

## Carolina Red-backed Vole

*Myodes gapperi carolinensis*

[formerly *Clethrionomys gapperi carolinensis*]

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### DESCRIPTION

#### Taxonomy and Basic Description

The red-backed vole was first described by Vigors in 1830 (Gapper 1930) and is a member of the group of rodents termed microtine or arvicoline rodents. This species is readily distinguished from the other voles in South Carolina by the presence of a reddish dorsal pelage, with grayish sides and a silvery white to pale yellow underside pelage. The reddish color is usually present as a broad band running from the forehead to the rump. The tail is bicolored. The ears are relatively prominent and extend above the fur. Females possess eight mammae. Young voles are gray until their post-juvenile molt, which occurs at approximately 30 days of age. There is no sexual dimorphism. Adult length is 116 to 172 mm (4.57 to 6.77 in.) with a tail length of 30 to 50 mm (1.18 to 1.98 in.). Adult weight varies from 14 to 42 g (0.49 to 1.48 oz.). In general, the animals from the Appalachians are larger than their northern counterparts (Whitaker and Hamilton 1998). The skull has a short rostrum, large auditory bullae, and the palate ends posteriorly as a straight, transverse shelf in contrast to the structure of the palate of other microtines.

The subspecies of red-backed vole that occurs in South Carolina is the Carolina red-backed vole, *Myodes gapperi carolinensis* (formerly *Clethrionomys gapperi carolinensis*). This subspecies is present in the Appalachian Mountains from northern Georgia north through eastern Tennessee, western North Carolina, the northwest corner of South Carolina, western Virginia and West Virginia. The separation line between *Myodes gapperi carolinensis* and *Myodes gapperi gapperi* is farther to the north in Virginia and West Virginia (Whitaker and Hamilton 1998).

#### Status

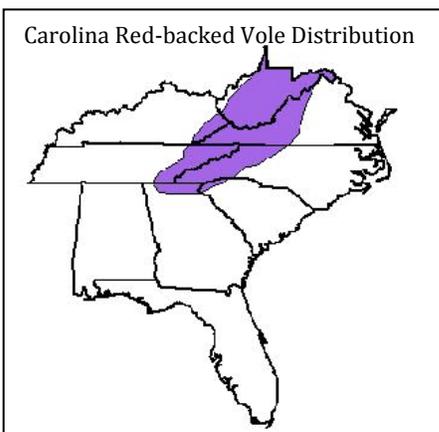
This species is tracked by the South Carolina Department of Natural Resources (SCDNR) Heritage Trust database and is of special concern in South Carolina. The state rank for the red-backed vole is imperiled/vulnerable (S2/S3), which indicates it is rare; the factor that makes the species vulnerable is the limitation of suitable habitat within South Carolina.



This species has a global rank of secure (G5) (NatureServe 2013). The red-backed vole is apparently secure in West Virginia, Tennessee and North Carolina (NatureServe 2013). Georgia and Kentucky have designated it as vulnerable (S3). Southern red-backed voles are included on the IUCN Red List as a species at lower risk /least concern (Cook and Kirkland, Jr. 1998; Lizney and NatureServe 2008), because the species is widespread, common, and no major threats have been noted across most of its range.

#### POPULATION SIZE AND DISTRIBUTION

The southern red-backed vole is distributed throughout Canada and the northern tier of states in the US. The range of this species extends south in the Appalachian Mountains to northern Georgia (Wharton and White 1967; Merritt 1981).



There are no population estimates available in the southern Appalachian Mountains, which represent the southern end of the red-backed vole's range. However, trapping records from collections in Highlands, North Carolina and the Smoky Mountains National Park indicate that this species can attain high densities and maintain viable populations in suitable habitats (Pivorun, pers. obs). In addition, the population was observed to cycle over 5 to 8 year intervals in the Highlands, North Carolina National Forest lands (Pivorun, pers. obs.); 6 to 10 year cycles (Patric 1962; Grant 1976) and 4.4 year cycles (Elias et al. 2006) have been observed in other localities. There is such a paucity of trapping records from South Carolina that no data are available on population cycles.

