

Meadow vole

From Wikipedia, the free encyclopedia

The **meadow vole** (*Microtus pennsylvanicus*), sometimes called the **field mouse** or **meadow mouse**, is a North American vole found across Canada, Alaska and the northern United States. Its range extends further south along the Atlantic coast. One subspecies, the Florida salt marsh vole (*M. p. dukecampbelli*), is found in Florida, and is classified as endangered. Previously it was also found in Chihuahua, Mexico, but has not been recorded since 1998.

The meadow vole is active year-round, usually at night. It also digs underground burrows, where it stores food for the winter and females give birth to their young. Although these animals tend to live close together, they are aggressive towards one another. This is particularly evident in males during the breeding season. They can cause damage to fruit trees, garden plants, and commercial grain crops.

Contents

- 1 Distribution
- 2 Plant communities
- 3 Habits
- 4 Reproduction
- 5 Habitat
- 6 Cover requirements
- 7 Diets
- 8 Predators
- 9 Management
- 10 Ecological importance
- 11 See also
- 12 Notes
- 13 External links

Distribution

The meadow vole has the widest distribution of any North American species of *Microtus*. It ranges from Labrador west to Alaska and south from Labrador and New Brunswick to South Carolina and extreme northeastern Georgia; east through Tennessee, Missouri, north-central Nebraska, the northern half of Wyoming, and central Washington to Alaska; south through Idaho into north-central Utah. It is excluded only from the extreme polar regions. A disjunct subset of its range occurs from central Colorado to northwestern New Mexico.^{[2][3]} The United States portion of the Souris River is alternately known as the Mouse River because of the large numbers of field mice that lived along its banks.

Meadow vole



Conservation status



Least Concern (IUCN 3.1)^[1]

Scientific classification

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Rodentia

Family: Cricetidae

Genus: *Microtus*

Subgenus: *Mynomes*

Species: *M. pennsylvanicus*

Binomial name

Microtus pennsylvanicus

(Ord, 1815)



Plant communities

Meadow voles are most commonly found in grasslands, preferring moister areas, but are also found in wooded areas.^[3] In eastern Washington and northern Idaho, meadow voles are found in relative abundance in sedge (*Carex* spp.) fens, but not in adjacent cedar (*Thuja* spp.)-hemlock (*Tsuga* spp.), Douglas-fir (*Pseudotsuga menziesii*), or ponderosa pine (*Pinus ponderosa*) forests. Meadow voles are also absent from fescue (*Festuca* spp.)-snowberry (*Symphoricarpos* spp.) associations. Moisture may be a major factor in habitat use; possibly the presence of free water is a deciding factor. In southeastern Montana, meadow voles were the second-most abundant small mammal (after deer mice, *Peromyscus maniculatus*) in riparian areas within big sagebrush (*Artemisia tridentata*)-buffalo grass (*Buchloe dactyloides*) habitats.^[4] Meadow voles are listed as riparian-dependent vertebrates in the Snake River drainage of Wyoming. In a compilation of 11 studies^[5] on small mammals, meadow voles were reported in only three of 29 sites in subalpine forests of the central Rocky Mountains. Their range extensions were likely to be related to irrigation practices.^[6] They are now common in hayfields, pastures, and along ditches in the Rocky Mountain states.^[7]



Meadow vole

In Pipestone National Monument, Minnesota, meadow voles were present in riparian shrublands, tallgrass prairie, and other habitats.^[8] In east-central Ohio, meadow voles were captured in reconstructed common cattail (*Typha latifolia*) wetlands.^[9] In Virginia, meadow voles were least abundant in eastern red cedar (*Juniperus virginiana*) glades and most abundant in fields with dense grass cover.^[10]

Habits

Meadow voles are active year-round^{[11][12]} and day or night, with no clear 24-hour rhythm in many areas.^[13] Most changes in activity are imposed by season, habitat, cover, temperature, and other factors. Meadow voles have to eat frequently, and their active periods (every two to three hours) are associated with food digestion.^{[11][12]} In Canada, meadow voles are active the first few hours after dawn and during the two- to four-hour period before sunset. Most of the inactive period is spent in the nest.^[12]

