclaimed surface mines in the eastern coalfields. *Microtus p. dukecampbelli* was described by Woods et al. (1982) as a Pleistocene relict, isolated from other *M. pennsylvanicus* populations and restricted to high saltmarsh habitat in a single locality in Levy County, Florida (Woods et al. 1982, Smith 1990, Woods 1992).

ABUNDANCE STATUS

Regional patterns of the species distribution and abundance are complex. Meadow voles are very common in the Bluegrass of central Kentucky (Barbour and Davis 1974) and throughout much of Virginia, but often rare in the Piedmont and Upper Coastal Plain in the Carolinas and Georgia (Golley 1966, Lee et al. 1982, Webster et al. 1985). Paradoxically, it can be locally common along the Atlantic coast (Feldhamer et al. 1987). Throughout forested regions of Appalachia, it is mostly restricted to grassy roadsides, montane meadows, and wildlife openings (Menzel et al. 1999). Recent surveys for *M. p. dukecampbelli* in Florida indicate the current population is very low – only a single specimen taken in a reported 1,025 trap night survey (Woods 1992). Densities in northern United States and southern Canada range from 10–410/ha (Whitaker and Hamilton 1998). Similar to other microtines, the meadow vole is susceptible to competition with other small mammals and dramatic cyclic population fluctuations (Rose and Birney 1985, Taitt and Krebs 1985, Getz et al. 1987, Krupa and Haskins 1996, Getz et al. 2001).

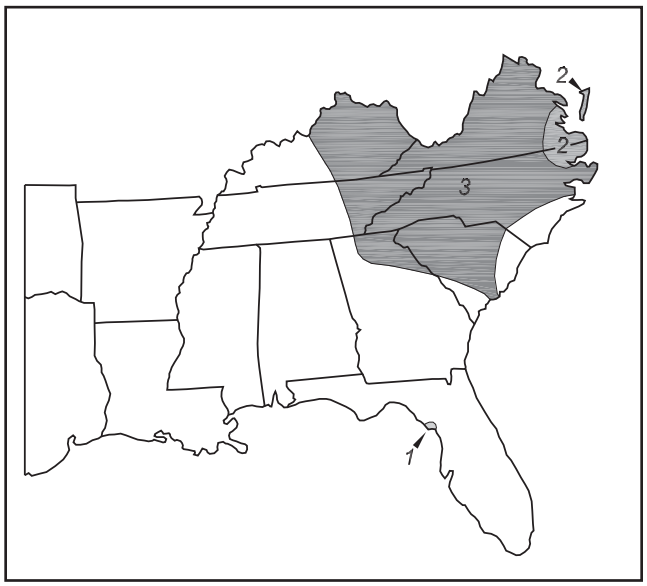

Figure 2. Distribution of *Microtus pennsylvanicus* in the South: (1) *M. p. dukecampbelli*; (2) *M. p. nigrans; (3) M. p. pennsylvanicus*.

PRIMARY HABITATS

The meadow vole inhabits a diversity of open habitats with low, dense vegetative cover (Getz 1985, Getz et al. 2001) including coastal and salt marshes, grassy meadows, pastures, fence rows, reclaimed surface mines, early successional seres, montane meadows, and bogs with thick grasses and sedges (Odum 1949, Harris 1953, Woods et al. 1982, Linzey and Cranford 1984, Linzey 1984, Rose 1986, Kirkland 1988, Cranford and Maly 1990, Pagels et al. 1992, Woods 1992, Kalko and Handley 1993, Francl 2003). The species typically is absent from later successional stages of forests (Pagels et al. 1992, Kalko and Handley 1993), but has been reported from isolated shrubby dominated forest clearings with a grassy understory (Getz 1985).

REPRODUCTION

The breeding season is year-round with highest activity in summer and lowest in winter (Keller 1985, Rose 1986). Gestation is 20–21 days; mean litter size ranges from 4.0–6.0 (Reich 1981, Nadeau 1985). Young are weaned 11–14 days (Nadeau 1985). Meadow voles are prolific breeders capable of multiple litters annually (Whitaker and Hamilton 1998). Longevity estimates in the field range from 2–16 months (Beer and MacLeod 1961, Hamilton 1941).

