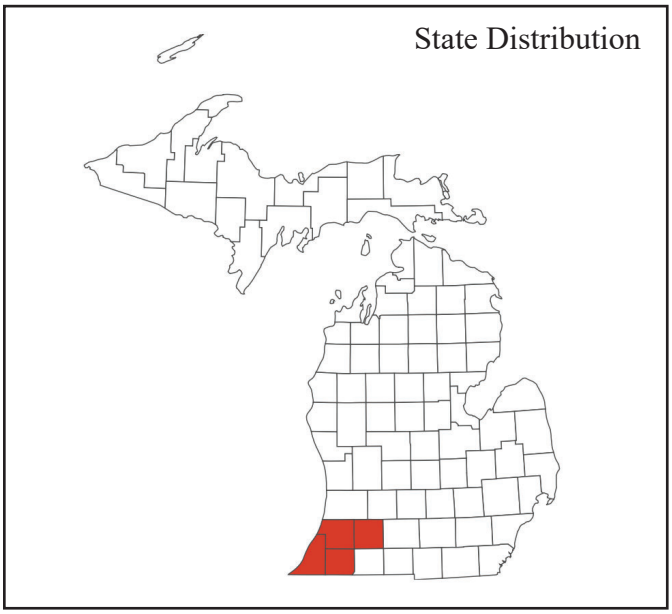
# *Microtus ochrogaster* Prairie Vole


Best Survey Period


**Status:** State Endangered

**Global and State Rank:** G5 (Globally Secure) / S3 (State Vulnerable)

**Family:** Cricetidae (New World mice and rats)

**Total Range:** The prairie vole is found throughout much of the central United States from northeastern New Mexico, Colorado, Wyoming, and Montana east to Alabama, Tennessee, Kentucky, West Virginia, and Ohio (NatureServe, 2024). The northern limit of this species' range extends into Alberta, Saskatchewan, and Manitoba (Stalling, 1990; NatureServe, 2024). Michigan lies on the northeastern edge of its range.

**State Distribution:** The prairie vole is only known from four Michigan counties, all in the southwest. In three of those counties, it has not been observed since the mid-1900s (Berrien, Cass, and Van Buren). It was last observed in Kalamazoo County in 2021. There are currently nine element occurrences (EOs) within the Michigan Natural Heritage Database, eight of which are historical and one is extant, the viability of which is estimated as Possibly Fair (MNFI, 2024).

**Recognition:** The prairie vole is a medium-sized vole that has a total adult length ranging from 130-172 mm and a mass that generally ranges from 37-48 g (up to 73 g; Martin, 1956; Stalling, 1990). Fur is generally gray-brown with longer hairs tipped in black and brownish-yellow. This gives them a "grizzled" or "salt-and-pepper" appearance (Mumford and Whitaker, 1982; Baker, 1983). The fur on the sides of the prairie vole is lighter in color than on the back and the fur on the ventral surface is usually tan, but can also be gray or white (Figure 1; Stalling, 1990). The tail is bicolored and ranges from 24-41 mm in length. Hind feet range in length from 17-22 mm and ear length ranges from 11-15 mm (Hall, 1981). The 16 teeth of the prairie vole are simple with a dental formula of 1/1, 0/0, 0/0, 3/3 (Stalling, 1990). The muzzle is stout. As in other voles, the ears are very small and not obviously visible.

**Similar Species**: The meadow vole (*Microtus pennsylvanicus*) is a similar species found across


Figure 1. Characteristic prairie vole ventral pelage.


Figure 2. Prairie vole hind foot showing the five plantar tubercules characteristic to this species.

much of the prairie vole's range. External characteristics can be used to differentiate between these voles, however they are often unreliable due to variation within each species (Henterly et al. 2011). On average, the meadow vole is slightly larger in size and has six small bumps (i.e., plantar tubercles) on each hind foot, while the prairie vole typically has five (Figure 2; DeCoursey, 1957; Henterly et al. 2011). Meadow voles have four pairs of mammary glands and prairie voles have three (Kurta, 1995). Meadow voles generally have longer tails (35-60 mm) than prairie voles (26-40 mm; Baker, 1983) and are more uniformly brown in color with a slate gray underside (Kurta, 1995).