Reproduction

Gestation lasts 20 to 23 days.^[12] Neonates are pink and hairless, with closed eyes and ears. Fur begins to appear by three days, and young are completely furred except for the belly by seven days. Eyes and ears open by eight days. Weaning occurs from 12 to 14 days. Young born in spring and early summer attain adult weight in 12 weeks, but undergo a fall weight loss. Young born in late summer continue growing through the fall and maintain their weight through the winter. Maximum size is reached between two and 10 months.^{[3][12]}

Typical meadow vole litters consist of four to six young, with extremes of one and 11 young. On average, 2.6 young are successfully weaned per litter. Litter size is not significantly correlated with latitude, elevation, or population density. Fall, winter, and spring litters tend to be smaller than summer litters. Litter size was positively correlated with body size, and is not significantly different in primiparous and multiparous females.^[3] Primiparous females had fewer young per litter than multiparous females.^[12] Litter size was constant in summer breeding periods at different population densities.^[3] Female meadow voles reach reproductive maturity earlier than males; some ovulate and become pregnant as early as three weeks old. Males are usually six to eight weeks old before mature sperm are produced.^[12] One captive female produced 17 litters in one year for a total of 83 young. One of her young produced 13 litters (totalling 78 young) before she was a year old.^[14]

Patterns of mortality apparently vary among meadow vole populations. The average meadow vole lifespan is less than one month because of high nestling and juvenile mortality.^[11] The average time adults are recapturable in a given habitat is about two months, suggesting the average extended lifespan (i.e. how much time adult meadow voles have left) is about two months, not figuring in emigration.^[11] Mortality was 88% for the first 30 days after birth,^[15] and postnestling juveniles had the highest mortality rate (61%), followed by young adults (58%) and older age groups (53%).^[16] Nestlings were estimated to have the lowest mortality rate (50%). Estimated mean longevity ranges from two to 16 months.^[3] The maximum lifespan in the wild is 16 months,^[11] and few voles live more than two years.^[12]



A young meadow vole in the open

Meadow vole populations fluctuate annually and also tend to reach peak densities at two- to five-year intervals, with population declines in intervening years.^{[11][12][17]} Breeding often ceases in January and starts again in March.^[12] Over the course of a year, meadow vole populations tend to be lowest in early spring; the population increases rapidly through summer and fall.^[12]

In years of average population sizes, typical meadow vole population density is about 15 to 45 meadow voles per acre in old-field habitat. In peak years, their population densities may reach 150 per acre in marsh habitat (more favorable for meadow voles than old fields).^[11] Peak meadow vole abundance can exceed 1,482 meadow voles per acre (600/ha) in northern prairie wetlands.^[18] Meadow voles in optimal habitats in Virginia (old fields with dense vegetation) reached densities of 983/ac (398/ha); populations declined to 67/ac (27/ha) at the lowest point in the cycle.^[10] Different factors influencing population density have been assigned primary importance by different authors. Reich^[3] listed the following factors as having been suggested by different authors: food quality, predation, climatic events, density-related physiological stress, and the presence of genetically determined behavioral variants among dispersing individuals.

Normal population cycles do not occur when dispersal is prevented; under normal conditions, dispersers have been shown to be behaviorally, genetically, and demographically different from residents.^[3] A threshold density of cover is thought to be needed for meadow vole populations to increase.^[19] Above the threshold amount, the quantity of cover influences the amplitude and possibly the duration of the population peak. Local patches of dense cover could serve as source populations or reservoirs to colonize less favorable habitats with sparse cover.^[19]

Meadow voles form extensive colonies and develop communal latrine areas. They are socially aggressive and agonistic; females dominate males and males fight amongst themselves.^[11]

