2016

The Small Mammals of Southeastern Virginia as Revealed by Pitfall Trapping

Robert K. Rose
Old Dominion University, rrose@odu.edu

Original Publication Citation

Rose, R. K. (2016). The small mammals of southeastern Virginia as revealed by pitfall trapping. *Banisteria: A Journal Devoted to the Natural History of Virginia.,* 47, 9-13. https://www.biodiversitylibrary.org/page/58270677#page/11/mode/1up

Banisteria, Number 47, pages 9-13

The Small Mammals of Southeastern Virginia as Revealed by Pitfall Trapping

Robert K. Rose

Department of Biological Sciences
Old Dominion University
Norfolk, Virginia 23529-0266

ABSTRACT

Pitfall trapping is a poor method to catch small mammals but the only way to catch and study the Southeastern Shrew (*Sorex longirostris*), the primary mammal of interest in the field studies reported here. While learning much about its distribution and abundance, still more was learned about the other small mammals present in forests and fields of eastern Virginia. A total of 15 species was captured at 19 locations during the 1990-2013 period, including five shrews, two moles, and eight rodents, representing all but one of the common small mammals in eastern Virginia.

Key words: moles, pitfall trapping, rodents, shrews, small mammals, Virginia.

INTRODUCTION

Pitfall trapping is a useful but labor-intensive method to census ground-dwelling animals, such as insects that cannot be collected in light traps or with sweep nets, or animals such as amphibians and snakes that do not respond to baited traps. As the name implies, pitfall traps, whether cups, cans, or buckets, are placed in the ground flush with the soil surface and the animal blunders in or is guided to the trap by constructed drift fences. The catch rate of pitfall traps is highly variable and determined by population density, season, and even weather factors.

I first used pitfall traps in February 1980 when, with the help of Old Dominion University undergraduates Rosalind Bowman and David Harrelson, we placed pitfall traps under a powerline in the northwest section of the Great Dismal Swamp National Wildlife Refuge (GDSNWR) in Suffolk, Virginia, in an attempt to collect *Synaptomys cooperi helaletes*, the Dismal Swamp subspecies of Southern Bog Lemming. Using specimens collected in 1895 by the US Biological Survey, C. Hart Merriam (1896) had described the Dismal Swamp form as a new species, but Wetzel (1955), in a revision of the genus, demoted *S. c. helaletes* to a subspecies. More importantly, lemmings had not been collected in the Dismal Swamp in the 20th Century, despite field efforts by Charles O. Handley, mammal curator of the US National Museum of Natural History, and others. Our purpose in using pitfall traps in the Refuge was to learn whether *S. c. helaletes* was still present in the Dismal Swamp, and our results confirmed that it was (Rose, 1981).

Pitfall traps for small mammals were first used intensively by Tuttle (1964) for collecting shrews in Tennessee. French (1980) popularized the method in his studies of shrews in Alabama, where he caught dozens of Southeastern Shrews (*Sorex longirostris*), a supposedly rare mammal. At the time, the one or two state records in several southeastern states were for specimens found dead on the ground or drowned in downspout basins, but never caught in traps.

Among the small mammals we trapped in 1980, besides Southern Bog Lemmings, were the first 20th Century specimens of *Sorex longirostris fisheri*, another distinctive Dismal Swamp subspecies with a similar collection and taxonomic history to *S. c. helaletes*. After receiving grant support from the US Fish and Wildlife Service's Office of Endangered Species, my graduate students and I began extensive studies of *S. l. fisheri*, at first centering on the GDSNWR and later more broadly, in order to learn details of abundance, distribution, and habitat for this long-tailed shrew. In 1986, the US Fish and Wildlife Service listed the Dismal Swamp Southeastern Shrew as a "Threatened" species. As a result of this listing, construction projects

planned for areas in potential shrew habitat were required to conduct surveys for the presence of the shrew, leading to a number of surveys that my students and I conducted using pitfall traps. The information presented in this paper is based on 19 such field surveys in southeastern Virginia. In our quest to learn the presence and other details of *S. l. fisheri,* we learned much about the distribution and habitats of the other small mammals in this region of Virginia. In fact, using pitfall traps we collected 15 species of small mammals, all but one (Marsh Rice Rat) of the common small mammals in eastern Virginia, including five shrew species, both moles, and eight species of rodents. (There are historic records of two other species from southeastern Virginia, *Peromyscus gossypinus* [Cotton Mouse] and *Zapus hudsonius* [Meadow Jumping Mouse], neither of which have I caught in Virginia.)