**Best Survey Time:** Prairie voles are active year-round, but population sizes vary throughout the year. Highest populations generally occur during the summer and fall, making the odds of observing a prairie vole much higher during these times. They are most active just before dawn and from sunset until dark, so live trapping from before dusk to after dawn is most likely to yield the highest capture rate in occupied habitat. Baiting traps one or two days before setting them is vital for trapping success. Diurnal activity decreases in the summer and nocturnal activity decreases in the winter (Madison, 1985; NatureServe, 2024). Populations are cyclical with peak densities occurring every two to four years, and with population densities varying by up to 90% between peak years, so surveys in multiple consecutive years are recommended to adequately assess presence/absence and average population density. Voles make use of surface runways (3.5-8.9 cm in diameter) formed through the base of vegetation. Runways are the most conspicuous sign of vole presence; however, mole tunnels are also used by voles (Stalling, 1990).

**Habitat:** In Michigan, historically prairie voles were likely associated with bur oak plains, dry-mesic prairie, mesic prairie, mesic sand prairie, oak barrens, and oak openings (MNFI, 2024). Most occurrences of these communities were destroyed or highly degraded following European settlement. Thus, the historic habitat of this species in Michigan is poorly understood. Most of the few records that exist of this species in Michigan are historical

with sparse habitat data. Insofar as Michigan habitat has been described, prairie vole is associated with old fields, agricultural landscapes, and railroad rights-of-way. This species prefers thick ground cover where grass grows sufficiently thick for nesting cover and runway construction (Getz, 1985; Stalling, 1990). Ideal habitat contains a mixture of forbs and grasses. Not only does this mixed vegetation provide increased heterogeneity, but it also provides varied food sources that are preferred by prairie voles (Pascarella and Gaines, 1991). Home ranges of prairie voles are usually less than 0.1 ha in extent (Kurta, 1995). Both prairie and meadow voles occur in southwestern Michigan and competition between the two species is likely (Klatt and Getz, 1987). Nests are built in burrows, under boards/logs, and in grassy clumps above ground (Stalling, 1990).

**Biology:** The prairie vole is crepuscular, though their peak activity periods change with the seasons. When day temperatures are high (e.g., summer), diurnal activity decreases and in winter, when night temperatures are low, nocturnal activity decreases (Madison, 1985). Social arrangements within populations also vary with season. They form three types of social structures: mated pairs, single females, and small groups. Mated pairs are more prevalent during warm months and communal behavior increases during cold months (Stalling, 1990; Getz and Carter, 1996).

The reproductive season in prairie voles continues throughout the year but activity is lowest from December to January and highest from May to October (Keller, 1985; Stalling, 1990). Breeding in Michigan occurs from the first week of February to the first week of November (MNFI, 2024) and is unlikely to occur year-round unless in the case of an unusually mild winter. Strong pair bonds created after mating, equal care of young by both sexes, and older young caring for younger siblings are all prairie vole behaviors that suggest that this species is monogamous (Wolff, 1985; Getz et al. 1987; Stalling, 1990). In a laboratory setting, female prairie voles have been observed selectively mating with more dominant males (Shapiro and Dewsbury, 1986). Both male and female prairie voles are able to discriminate their mate's scent from others (Newman and Halpin, 1988). There is a high level of aggression from either member of a pair towards other voles of either sex, however when separated for eight days or more, females will pair up with new males and break the previous pair bond (Thomas and Birney, 1979; Getz and Pizzuto, 1987; Stalling, 1990). In areas with increased population density, prairie voles will shift from monogamous pair territories to polygynous or promiscuous groups (Hofmann et al. 1987). Most communal groups (at least 12 individuals) are familial, with the oldest female mating with only one male and inhibiting the reproductive activity of her daughters using pheromones (Getz and Carter, 1996). Males often aid in the protection and care of their young. Paired individuals will often join communal groups in the winter but will then separate when breeding begins (Getz and Carter, 1996). These male-female pairs generally stay together until one member of the pair dies. Females whose mates have died will nest alone, whereas single males will wander unpaired for the remained of their lives (Getz and Hofmann, 1986).