Habitat

Optimal meadow vole habitat consists of moist, dense grassland with substantial amounts of plant litter. Habitat selection is largely influenced by relative ground cover of grasses and forbs; soil temperature, moisture, sodium, potassium, and pH levels; humidity; and interspecific competition.^{[19][20]} Meadow voles are most commonly associated with sites having high soil moisture.^[21] They are often restricted to the wetter microsites when they occur in sympatry with prairie voles (*Microtus ochrogaster*) or montane voles.^[19] In an Iowa prairie restoration project, meadow voles experienced an initial population increase during the initial stage of vegetation succession (old field dominated by foxtail grass (*Setaria* spp.), red clover (*Trifolium pratense*), annual ragweed (*Ambrosia artemisiifolia*), alfalfa (*Medicago sativa*), and thistles *Cirsium* spp.). However, populations reached their peak abundance during the perennial grass stage of succession from old field to tallgrass prairie.^[22] Meadow vole habitat devoid of tree cover and grasses dominated the herb

layer.^[23] with low tolerance for habitat variation (i. e., a species that is intolerant of variations in habitat, is restricted to few habitats, and/or uses habitats less evenly than tolerant species).^[23]

In most areas, meadow voles clearly prefer habitat with dense vegetation. In tallgrass prairie at Pipestone National Monument, they were positively associated with dense vegetation and litter.^[8] The variables important to meadow vole habitat in Virginia include vegetative cover reaching a height of 8 to 16 inches (20–41 cm) and presence of litter.^[24] Meadow voles appeared to be randomly distributed within a grassland habitat in southern Quebec.^[25] Grant and Morris^[25] were not able to establish any association of meadow vole abundance with particular plant species. They were also unable to distinguish between food and cover as the determining factor in meadow vole association with dense vegetation.



Meadow vole on the ground amid strands of grass in Virginia, USA

In eastern Massachusetts, meadow vole density on a mosaic of grassy fields and mixed woods was positively correlated with decreasing vertical woody stem density and decreasing shrub cover. Density was highest on plots with more forbs and grasses and less with woody cover; meadow voles preferred woody cover over sparse vegetation where grassy cover was not available.^[26]

In West Virginia, the only forested habitats in which meadow voles were captured were seedling stands.^[27] In South Dakota, meadow voles prefer grasslands to Rocky Mountain juniper (*Juniperus scopulorum*) woodlands.^[28] In New Mexico, meadow voles were captured in stands of grasses, wild rose (*Rosa* spp.), prickly pear (*Opuntia* spp.), and various forbs; meadow voles were also captured in wet areas with tall marsh grasses.^[29]

Open habitat with a thick mat of perennial grass favors voles.^[30] In west-central Illinois, they were the most common small mammals on Indian grass (*Sorghastrum nutans*)-dominated and switchgrass (*Panicum virginicus*)-dominated study plots. They were present in very low numbers on orchard grass (*Dactylis glomerata*)-dominated plots. The most stable population occurred on unburned big bluestem (*Andropogon gerardii*)-dominated plots.^[31] In Ontario, meadow voles and white-footed mice (*Peromyscus leucopus*) occur together in ecotones. Meadow voles were the most common small mammals in oak savanna/tallgrass prairie dominated by northern pin oak (*Quercus palustris*) and grasses including bluejoint reedgrass (*Calamagrostis canadensis*), prairie cordgrass (*Spartina pectinata*), big bluestem, switchgrass, and Indian grass.

In Michigan, strip clearcuts in a conifer swamp resulted in an increase in the relative abundance of meadow voles. They were most abundant in clearcut strip interiors and least abundant in uncut strip interiors. Slash burning did not appear to affect meadow vole numbers about 1.5 years after treatment.^[32]

In Pennsylvania, three subadult meadow voles were captured at least 1.6 miles (2.6 km) from the nearest appreciable suitable meadow vole habitat, suggesting they are adapted to long-distance dispersal.^[33]

In Ohio, the effects of patch shape and proportion of edge were investigated by mowing strips between study plots. The square plots were 132 feet per side (40 m x 40 m), and the rectangular patches were 52.8 feet by 330 feet (16 m x 100 m). Square habitat patches were not significantly different from rectangular patches in meadow vole density. Edge effects in patches of this size were not found, suggesting meadow voles are edge-tolerant. Habitat patch shape did affect dispersal and space use behaviors. In rectangular patches, home ranges were similar in size to those in square patches, but were elongated.^[34]