MATERIALS AND METHODS

In our efforts to learn details of the biology of the Southeastern Shrew we trapped in a range of seral habitats using #10 tin cans (23 cm tall, 15 cm diameter) as pitfalls, traps that we placed in a 5 by 5 grid, with 12.5 m intervals between traps. This grid encompassed an effective trapping area of 0.25 ha, and the repeated use of this design enabled us to determine relative densities among different sites and habitats. Using an Iwan auger, we drilled a hole in the ground that just accommodated the tin can; we then placed 5-8 cm of water in the can, in which the small mammals were drowned. Depending on season, we checked the traps once or twice a week for an extended period. During the first year we learned that little new information on small mammal abundance was obtained by trapping longer than 21 days, so our standard protocol for field sampling was established as a 0.25-ha grid of 25 pitfall traps for 21 days. Occasionally, flooding, which fills pitfall traps and renders them useless as traps, required extending the study beyond 21 days. By having used these standard methods throughout, it was possible to compare relative densities of small mammals across habitats and also to calculate capture rates (number of collected specimens divided by the total number of nights the traps were in the ground times 100, which yields the number of small mammals per 100 trap nights). One trap in place for one night equals one trap night.

These field studies were conducted during the 1990-2013 period in the cities of Virginia Beach, Chesapeake, and Suffolk, all large areas because each municipality had incorporated the area of its former county. This region of the Coastal Plain is low-lying, often with a high water table and winter flooding, and many soils are highly organic of Dismal Swamp type. Although old dunes and centuries of excavation and filling have created some upland habitats in the region, it is likely that some version of swamp forest dominated the region when Europeans arrived in the early 1600s.

All specimens collected in pitfall traps were returned to the lab, dried with paper towels, and then weighed (g) and standard measurements (mm) were taken. Each small mammal was given a catalog number, and detailed information was recorded, including such variables as number of embryos or testes weight. After removal of entrails and brain, the carcass was given a numbered skull tag, wrapped with thread, dried in a lab hood, and then stored in an insect-proof museum specimen case. Later, these dried specimens and copies of the related data forms were donated to museums, almost all to the US National Museum of Natural History.

RESULTS

Pitfall trapping at 19 sites yielded 15 species of small mammals, including five shrews, two moles, and eight rodents (Table 1). Some, such as Pygmy Shrew, Star-nosed Mole, and Golden Mouse, were taken at only one site, whereas others (Southeastern Shrew and Southern Short-tailed Shrew) were collected at more than half of the sites. These latter two shrews were also seen in greatest numbers (n = 58, 93), collectively comprising more than half of the total (n = 285). The totals for the five shrews (n = 203) were > 70 percent of the total catch.

Most sites for proposed construction projects were predominantly forested, resulting in the majority of study grids being placed in forests (87), compared to only 17 in early successional habitat or oldfields (Table 2). The grids in oldfields often yielded 5-7 species, compared to forested grids, which collectively yielded fewer species and individuals (Table 2). At Site 13 (Table 2), the single oldfield grid yielded the same number of species, seven, and more specimens, than the 16 forested grids. Overall, the oldfield grids yielded 164 small mammals (9.6 specimens per grid), whereas the more numerous forested grids yielded only 121 small mammals (1.4 specimens per grid). This crude comparison nicely describes the relative abundances of small mammals in field and forest.

The capture rates in oldfields and forests showed the same pattern as the number of specimens per grid: pitfall traps in oldfields (11,775 trap-nights) had a capture rate of 1.39 mammals per 100 trap-nights whereas forest pitfall traps (65,910 trap-nights) yielded only 0.18 mammals per 100 trap-nights. Even if the four forest sites (numbers 4, 6, 11, and 17) that yielded

Table 1. Small mammals collected with pitfall traps in southeastern Virginia, 1990-2013. A total of 15 species was collected at 19 survey locations, including five shrews, two moles, and eight rodents.

Scientific name/common name	# sites	# specimens #/site	# specimens Total
Cryptotis parva, Least Shrew	6	1–9	26
Sorex longirostris, Southeastern Shrew	11	1–19	58
Sorex hoyi, Pygmy Shrew	1	5	5
Blarina brevicauda, Short-tailed Shrew	4	2–8	21
Blarina carolinensis, Southern Short-tailed Shrew	12	1–36	93
Condylura cristata, Star-nosed Mole	1	1	1
Scalopus aquaticus, Eastern Mole	2	1	2
Reithrodontomys humulis, Eastern Harvest Mouse	6	1–13	26
Peromyscus leucopus, White-footed Mouse	7	1–6	16
Ochrotomys nuttalli, Golden Mouse	1	1	1
Sigmodon hispidus, Hispid Cotton Rat	2	1–2	3
Microtus pennsylvanicus, Meadow Vole	2	2–3	5
Microtus pinetorum, Woodland Vole	4	1–4	8
Synaptomys cooperi, Southern Bog Lemming	3	1–9	11
Mus musculus, House Mouse	4	1–5	9
Totals			285

Table 2. Numbers of species and specimens of small mammals collected in pitfall traps at each of 19 sites in southeastern Virginia, 1990-2013; locations are given numbers to protect their anonymity. Seventeen grids placed in oldfields yielded 164 small mammals and 87 grids in forests yielded 121 small mammals. Sites with no specimens are denoted with an asterisk.