FOOD HABITS

The meadow vole feeds on a variety of plant stems, leaves, flowers, seeds, and roots, as well as fungi, insects, and occasionally carrion (Zimmerman 1965, Fish 1974, Batzli 1985). The species caches food for use in the dormant season (Whitaker and Hamilton 1998).

ASSOCIATED SPECIES

Common faunal associates of the meadow vole include the least shrew (*Cryptotis parva*), marsh rice rat (*Oryzomys palustris*), white-footed mouse (*Peromyscus leucopus*), eastern harvest mouse (*Reithrodontomys humulis*), hispid cotton rat (*Sigmodon hispidus*), prairie vole (*Microtus ochrogaster*), southern bog lemming (*Synaptomys cooperi*), and meadow jumping mouse (*Zapus hudsonius*). It apparently avoids microhabitats inhabited by the northern short-tailed shrew (*Blarina brevicauda*; Eadie 1952, Funk 1972). Competitive interactions may play a significant role in the limited distribution and patchiness of regional meadow vole populations (Rose and Birney 1985).

VULNERABILITY AND THREATS

Throughout most of its range, the meadow vole is a common component of grassland small mammal communities with few threats to its long-term viability. Conversely, isolated populations such as those in coastal South Carolina (which may represent an undescribed subspecies) and those in Florida may be highly vulnerable. Given the dramatic population fluctuations that characterize microtines in general, the possibility for competitive exclusion by other rodent species, the inundation of coastal areas by storms, and habitat destruction due to development, these populations are beset with a myriad of serious threats (Woods 1992, U. S. Fish and Wildlife Service 1997).

MANAGEMENT SUGGESTIONS

Preventing woody succession through the maintenance of grassy habitats such as wildlife openings, relict prairies, powerline, railroad and highway rights-of-way, and pastures by mowing, grazing, or herbicide control are beneficial to the meadow vole.

REFERENCES

Adams, W. F., C. S. Pike, III, W. D. Webster, and J. F. Parnell. 1987. Composition of barn owl, *Tyto alba*, pellets from two locations in North Carolina. Journal of the Elisha Mitchell Scientific Society 102:16–18.

Barbour, R. W., and W. H. Davis. 1974. Mammals of Kentucky. University of Kentucky, Lexington, Kentucky, USA.

Batzli, G. O. 1985. Nutrition. Pages 779–811 *in* R. H. Tamarin, editor. Biology of New World Microtus. Special Publication, American Society of Mammalogists 8:1–893.

Beer, J. R., and C. F. MacLeod. 1961. Seasonal reproduction in the meadow vole. Journal of Mammalogy 42:483–489.

Carter, J. L., and J. F. Merritt. 1981. Evaluation of swimming ability as a means of island invasion by small mammals in coastal Virginia. Annals of the Carnegie Museum 50:31–46.

Chamberlain, W. D. 1979. Diet of the barn owl on a South Carolina barrier island. Chat 43:64–65.

Clark, M. K., D. S. Lee, and J. B. Funderburg, Jr. 1985. The mammal fauna of Carolina bays, pocosins, and associated communities in North Carolina. Brimleyana 11:1–38.

Cottam, C., and A. L. Nelson. 1937. Winter nesting and winter food of the barn owl in South Carolina. Wilson Bulletin 49:283–285.

Cranford, J. A., and M. S. Maly. 1986. Habitat associations among small mammals in an oldfield community on Butt Mountain, Virginia. Virginia Journal of Science 37:172.

Cranford, J. A., and M. S. Maly. 1990. Small mammal population densities and habitat associations on Chincoteague National Wildlife Refuge, Assateague Island, Virginia. Virginia Journal of Science 41:321–329.

Dueser, R. D., W. C. Brown, G. S. Hogue, C. McCaffrey, S. A. McCuskey, and G. J. Hennessey. 1979. Mammals on the Virginia barrier islands. Journal of Mammalogy 60:425–429.

Eadie, W. R. 1952. Shrew predation and vole population on a localized area. Journal of Mammalogy 33:185–189.

Feldhamer, G. A., M. B. Epstein, and W. B. Taliaferro. 1987. Prey remains in barn owl pellets from a South Carolina barrier island. Georgia Journal of Science 45:148–151.

Fish, P. G., 1974. Notes on the feeding habits of *Microtus ochrogaster* and *M. pennsylvanicus*. American Midland Naturalist 92:460–461.