Meadow voles tend to remain in home ranges and defend at least a portion of their home ranges from conspecifics. Home ranges overlap and have irregular shapes.^[12] Home range size depends on season, habitat, and population density: ranges are larger in summer than winter, those in marshes are larger than in

meadows, and are smaller at higher population densities.^[3] Home ranges vary in size from 0.08 to 2.3 acres (0.32-0.9 ha). Females have smaller home ranges than males, but are more highly territorial than males; often, juveniles from one litter are still present in the adult female's home range when the next litter is born.^{[11][12]} Female territoriality tends to determine density in suboptimal habitats; the amount of available forage may be the determining factor in female territory size, so determines reproductive success.^[35]

Cover requirements

Nests are used as nurseries, resting areas, and as protection against weather. They are constructed of woven grass; they are usually subterranean or are constructed under boards, rocks, logs, brush piles, hay bales, fenceposts, or in grassy tussocks. Meadow voles dig shallow burrows,^[12] and in burrows, nests are constructed in enlarged chambers. In winter, nests are often constructed on the ground surface under a covering of snow, usually against some natural formation such as a rock or log.^{[11][12]}

Meadow voles form runways or paths in dense grasses.^{[11][12]}

Diets

Meadow voles eat most available species of grasses, sedges, and forbs, including many agricultural plant species.^{[3][12]} In summer and fall, grasses are cut into match-length sections to reach the succulent portions of the leaves and seedheads. Leaves, flowers, and fruits of forbs are also typical components of the summer diet. Fungi, primarily endogones (*Endogone* spp.), have been reported in meadow vole diets. They occasionally consume insects and snails, and occasionally scavenge on animal remains; cannibalism is frequent in periods of high population density. Meadow voles may damage woody vegetation by girdling when population density is high.^[3]

In winter, meadow voles consume green basal portions of grass plants, often hidden under snow. Other winter diet components include seeds, roots, and bulbs. They occasionally strip the bark from woody plants. Seeds and tubers are stored in nests and burrows.^{[11][12]} Evidence of coprophagy is sparse, but thought to occur.^[12]

In an old-field community in Quebec, plants preferred by meadow voles included quackgrass (*Elytrigia repens*), sedges, fescues (*Festuca* spp.), wild strawberry (*Fragaria virginiana*), timothy (*Phleum pratense*), bluegrasses (*Poa* spp.), and bird vetch (*Vicia cracca*).^[36]

Predators

Meadow voles are an important prey for many hawks, owls, and mammalian carnivores, and they are also taken by some snakes.^[3] Almost all species of raptors take microtine (*Microtus* spp.) rodents as prey. Birds not usually considered predators of mice do take voles; examples include gulls (*Larus* spp.), northern shrike (*Larius borealis*), black-billed magpie (*Pica pica*), common raven (*Corvus corvax*), American crow (*C. brachyrhynchos*), great blue heron (*Ardea herodias*), and American bittern (*Botaurus lentiginosus*).^[12] In Ohio, meadow voles comprised 90% of the individual prey remains in long-eared owl (*Asio otus*) pellets on a relict wet prairie,^[37] and in Wisconsin, meadow voles comprised 95% of short-eared owl (*A. flammeus*) prey.^[38] Most mammalian predators take microtine prey.^[12] The American short-tailed shrew (*Blarina brevicauda*) is major predator; meadow voles avoid areas frequented by short-tailed shrews.^[3] Other major mammalian predators include the badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), weasels (*Mustela* spp.), marten (*Martes americana*), and domestic cat (*Felis catus*). Other animals reported to have ingested voles include trout (*Salmo* spp.), Pacific giant salamander (*Dicamptodon ensatus*), garter snake (*Thamnophis* spp.), yellow-bellied racer (*Coluber constrictor flaviventris*), gopher snake (*Pituophis melanoleucas*), rattlesnake (*Crotalus viridis*), and rubber boa (*Charina bottae*).^[12]