The red-backed vole is restricted to the higher elevation habitats of South Carolina within the Southern Appalachians Ecoregion. Currently, the only published records for this species are from Oconee (Pivorun et al. 1984) and Pickens Counties (Laerm et al. 1995). Suitable habitat for the Carolina red-backed vole is present in Greenville County. Current population studies are not being conducted on the distribution and abundance of this species in South Carolina. This species was one of the most abundant mammals on the summit of Mt. Rogers in western Virginia (Lizney 1998); the higher density populations are usually located at altitudes above 610 to 915 m (2,000 to 3,000 ft.) in the Southern Appalachians. In the eastern states population size ranged from 24-65 individuals/hectare (or per 2.5 acres) in New York (Fisher 1968); 0-37 per hectare in Connecticut and Vermont (Miller and Getz 1977a). The majority of suitable habitat in South Carolina is limited and one would expect smaller population numbers in this state. The presence of voles in South Carolina may also be dependent upon immigration of voles to South Carolina from higher altitudes in the North Carolina mountains when population cycles result in high densities there.

A recent study has shown that since many Southern Appalachian populations of this species are located on "sky islands", or high altitude locations separated by lower altitude

valleys or “oceans” of unsuitable habitat, a relatively low genetic variability and a high degree of inbreeding is occurring in these isolated populations (Browne and Ferree 2007). Comparable situations have been noted for the boreal habitat-dependent Southern Appalachian *Desmognathus wright*, the dwarf salamander (Crespi et al. 2003) and *Glaucomys sabrinus*, the northern flying squirrel (Arbogast et al. 2005). This results in limited gene flow between various insular populations. The effect of this bottlenecking could result in the loss of local populations due to stochastic fluctuations in climatic conditions or resource availability (Bonnell and Selander 1974; Hartl and Clark 1997).

Predators of red-backed voles include snakes, owls, foxes, bobcats, coyote and weasels. Although these voles are prey of several species, survival of the red-backed vole population is usually not threatened by these predators.

#### HABITAT AND NATURAL COMMUNITY REQUIREMENTS

The red-backed vole is found in the Southern Appalachians Ecoregion. Within that ecoregion, the vole can be found in habitat with mesic mixed forests, mesic deciduous hardwood, and high altitude coniferous forests and beech gaps. A mesic environment with an abundance of litter, rotting logs, moss covered rocks, exposed roots and rock crevices would be considered an ideal habitat (Miller and Getz 1977b; Merritt 1981). This species has also been observed on mountain balds and in rhododendrom thickets (Pivorun, per obs.). Generally, the presence of a bog area or streambed at altitudes above 762 m (2,500 ft.) offers an appropriate habitat (Webster et al. 1985). Neither forest age nor successional stage has been reported as critical factors in determining habitat preference (Merritt 1981). Red-backed voles do not colonize post burn communities as readily as other species (Martell and Radvanyi 1977), but will inhabit clear cuts (Kirkland 1990; Schloyer 1977; Martell 1983; Monthey and Soutiere 1985). One study in Wyoming demonstrated that *C. gapperi* clearly preferred forest to harvested stands on all study sites and avoided crossing boundaries between those stands (Keinath and Hayward 2003).

In South Carolina, red-backed voles have only been found in Oconee and Pickens County at altitudes above 915 m (3,000 ft.) in mixed deciduous forests associated with boggy and stream bed habitats that contain rhododendron. In the Southern Appalachians, associated species include the woodland jumping mouse (*Napaeozapus insignis*), star-nosed mole (*Condylura cristata*), the hairy-tailed mole (*Parscalops breweri*), smoky shrew (*Sorex fumeus*) and masked shrew (*Sorex cinereus*) (Watts 1970). Home range varies from 0.25 to 3.5 acres (Merritt and Merritt 1978). Experimentation by Gillis and Nams (1998) suggests that populations separated by an inter-patch distance of 60-70 m (197-230 ft.) would likely be considered isolated from one another.