Francl, K. 2003. Community characterization of high elevation central Appalachian wetlands. Dissertation, University of Georgia, Athens, Georgia, USA.

Funk, G. W. 1972. The effect of shrews on the space utilization of voles. Journal of Mammalogy 53:461–478.

Getz, L. L. 1985. Habitats. Pages 286–309 *in* R. H. Tamarin, editor. Biology of New World *Microtus*. Special Publication, American Society of Mammalogists 8:1–893.

Getz, L. L., J. E. Hoffman, and C. S. Carter. 1987. Fourteen years of population fluctuations of *Microtus ochrogaster* and *M. pennsylvanicus* in east central Illinois. Canadian Journal of Zoology 65:1317–1325.

Getz, L. L., J. E. Hoffman, B. McGuire, and T. W. Dolan III. 2001. Twenty-five years of population fluctuations of *Microtus ochrogaster* and *M. pennsylvanicus* in three habitats in east-central Illinois. Journal of Mammalogy 82:22–34.

Golley, F. B. 1962. Mammals of Georgia: A study of their distribution and functional role in the ecosystem. University of Georgia, Athens, Georgia, USA.

Golley, F. B. 1966. The mammals of South Carolina. Contributions from the Charleston Museum XV, Charleston, South Carolina, USA.

Hall, E. R. 1981. The mammals of North America. Volume 2. John Wiley and Sons, New York, New York, USA.

Hamilton, W. J., Jr. 1941. Reproduction in the field mouse (*Microtus pennsylvanicus*). Cornell University Agricultural Experiment Station, Memoirs 237:3–23.

Handley, C. O., Jr. 1979. Mammals of the Dismal Swamp: A historical account. Pages 297–357 *in* P. W. Kirk, Jr., editor. The Great Dismal Swamp. University of Virginia, Charlottesville, Virginia, USA.

Harris, V. T. 1953. Ecological relationships of meadow voles and rice rats in tidal marshes. Journal of Mammalogy 34:479–487.

Hart, E. B. 2000. The meadow vole, *Microtus pennsylvanicus*, in western South Carolina. South Carolina Academy of Science Bulletin 62:62.

Hoffman, R. S., and J. W. Koeppl. 1985. Zoogeography. Pages 85–115 *in* R. H. Tamarin, editor. Biology of New World *Microtus*. Special Publication, American Society of Mammalogists 8:1–893.

Jackson, R. S., J. F. Pagels, and D. N. Trumbo. 1976. The mammals of Presquille, Chesterfield County, Virginia. Virginia Journal of Science 27:20–23.

Johnson, M. L., and S. Johnson. 1982. Voles. Pages 327–354 *in* J. A. Chapman and G. A. Feldhamer, editors. Wild mammals of North America. Johns Hopkins University, Baltimore, Maryland, USA.

Kalko, E. K., and C. O. Handley, Jr. 1993. Comparative studies of small mammal populations with transects of snap traps and pitfall arrays in southwestern Virginia. Virginia Journal of Science 44:3–18.

Keller, B. L. 1985. Reproductive patterns. Pages 725–778 *in* R. H. Tamarin, editor. Biology of New World *Microtus*. Special Publication, American Society of Mammalogists 8:1–893.

Kirkland, G. L., Jr. 1988. Meadow voles (*Microtus pennsylvanicus*) on forest clearcuts: The role of long distance dispersal. Journal of the Pennsylvania Academy of Science 62:83–85.

Krupa, J. J., and K. E. Haskins. 1996. Invasion of the meadow vole (*Microtus pennsylvanicus*) in southeastern Kentucky and its possible impact on the southern bog lemming (*Synaptomys cooperi*). American Midland Naturalist 135:14–22.

Laerm, J., L. E. Logan, M. E. McGhee, and H. N. Neuhauser. 1982. Annotated checklist of the mammals of Georgia. Brimleyana 7:121–135.

Lee, S. D., J. B. Funderburg, Jr. and M. K. Clark. 1982. A distributional survey of North Carolina mammals. Occasional Papers of the North Carolina Biological Survey. Raleigh, North Carolina, USA.

Linzey, A. V. 1984. Patterns of coexistence in *Synaptomys cooperi* and *Microtus pennsylvanicus*. Ecology 65:382–393.