In northern prairie wetlands, meadow voles are a large portion of the diets of red fox (*Vulpes vulpes*), mink (*Mustela vison*), short-eared owl, and northern harrier (*Circus cyaneus*).^[18] Voles (*Microtus* spp.) are frequently taken by racers (*Coluber* spp.); racers and voles often use the same burrows.^[39]

Management

Meadow voles are abundant in agricultural habitats. The list of crops damaged by meadow voles includes root and stem crops (asparagus, kohlrabi), tubers, leaf and leafstalks, immature inflorescent vegetables (artichoke, broccoli), low-growing fruits (beans, squash), the bark of fruit trees, pasture, grassland, hay, and grains.^[12] Meadow voles are listed as pests on forest plantations.^[40] In forest plantations in British Columbia, an apparently abundant (not measured) meadow vole population was associated with a high rate of "not sufficient regeneration"; damage to tree seedlings was attributed to meadow voles and lemmings (*Synaptomys* spp.).^[41] In central New York, colonization of old fields by trees and shrubs was reduced due to seedling predation by meadow voles, particularly under the herb canopy.^[42]

Management of meadow vole populations in agricultural areas includes reduction of habitat in waste places such as roadsides and fencerows by mowing, plowing, and herbicide application. Predators, particularly raptors, should be protected to keep meadow vole populations in check. Direct control methods include trapping, fencing, and poisoning; trapping and fencing are of limited effectiveness. Poisons are efficient. Repellents are largely ineffective at present.^[12] Plastic mesh cylinders were effective in preventing seedling damage by meadow voles and other rodents.^[43] Properly timed cultivation and controlled fires are at least partially effective in reducing populations.

The cycle of meadow vole abundance is an important proximate factor affecting the life histories of its major predators. Meadow voles are usually the most abundant small mammals in northern prairie wetlands, often exceeding 40% of all individual small mammals present.^[18] Numbers of short-eared owls, northern harriers, rough-legged hawks (*Buteo lagopus*), coyotes (*Canis latrans*), and red foxes were related to large numbers of meadow voles in a field in Wisconsin.^[38] Predator numbers are positively associated with meadow vole abundance.^{[12][44]}

Ecto- and endoparasites have been reported to include trematodes, cestodes, nematodes, acanthocephalans, lice (Anoplura), fleas (Siphonaptera), Diptera, and ticks and mites (Acari).^{[3][12]}

Human diseases transmitted by microtine rodents include cystic hydatid disease, tularemia, bubonic plague, babesiosis, giardiasis^[12] and the Lyme disease spirochete *Borrelia burgdorferi*.^[45]

Ecological importance

As with many other small mammal species, *M. pennsylvanicus* plays important ecological roles.^[46] The meadow vole is an important food source for many predators, and disperses mycorrhizal fungi. It is a major consumer of grass and disperses grass nutrients in its feces.^[46] After disruptive site disturbances such as forest or meadow fires, the meadow vole's activities contribute to habitat restoration.^[46] It prefers open, nonforest habitats and colonizes such open areas created by fire or other clearing disturbances. Very few meadow voles are found in forest or woodland areas. In newly opened areas, it is quite abundant.^[46] In these new open areas, the vole quickly becomes a food source for predators.^[47]

See also

- Gull Island vole

Notes

This article incorporates public domain material from the United States Department of Agriculture document "Microtus pennsylvanicus" (<http://www.fs.fed.us/database/feis/animals/mammal/miipe/all.html>).