Site Number	# species	oldfield habitats		forested habitats	
		# grids	#species/specimens	# grids	# species/specimens
1	7	5	7/38	5	4/22
2	2	0		4	2/3
3	8	1	5/13	5	4/14
4*	0	0		2	0/0
5	8	5	7/42	5	6/13
6*	0	0		4	0/0
7	3	0		1	3/4
8	2	0		1	2/2
9	2	0		1	2/2
10	1	0		2	1/3
11*	0	0		1	0/0
12	3	2	2/2	5	2/2
13	7	1	7/23	16	5/22
14	5	0		6	5/9
15	4	0		7	4/5
16	2	0		7	2/9
17*	0	0		2	0/0
18	7	2	6/42	6	3/4
19	5	1	2/4	7	4/7
TOTALS		17	164 mammals	87	121 mammals

no small mammals were excluded from the calculation, the catch rate would be only slightly higher, 0.21 mammals per 100 trap-nights. This rate equates to about 1 mammal for the 21-day trapping period on the grid.

DISCUSSION

Despite the low capture rate, pitfall trapping did reveal that the Southeastern Shrew (a long-tailed shrew averaging 100 mm and 4-5 g) has a broad distribution in the region, and confirmed that higher densities are present in oldfields than in forests. Sometimes the Southeastern Shrew was numerous (e.g., n = 10, 16, 19 per site), which conformed to earlier studies conducted in and near the GDSNWR (Rose et al., 1990); sometimes it was the most numerous species. The Southern Short-tailed Shrew was even more numerous and widespread in oldfields than in forests (Table 1). This shrew averages 100 mm and 10 g, compared to 120 mm and 18 g for *Blarina brevicauda,* the largest shrew species in North America. The Least Shrew is more predictably restricted to upland habitats, usually oldfields with mineral soils. Of all the species in eastern Virginia, the Least Shrew has the greatest fidelity to a type of habitat: fairly dry, upland oldfields. The Pygmy Shrew, at 70 mm and 2-3 g the smallest North American shrew and one of the world's smallest, was found in pine forest. This shrew, also taken only with pitfall traps, has a patchy distribution in the Coastal Plain of Virginia and North Carolina (Padgett & Rose, 1994) but, like the Southeastern Shrew, also occupies a range of habitats.

Relatively little is known about the distribution and abundance of the two moles in eastern Virginia. Star-nosed and Eastern Moles probably are equally common and occupy a range of habitats, their one universal requirement being a rich loamy or organic soil productive of earthworms, grubs, and other invertebrates which they obtain by "mining" the soil. Both moles are almost exclusively subterranean so their appearance in pitfall traps is unexpected.

I have given the sites numbers rather than names (Table 2) to protect the anonymity of the clients, which in some cases were municipalities, highway departments, or military facilities. Four of the 19 sites yielded no small mammals, usually due in part to the small area of a site and the resulting small number of grids, often only 1 or 2; one site was only 10 m by 35 m and accommodated transects rather than grids of traps. In other instances, the absence of mammals seemed to be attributable to the isolation of the site, such as a small forested plot surrounded by housing developments or farm fields, locations where it seemed possible that predation by House Cats or the dry conditions of forest edges had contributed to the disappearances of already small populations. Forests are known to support fewer species of small mammals than oldfield or shrub habitats, as well as low densities of those few species (Kirkland & Griffin, 1974).

In southeastern Virginia, the small mammal most predictably found in forests is the White-footed Mouse, an arboreal rodent that usually nests in tree holes (Batzli, 1977). The only other arboreal small mammal among the 15 regional species is the Golden Mouse (*Ochrotomys nuttalli*), which is found mostly in 8-10 year-old pine stands (Dolan & Rose, 2007; Rose, pers. obs.) or forest edge habitats (Rose & Stankavich, 2008) in eastern Virginia. As its name implies, the Woodland Vole (*Microtus pinetorum*) is another small mammal found (in low densities) in forests, but it sometimes achieves higher densities in early successional habitats in eastern Virginia (Rose & Ford, 2012).