Ovulation occurs about 10.5 hours after mating (Kruckenberg et al. 1976). Average gestation length ranges from 20 to 22.8 days and the average litter size in field-captured individuals is 3.5 (Nadaeu, 1985). Females give birth to up to five litters of pups per year, if breeding year-round and generally have four pups per litter (Kurta, 1995). Pups are born with their eyes and external ears closed, range from 30 to 35 mm in length, and are an average mass of 3.5 g (Kruckenberg et al. 1973). Pup incisors emerge by day one or two, their brown fur begins to grow on day two, their external ears unfold by day two or three, they begin to crawl by day four or five, their eyes open between day five and 10, weaning occurs when their weight is between 11.9 and 18.4 g, their first molt begins between day 21 and 28 and their second molt occurs between day 40 and 84 (Nadeau, 1985; Stalling, 1990). Nearly all growth is complete by two months of

age and growth rates are positively correlated with temperature, precipitation, and day length and negatively correlated with population size (Martin, 1956; Sauer and Slade, 1986). Post-partum oestrus is often seen in prairie voles, allowing females to conceive again shortly after the birth of a litter (Kurta, 1995). Sexual maturity is reached between 42 and 45 days of age in males and around 35 days in females, however younger females usually produce smaller litters than more experience females (Gier and Cooksey, 1967; Kurta, 1995). Most prairie voles live one year or less in nature, but they have reached a maximum longevity of 5.3 years in captivity (Weigl, 2005).

Prairie voles utilize extensive systems of runway tunnels through the grass to avoid predation (Kurta, 1995). When vegetation is sparse, underground tunnels are more likely to be used than above ground runways (Jameson, 1947). Almost every predator found within the range of this vole has been observed feeding on it including hawks, shrikes, coyotes, raccoons, owls, snakes, weasels, foxes, and bobcats (Stalling, 1990; Kurta, 1995). The number of runways per meter of habitat depends on population density, meaning that the space an individual utilizes for runways may remain constant with varying population density (Carroll and Getz, 1976; Wolff, 1985; Stalling, 1990). Each runway system is made up of a crooked trunk with branches and the soil appears bare and depressed due to repetitive use (Jameson, 1947; Martin, 1956). Burrows are usually short (less than 90 cm long) and shallow (less than 60 cm deep) but can be complex with multiple chambers and are used for both nesting and feeding. Food or nesting chambers are 200 mm in diameter or less and contain tunnels to the surface that vary from a few millimeters to several meters in length (Stalling, 1990). Nests that are created underground in burrows are ellipsoidal in shape and are on average a length of 180 mm, a width of 150 mm, and a depth of 100 mm (Fisher, 1945; Stalling, 1990). In warmer months, nests are often constructed under boards or logs and the dimensions of these surface-nests only vary slightly from those of subterranean nests (Hahn, 1908; Stalling, 1990; Kurta, 1995). Nests are created using coarse dry grass on the exterior and fine shredded grass inside (Stalling, 1990).

The diet of the prairie vole is largely herbivorous feeding on the soft segments of grasses, tubers, roots, and seeds. The underground tunnel systems are utilized to feed on plant roots. Foods that are commonly stored underground in burrows are abundant seeds and roots/stems of plants (Jameson, 1947). These cache chambers can be quite large and hold up to four liters of food (Fisher, 1945). In winter, the bark of woody vegetation is also occasionally eaten (Kurta, 1995). Zimmerman (1965) studied the diet of prairie voles in Indiana and found that the leaves, stems, roots, and seeds from grasses such as *Poa compressa* (Canada bluegrass) and clovers such as *Trifolium pratense* (red clover) and *Lespedeza* spp. (bush clovers) made up the majority of stomach contents in addition to smaller amounts of various other abundant plant species within the study area. Insects are also eaten when available and have been shown to make up 0% of diets in the spring and 44.3% in late summer in South Dakota (Agnew et al. 1988). There is also limited evidence from an Indiana cave that this species may prey on hibernating bats (Martin, 1961).

Where the ranges of prairie and meadow voles overlap, prairie vole tends to dominate, and meadow voles generally retreat to moister marshy areas, though this may not be true in Michigan where the meadow vole is a rare species at the edge of its range (Findley, 1954; Getz, 1962; Stalling, 1990). Meadow voles are capable of entering and occupying areas already inhabited by prairie voles; however, the opposite has not been documented (Klatt and Getz, 1987). Removing either vole species from a shared area results in population growth from the remaining species, providing evidence for considerable competition between these two species (Klatt and Getz, 1987). Varying degrees of competition has also been documented between prairie voles and the cotton rat (*Sigmodon hispidus*), *Peromyscus* spp.(deer mice), house mouse

(*Mus musculus*), and southern bog lemming (*Synaptomys cooperi*) (Stalling, 1990).