1. Linzey, A.V. & Hammerson, G. (2008). "*Microtus pennsylvanicus*" (<http://www.iucnredlist.org/details/13452>). *IUCN Red List of Threatened Species. Version 2009.2*. International Union for Conservation of Nature. Retrieved 4 February 2010.
2. Askham, Leonard R. 1992. Voles. In: Black, Hugh C., ed. "Silvicultural approaches to animal damage management in Pacific Northwest forests". *Gen. Tech. Rep. PNW-GTR-287*. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 187-204.
3. Reich, Lawrence M. 1981. *Microtus pennsylvanicus*. *Mammalian Species*. No. 159: 1-8.
4. MacCracken, James G.; Uresk, Daniel W.; Hansen, Richard M. 1985. "Rodent-vegetation relationships in southeastern Montana". *Northwest Science*. 59(4): 272-278; 1985.
5. Raphael, Martin G. 1987. "Nongame wildlife research in subalpine forests of the central Rocky Mountains". In: *Management of subalpine forests: building on 50 years of research: Proceedings of a technical conference; 1987 July 6–9; Silver Creek, CO*. *Gen. Tech. Rep. RM-149*. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 113-122.
6. Davis, W. B. 1939. *Recent mammals of Idaho*. Caldwell, ID: Caxton Printers Ltd.
7. Hoffman, George R. 1960. "The small mammal components of six climax plant associations in eastern Washington and northern Idaho". *Ecology*. 41(3): 571-572.
8. Snyder, Ellen J.; Best, Louis B. 1988. "Dynamics of habitat use by small mammals in prairie communities". *The American Midland Naturalist*. 119(1): 128-136.
9. Lacki, Michael J.; Hummer, Joseph W.; Webster, Harold J. 1991. "Effect of reclamation technique on mammal communities inhabiting wetlands on mined lands in east-central Ohio". *Ohio Journal of Science*. 91(4): 154-158.
10. Linzey, Alicia V.; Cranford, Jack A. 1984. "Habitat selection in the southern bog lemming, *Synaptomys cooperi*, and the meadow vole, *Microtus pennsylvanicus*, in Virginia". *Canadian Field-Naturalist*. 98: 463-469.
11. Banfield, A. W. F. 1974. *The mammals of Canada*. Toronto, ON: University of Toronto Press.
12. Johnson, Murray L.; Johnson, Sherry. 1982. "Voles: *Microtus* species". In: Chapman, Joseph A.; Feldhamer, George A., eds. *Wild mammals of North America: Biology, management, and economics*. Baltimore, MD: The Johns Hopkins University Press: 326-354.
13. Webster, A. Bruce; Brooks, Ronald J. 1981. "Daily movements and short activity periods of free-ranging meadow voles *Microtus pennsylvanicus*". *Oikos*. 37(1): 80-87.
14. Bailey, Vernon. 1924. "Breeding, feeding, and other life habits of meadow mice (*Microtus*)". *Journal of Agricultural Research*. 27(8): 523-536.
15. Getz, Lowell L. 1960. A population study of the vole, *Microtus pennsylvanicus*. *The American Midland Naturalist*. 64: 392-405.
16. Golley, Frank B. 1961. Interaction of natality, mortality and movement during one annual cycle in a *Microtus* population. *The American Midland Naturalist*. 66(1): 152-159.
17. Krebs, Charles J.; Myers, Judith H. 1974. "Population cycles in small mammals". In: MacFadyen, A, ed. *Advances in ecological research: volume 8. Advances in ecological research*. London: Academic Press: 267-399.
18. Fritzell, Erik K. 1989. "Mammals in prairie wetlands". In: Vander Valk, Arnold, ed. *Northern prairie wetlands*. Ames, IA: Iowa State University Press: 268-301.