The other small mammal species are more often associated with early successional habitats, where herbaceous stems and leaves, seeds, and insect foods are found in greater abundance. Fields dominated by grasses and forbs are the prime habitat for Meadow Voles, Hispid Cotton Rats, Eastern Harvest Mice, and sometimes Southern Bog Lemmings. The shrews would be mostly Least, Southeastern, and Southern Short-tailed. These rodents and shrews would comprise the typical small mammal community of approximately seven species found in oldfields, with the Southern Bog Lemming less often present (sedges and rushes and generally wetter conditions are better predictors for the lemmings–Rose, 2006, 2011). When the grasses disappear as secondary succession progresses, Meadow Voles disappear first, then Cotton Rats and probably the lemmings, leaving the habitat to the others, especially Eastern Harvest Mice, until Golden Mice and White-footed Mice arrive.

The one non-native small mammal, *Mus musculus*, the House Mouse, was mostly present in early successional (oldfield) habitat. An excellent colonizer of newly created grassy fields, the House Mouse exploits the bountiful seeds and insects for a season or two, then is displaced when Meadow Voles and other herbivorous mammals arrive in numbers. The Eastern Harvest Mouse, found in highest densities in oldfields, has broad habitat tolerances, and surprisingly is sometimes abundant in shrubby or forest-edge habitat and can be present almost anywhere. Mostly a seed and perhaps insect eater, this harvest mouse is tiny, with adults weighing about 8 g; they usually build small grassy nests in tufts of grass or low in shrubs. Finally, the one common small mammal not taken during these pitfall trapping studies was the Marsh Rice Rat,

Oryzomys palustris. As the name implies, this 80-g rodent is found mostly in marshes, many of which are tidal in eastern Virginia. Pitfall traps do not work when flooded, and so their absence was not unexpected, given the kinds of sites being surveyed in these studies.

In conclusion, the pitfall traps used for more than 75,000 trap-nights in these studies captured all but one of the common species of small mammal in eastern Virginia. The five shrew species comprised over half of the total small mammal captures, and oldfields yielded about seven times more small mammals than forests, whether based on number caught per grid or on catch rates.

ACKNOWLEDGMENTS

The funds from payment for these projects were (mostly) deposited into a research account, which supported field work by graduate students, their attendance in regional or national meetings, and per diem support during a sabbatical leave. Thanks to the several students for their assistance in the field (many of them coauthors on cited papers) and to the Department of Biological Sciences at Old Dominion University for equipment and other support. Thanks also to Shirl Dressler, Virginia Department of Game and Inland Fisheries, for her assistance in securing the permits under which this work was conducted. All field procedures in this study were conducted in compliance with guidelines established by the American Society of Mammalogists (Animal Care and Use Committee, the most recent citation for which is Sikes et al. [2016]).

LITERATURE CITED

Batzli, G. O. 1977. Population dynamics of the White-footed Mouse in floodplain and upland forests. American Midland Naturalist 97: 18-32.

Dolan, J. D., & R. K. Rose. 2007. Depauperate small mammal communities in managed pine plantations in eastern Virginia. Virginia Journal of Science 58: 147-163.

French, T. W. 1980. Natural history of the Southeastern Shrew, *Sorex longirostris* Bachman. American Midland Naturalist 104: 13-31.

Kirkland, G. L., Jr., & R. J. Griffin. 1974. Microdistribution of small mammals at the coniferous-deciduous forest ecotone in northern New York. Journal of Mammalogy 65: 417-427.

Merriam, C. H. 1896. Revision of the lemmings of the genus *Synaptomys*, with descriptions of new species. Proceedings of the Biological Society of Washington 10: 55-64.

Padgett, T. M., & R. K. Rose. 1994. The Pygmy Shrew, *Sorex hoyi winnemana* (Insectivora: Soricidae), from the Coastal Plain of North Carolina. Brimleyana 21: 87-90.

Rose, R. K. 1981. *Synaptomys* not extinct in the Dismal Swamp of Virginia. Journal of Mammalogy 62: 844-845.

Rose, R. K. 2006. Distribution and status of the Southern Bog Lemming, *Synaptomys cooperi*, in southeastern Virginia. Virginia Journal of Science 57: 153-165.

Rose, R. K. 2011. Range extension for the Dismal Swamp Southern Bog Lemming, *Synaptomys cooperi helaletes*, in eastern Virginia. Banisteria 38: 61-65.

Rose, R. K., & L. J. Ford. 2012. Minor species as the dominant rodents in an oldfield. American Midland Naturalist 168: 1-8.

Rose, R. K., & J. F. Stankavich. 2008. Low-density rodent communities in eastern Virginia. Virginia Journal of Science 59: 169-184.

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

Sikes, R. S., and the Animal Care and Use Committee. 2016. Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. Journal of Mammalogy 97: 663-688.

Tuttle, M. D. 1964. Additional records of *Sorex longirostris* in Tennessee. Journal of Mammalogy 45: 146-147.

Wetzel, R. M. 1955. Speciation and dispersal of the Southern Bog Lemming, *Synaptomys cooperi* (Baird). Journal of Mammalogy 36: 1-20.