The red-backed vole is semifossorial and utilizes underground tunnels of other species such as shrews and moles for den and nest sites; they also use crevices among exposed roots and rocks for these purposes. These voles forage along the ground and around downed trees. This vole is omnivorous and opportunistic, consuming nuts, berries, mosses, lichens, ferns, fungi, arthropods and seeds (Merritt 1981). There is very little known about the use of subterranean fungi use by this species in the Southern

Appalachians. One study in Virginia demonstrated the consistent presence of spores in fecal pellets suggesting that fungi are an important food item and that *C. gapperi* may be an important disperser of fungal spores. This work supports the notion that *C. gapperi* is a fungal generalist since spores from the genera *Melanogaster*, *Coprinus*, *Elaphomyces* and Glomalean were present in fecal pellets. In addition, fungi are considered a primary food source for populations inhabiting forests in New York (Fisher 1968). Up to 20-40% of the total food consumed was the fungus *Endogone* and related hypogeous species during the fall and summer; during the winter months, some individuals were found to have stomach contents that were 100% fungal. Bark and roots are also an important food source during the winter months

## CHALLENGES

Since this vole is located on a multitude of protected areas across its range in North America and since no widespread declines in populations have been noted, this species is generally not considered of conservation concern (Lizney and NatureServe 2008). However, in South Carolina, it is rare and considered worthy of inclusion in the SWAP. Luckily, a large portion of the habitat in the Blue Ridge Ecoregion that is appropriate for red-backed voles is on public land, including National Forests, State Parks and SCDNR managed properties. Additionally, some lands that contain red-backed vole habitat are owned or held in easement by various land trusts. None of these properties were purchased specifically to protect the red-backed vole; however, the species benefits from acquisition and protection of its habitat. While these protected areas provide needed habitat, populations on private lands are still impacted by land conversion.

Land development in the Southern Appalachians represents a major challenge to the red-backed vole. Land use in this region is rapidly changing from rural/agricultural to urban/retirement or vacation homes. An unpublished study conducted by SCDNR showed a 4-fold increase in development to every one-fold increase in population between 1983 and 1998 (Richard Lacy, pers. comm.). As these conversions occur, habitat for this species is being lost. Even when development proceeds in close proximity to existing red-backed vole habitat, the species may be adversely affected as these animals require relatively undisturbed habitats. Additionally, the changes in hydrology that result from urbanization will affect habitat for this species. Red-backed voles require wet areas like bogs; these areas are expected to diminish as development continues.

The appropriate habitat for this species in South Carolina is limited, and a concern that needs to be addressed is the impact of climate change, elevated temperatures, and drought in the state. In addition the loss of hemlock forests to the hemlock woolly adelgid (*Adelges tsugae*) may have significant impacts on populations. These factors all adversely impact the montane habitats thereby contracting the ideal habitat that this species requires.

## CONSERVATION ACCOMPLISHMENTS

Terrestrial small mammal surveys that have been conducted in the South Carolina

mountains have provided data to better understand habitat requirements and population dynamics of the various rodent and insectivore species. These studies were possible as a result of partnerships between several interested parties including the University of Georgia, the US Forest Service, Clemson University and SCDNR.

#### CONSERVATION RECOMMENDATIONS

- Discourage major developments in known red-backed vole habitat in the Blue Ridge Ecoregion
- Complete ecoregion-wide surveys for red-backed vole distribution and density. Surveys and survey techniques should be standardized throughout the Southeast so that results and data are readily comparable. All capture data should be made available through the statewide Heritage Trust database as well as shared with neighboring states.
- These surveys need to be conducted over a period of at least ten years. The impact of climate change, elevated temperatures, drought in the state, and the loss of hemlock forests need to be addressed.
- Concurrent with surveys, the subspecies designation and distribution needs to be resolved for red-backed voles (*M.c. carolinensis*) using molecular data and intensive morphometric analysis. This will require cooperation or partnerships with neighboring states. Genetic analyses are needed to determine if a relatively low genetic variability and a high degree of inbreeding is occurring in the isolated populations distributed across the northwestern montane regions of the state. One would expect bottlenecking which could result in the loss of local populations due to fluctuations in climatic conditions or resource availability.
- Provide information on the ecological role and benefits of red-backed voles. This species is not considered a nuisance species. This information would allow for better management of private, state and federal lands in the montane regions of the state; management would be partially based on consideration of the impact on mammalian species that are major prey items for predators such as fox, bobcat, and birds of prey.

#### MEASURES OF SUCCESS

As research and management needs are identified, projects should be proposed and prioritized by those with the greatest conservation applicability. Surveys and density estimates in the Southern region should provide some population estimations, which will be used to more accurately rank the species and prioritize future management needs.

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