19. Birney, Elmer C.; Grant, W. E.; Baird, Donna Day. 1976. "Importance of vegetative cover to cycles of *Microtus* populations". *Ecology*. 57(5): 1043-1051.
20. Schramm, Peter; Clover, Catherine A. 1994. "A dramatic increase of the meadow jumping mouse (*Zapus hudsonius*) in a post-drought, restored, tallgrass prairie". In: Wickett, Robert G.; Lewis, Patricia Dolan; Woodliffe, Allen; Pratt, Paul, eds. *Spirit of the land, our prairie legacy: Proceedings, 13th North American prairie conference*; 1992 August 6–9; Windsor, ON. Windsor, ON: *Department of Parks and Recreation*: 81-86.
21. Pendleton, G. W. 1984. *Small mammals in prairie wetlands: habitat use and the effects of wetland modification*. Brookings, SD: South Dakota State University. Thesis
22. Schwartz, Orlando A.; Whitson, Paul D. 1986. "A 12-year study of vegetation and mammal succession on a reconstructed tallgrass prairie in Iowa". *The American Midland Naturalist*. 117(2): 240-249.
23. Geier, Anthony R.; Best, Louis B. 1980. "Habitat selection by small mammals of riparian communities: evaluating effects of habitat alterations". *Journal of Wildlife Management*. 44(1): 16-24.
24. Conley, Walt; Tipton, Alan R.; Kukila, Susan. 1976. "Habitat preference in *Microtus pennsylvanicus*: a preliminary multivariate analysis". *Virginia Journal of Science*. 27(2): 43.
25. Grant, P. R.; Morris, Ralph D. 1971. "The distribution of *Microtus pennsylvanicus* within grassland habitat". *Canadian Journal of Zoology*. 49(7): 1043-1052.
26. Adler, Gregory H. 1988. "The role of habitat structure in organizing small mammal populations and communities". In: Szaro, Robert C.; Severson, Kieth E.; Patton, David R., technical coordinators. *Management of amphibians, reptiles, and small mammals in North America: Proceedings of the symposium*; 1988 July 19–21; Flagstaff, AZ. Gen. Tech. Rep. RM-166. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 289-299.
27. Brooks, Robert T.; Healy, William M. 1988. "Response of small mammal communities to silvicultural treatments in eastern hardwood forests of West Virginia and Massachusetts". In: Szaro, Robert C.; Severson, Kieth E.; Patton, David R., technical coordinators. *Management of amphibians, reptiles, and small mammals in North America*; 1988 July 19–21; Flagstaff, AZ. Gen. Tech. Rep. RM-166. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 313-318.
28. Sieg, Carolyn Hull. 1988. "The value of Rocky Mountain juniper (*Juniperus scopulorum*) woodlands in South Dakota as small mammal habitat". In: Szaro, Robert C.; Severson, Kieth E.; Patton, David R., technical coordinators. *Management of amphibians, reptiles, and small mammals in North America: Proceedings of the symposium*; 1988 July 19–21; Flagstaff, AZ. Gen. Tech. Rep. RM-166. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 328-332.
29. Finley, Robert B., Jr. 1986. "Distributions and habitats of voles in southeastern Colorado and northeastern New Mexico". *The Southwestern Naturalist*. 31(2): 263-266.
30. M'Closkey, Robert T.; Hecnar, Stephen J. 1994. "Small mammals of the Ojibway Prairie Provincial Nature Reserve, Windsor, Ontario". In: Wickett, Robert G.; Lewis, Patricia Dolan; Woodliffe, Allen; Pratt, Paul, eds. *Spirit of the land, our prairie legacy: Proceedings, 13th North American prairie conference*; 1992 August 6–9; Windsor, ON. Windsor, ON: Department of Parks and Recreation: 75-80.
31. Moreth, Louis H.; Schramm, Peter. 1973. "A comparative survey of small mammal populations in various grassland habitats with emphasis on restored prairie". In: Hulbert, Lloyd C., ed. *Third Midwest prairie conference* pr; 1972 September 22–23; Manhattan, KS. Manhattan, KS: Kansas State University, Division of Biology: 79-84.
32. Verme, Louis J.; Ozoga, John J. 1981. "Changes in small mammal populations following clear-cutting in upper Michigan conifer swamps". *Canadian Field-Naturalist*. 95(3): 253-256.
33. Kirkland, Gordon L., Jr. 1988. "Meadow voles (*Microtus pennsylvanicus*) on forest clearcuts: the role of