**Conservation/Management:** Prairie, savanna, and other grassy habitats as well as grassy corridors between grassy habitats should be maintained. Grazing and mowing are generally not recommended when managing for small mammals, including voles, as any lack of cover can be detrimental to populations. Grazing by large, domesticated herbivores in tallgrass communities decreases plant diversity, cover composition, and can displace prairie voles by other more common rodents. Clark et al. (1989) found that prairie voles were most prevalent in ungrazed, unburned habitats that had well-developed litter layers. The movements of large herd animals can also destroy runways and tunnels and can disrupt home range establishment by prairie voles, especially when grazing levels are high (Steen et al. 2005). To preserve the litter layers and dense grass growth required for successful runway creation, frequent mowing and grazing should be avoided.

Woody vegetation encroachment in grassland ecosystems can cause a decrease in grassland-dependent small mammal diversity. The likelihood that prairie voles will utilize an area decreases as woody vegetation increases (Matlack et al. 2008). The primary threat of the prairie vole population found in Kalamazoo County, Michigan is woody plant encroachment by winged sumac (*Rhus copallina*) and black locust (*Robinia pseudoacacia*), decreasing the grass-dominated habitat available to this species (Cooper, 2000; Legge, 2017; Cole-Wick et al. 2022). Management techniques suggested to help improve prairie vole habitat include mowing woody vegetation dominated areas with blades raised to leave 20-30 cm of grass stubble for cover (Cooper, 2000) and prescribed fire. Prescribed fire has been shown to increase prairie vole abundance while meadow voles have shown decreased abundance in recently burned habitats (Schramm and Willcutts, 1983). However, conflicting results have been observed in restored tall-grass prairies in Illinois and a native tall-grass prairie in Kansas (Schramm, 1970; Clark et al. 1989). Geluso and Bragg (1986) found that underground burrows are generally deep enough to provide enough insulation from the heat of fires. Because this species is active year-round, there is no season where causalities of prescribed burns can be eliminated; however, slow-moving fires allow voles more time to get to their burrows. These low intensity fires should be selected over fast moving, high intensity fires if possible and because prairie voles depend on vegetation for cover, burning should only occur in a small portion of occupied sites to limit exposure of bare ground after a burn. Herbicide and pesticide use should be avoided when managing for small mammals, as both direct and secondary consumption can be harmful to them.

Increasing densities of non-native predators, such as the domestic cat (*Felis catus*), are associated with high rodent mortality. Not only do domestic cats reduce rodent populations through direct predation, but they can also indirectly impact the survival and reproductive success of rodent populations by influencing their stress responses, and their foraging, movement, and defense behaviors (Loss and Marra, 2017). George (1974) found that rodents make up 95.9% of rural cats' diets in Michigan. In southern Illinois, the prairie vole was the most captured prey item by three domestic cats between 1968 and 1971. In this time frame, these cats captured over 200 prairie voles and over 70 pine voles, making voles nearly 57% of the vertebrate prey they caught (George, 1974). Keane et al. (2020) observed that cat odors did not influence prairie voles' use of an area potentially revealing that a lack of time to co-evolve has left this species vulnerable to domestic cat predation. Managing feral cat populations (e.g., trap-neuter-release) and restricting outdoor access for pet cats are strategies that may be necessary to alleviate this stressor on prairie vole populations across their range (Loss and Marra, 2017).

**Research Needs:** The primary research need are studies that compare the genetic and morphological variation of the prairie vole to the very similar meadow vole to allow for better verification of

the species in the field. Additional research is also needed regarding prairie vole adaptability in the face of habitat management techniques, agriculture practices, and invasive predators. In Michigan, basic knowledge of habitat preference, predation, population density, and reproduction is limited and resurveying sites that were previously known to support prairie voles should be conducted to better understand the abundance and the range of this species in the state.

**Related Abstracts:** Dry-mesic prairie, mesic prairie, mesic sand prairie, bur oak plains, oak openings, oak barrens, Henslow's sparrow, grasshopper sparrow, dickcissel.

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