Linzey, A. V. and J. A. Cranford. 1984. Habitat selection in the southern bog lemming, *Synaptomys cooperi*, and the meadow vole, *Microtus pennsylvanicus*, in Virginia. Canadian Field Naturalist 94:462–469.

Linzey, A. V. and D. W. Linzey. 1967. *Microtus pennsylvanicus* in North Carolina and Tennessee. Journal of Mammalogy 48:310.

Menzel, M. A., W. M. Ford, J. Laerm, and D. Krishon. 1999. Forest to food plot: Habitat gradient analysis among small mammals in the southern Appalachians. Forest Ecology and Management 114:233–244.

Nadeau, J. H. 1985. Ontogeny. Pages 254–285 *in* R. H. Tamarin, editor. Biology of New World *Microtus*. Special Publication, American Society of Mammalogists 8:1–893.

NatureServe. 2007. An online encyclopedia of life [Database]. Version 6.1. Association for Biodiversity Information. *http://www.natureserve.org/*.

Odum, E. P. 1948. *Microtus* from the Piedmont of Georgia. Journal of Mammalogy 29:74.

Odum, E. P. 1949. Small mammals of the Highlands (North Carolina) Plateau. Journal of Mammalogy 30:179–192.

Pagels, J. F., S. Y. Erdle, K. L. Uthus, and J. C. Mitchell. 1992. Small mammal diversity in forested and clearcut habitats in the Virginia Piedmont. Virginia Journal of Science 43:171–176.

Reich, L. M. 1981. Microtus pennsylvanicus. Mammalian Species 159:1–8.

Rose, R. K. 1986. Reproductive strategies of meadow voles, hispid cotton rats, and eastern harvest mice in Virginia. Virginia Journal of Science 37:230–239.

Rose, R. K., and E. C. Birney. 1985. Community ecology. Pages 310–339 *in* R. H. Tamarin, editor. Biology of New World *Microtus*. Special Publication, American Society of Mammalogists 8:1–893.

Rose, R. K., R. K. Everton, J. F. Stankavitch, and J. W. Walke. 1990. Small mammals in the Great Dismal Swamp of Virginia and North Carolina. Brimleyana 16:87–101.

Sanders, A. E. 1978. Mammals of the coastal zone of South Carolina. Pages 296–308 *in* R. G. Zingmark, editor. An annotated checklist of the biota of the coastal zone of South Carolina. University of South Carolina, Columbia, South Carolina, USA.

Smith, C. R., J. Giles, M. E. Richardson, J. Nagel, and D. W. Yambert. 1974. The mammals of northeastern Tennessee. Journal of the Tennessee Academy of Science 49:88–94.

Smith, L. H. 1990. The saltmarsh vole. Florida Naturalist 63:5–8.

Taitt, M. J., and C. J. Krebs. 1985. Population dynamics and cycles. Pages 567–620 *in* R. H. Tamarin, editor. Biology of New World *Microtus*. Special Publication, American Society of Mammalogists 8:1–893.

U. S. Department of the Interior, Fish and Wildlife Service. 2007. Southeast Region 4. *http://www.endangered.fws.gov/wildlife/html*.

U. S. Department of the Interior, Fish and Wildlife Service. 1997. Recovery plan for the Florida salt marsh vole. U. S. Fish and Wildlife Service, Atlanta, Georgia, USA.

Webster, W. D., J. F. Parnell, and W. C. Biggs. 1985. Mammals of the Carolinas, Virginia and Maryland. University of North Carolina, Chapel Hill, North Carolina, USA.

Whitaker, J. O. and W. J. Hamilton. 1998. Mammals of the eastern United States. Cornell University, Ithaca, New York, USA.

Woods, C. A. 1992. Florida saltmarsh vole: *Microtus pennsylvanicus dukecampbelli*. Pages 131–139 *in* S. H. Humphrey, editor. Rare and endangered biota of Florida, Volume 1. Mammals. University of Florida, Gainesville, Florida, USA.

Woods, C. A., W. Post, and C. W. Kilpatrick. 1982. *Microtus pennsylvanicus* (Rodentia: Muridae) in Florida: A Pleistocene relict in a coastal salt marsh. Bulletin of the Florida State Museum. Biological Sciences 28:25–52.

Zimmerman, E. G. 1965. A comparison of habitat and food of two species of *Microtus*. Journal of Mammalogy 46:605–612.