- long-distance dispersal". *Journal of the Pennsylvania Academy of Science*. 62(2): 83-85.
34. Harper, Steven J.; Bollinger, Eric K.; Barrett, Gary W. 1993. "Effects of habitat patch shape on population dynamics of meadow voles (*Microtus pennsylvanicus*)". *Journal of Mammalogy*. 74(4): 1045-1055.
 35. Jones, Eric N. 1990. "Effects of forage availability on home range and population density of *Microtus pennsylvanicus*". *Journal of Mammalogy*. 71(3): 382-389.
 36. Bergeron, Jean-Marie; Jodoin, Louise. 1989. "Patterns of resource use, food quality, and health status of voles (*Microtus pennsylvanicus*) trapped from fluctuating populations". *Oecologia*. 79: 306-314.
 37. Osborn, Eric D.; Hoagstrom, Carl W. 1989. "Small mammals of a relict wet prairie in Ohio". In: Bragg, Thomas B.; Stubbendieck, James, eds. *Prairie pioneers: ecology, history and culture: Proceedings, 11th North American prairie conference*; 1988 August 7–11; Lincoln, NE. Lincoln, NE: University of Nebraska: 247-250.
 38. Evrard, James O.; Snobl, DeWayne A.; Doeneir, Paul B.; Dechant, Jill A. 1991. "Nesting short-eared owls and voles in St. Croix County". *Passenger Pigeon*. 53(3): 223-226.
 39. Madison, Dale M. 1978. "Behavioral and sociochemical susceptibility of meadow voles (*Microtus pennsylvanicus*) to snake predators". *The American Midland Naturalist*. 100(1): 23-28.
 40. Askham, Leonard R. 1992. "Voles". In: Black, Hugh C., ed. *Silvicultural approaches to animal damage management in Pacific Northwest forests*. Gen. Tech. Rep. PNW-GTR-287. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 187-204.
 41. Sullivan, Thomas P.; Martin, Wayne L. 1991. "Influence of site factors on incidence of vole and lemming feeding damage to forest plantations". *Western Journal of Applied Forestry*. 6(3): 64-67.
 42. Gill, David S.; Marks, P. L. 1991. "Tree and shrub seedling colonization of old fields in central New York". *Ecological Monographs*. 61(2): 183-205.
 43. Pauls, Ronald W. 1986. "Protection with vexar cylinders from damage by meadow voles of tree and shrub seedlings in northeastern Alberta". In: Salmon, Terrell P.; Marsh, Rex E.; Beadle, Dorothy E., eds. *Proceedings--12th vertebrate pest conference*; 1986 March 4–6; San Diego, CA. Davis, CA: University of California: 199-204.
 44. Walley, W. J. 1972. "Summer observations of the short-eared owl in the Red River Valley". *Prairie Naturalist*. 4(2): 39-41.
 45. <http://www.ncbi.nlm.nih.gov/pubmed/9775612>
 46. Lautenschlager, R.A., Sullivan, T. P., Wagner, R. G. (1999). Clearcutting and burning of northern spruce-fir forests: implications for small mammal communities. *Journal of Applied Ecology* vol. 36 issue 3, pages 327–344.
 47. Cantú-Salazar, L; Hidalgo-Mihart, M. G.; González-Romero, A.; López-González, C. A. (2004). Historical and present distribution of coyote (*Canis latrans*) in Mexico and Central. America *Journal of Biogeography* vol. 31, issue 12, pages 2025–2038.

External links

Retrieved from "http://en.wikipedia.org/w/index.php?title=Meadow_vole&oldid=640837894"

Categories: IUCN Red List least concern species | Microtus
 | Bioindicators | Indicator species | Mammals of North America
 | Mammals of the United States | Mammals of Canada
 | Voles and lemmings | Animals described in 1815



Wikimedia Commons has media related to ***Microtus pennsylvanicus***.



Wikispecies has information related to: ***Microtus pennsylvanicus***

- This page was last modified on 3 January 2015, at 19:32.
- Text is available under the Creative Commons Attribution-ShareAlike License; additional terms may apply. By using this site, you agree to the Terms of Use and Privacy Policy. Wikipedia® is a registered trademark of the Wikimedia Foundation, Inc., a non-profit organization.