estad and Bunnell, 1979; Swihart et al., 1988) were derived from data in which there was inherent variation around the estimated regression line. The results of the present study may reflect the inherent variation of estimating home-range size from models derived from body mass data.

The Virginia opossum is a versatile species that uses a number of food sources. This omnivorous feeding strategy is consistent with a nomadic lifestyle, and thus, a relatively large home-range size. Although the Harestad and Bunnell (1979) model predicted the subadult Virginia opossum home-range size, because of the nomadic lifestyle, models estimating home-range size of other age classes of Virginia opossums may need to accommodate nomadism and habitat use behavior.

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DISTRIBUTION AND HABITAT USAGE OF THE PYGMY SHREW (*SOREX HOYI*) IN TENNESSEE

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ABSTRACT—The distribution of the pygmy shrew (*Sorex hoyi*) in Tennessee ranges from the Appalachian Mountains in the east to the Tennessee River Valley in the west. The species demonstrates a wide tolerance for habitat. However, the greatest numbers of individuals have been collected in the western part of its distribution in habitat characterized by mixed mesic and xeric vegetation associated with rock outcroppings.

Sorex hoyi winnemana (pygmy shrew) has the most southern distribution for a subspecies of *S. hoyi* and occurs from southern Illinois to southern Maryland and south to northern Georgia (Diersing, 1980). Although described >85 years ago as *Microsorex winnemana* (Preble, 1910), *S. h. winnemana,* until recently, has been considered rare because it was represented in the literature by only a small number of specimens (Caldwell, 1980; Diersing, 1980). Guilday et al. (1969) speculated that the pygmy shrew might occupy some of the higher peaks in eastern Tennessee, but it was not until Kennedy et al. (1979) reported on two specimens from Monroe County (Whigg Meadow) that it was documented in this region. Soon after this work, additional specimens were reported by Baumgardner et al. (1979), and Kennedy and Harvey (1979) from Cannon County (Short Mountain, $n = 1$), Fentress County (Northrup Falls, $n = 2$), Grundy County (Savage Gulf, $n = 2$), Monroe County (Whigg Meadow, $n = 1$), and Van Buren County (Fall Creek Falls State Park, $n = 2$). The next published records for this taxon in Tennessee were at least 9 years later. Tims et al. (1989) discussed a pygmy shrew from Perry County in the west central part of Tennessee that extended the known distribution in this state considerably. Additional records were added for Monroe County ($n = 10$) and Polk County ($n = 6$) by Harvey et al. (1991) and for Unicoi County ($n = 14$) by Harvey et al. (1992). Later, Feldhamer et al. (1993) reported the species in Kentucky and Tennessee ($n = 89$); Tennessee specimens would have been from Stewart County but, neither the specific capture sites nor the number of shrews obtained in Tennessee were disclosed.

While a number of records have been published for *S. hoyi* in Tennessee, there has been no published account of this species that views the records collectively and focuses on determining statewide distribution and habitat affinities. Overall, there is a need to better understand the natural history of the pygmy shrew in the southeastern United States. The purposes of this account were to: collectively report all known records of *S. hoyi* from Tennessee (including three new capture sites); describe, at a general level, the habitat at selected sites where this shrew has been captured; and discuss the possible biogeographic history for this shrew in the southern portion of its distribution.

Materials and Methods

Specimens and field notes by students and faculty from The University of Memphis, Memphis, Tennessee, relating to *S. hoyi winnemana* provided most of the distributional records and the majority of the information relating to habitat features reported in this account. Specimens were collected from 1974 to 1994 using pit-fall containers (3.8 l cans, 0.9 l plastic cups, and 19 l plastic buckets). Containers were buried level with the ground surface in areas having cover suitable for shrews (in or adjacent to logs, stumps, rock ledges, low vegetation, and dead litter). Additional sampling using other trapping procedures (Sherman live traps, Museum Special snap traps, and Victor snap traps) supplemented the effort with pit-fall containers at most sites. Sampling was conducted in all of the physiographic regions of Tennessee defined by Miller (1974). Voucher specimens of species discussed herein are deposited in The University of Memphis Biological Collections. Some additional information was taken from previous literature.

Results and Discussion

Distribution—New records for *S. hoyi* are reported as follows: Johnson County Shady Valley ($n = 1$); Marion County Sequatchie Valley ($n = 1$); Perry County Tennessee Valley Authority Lands, Cedar Creek, Kelly's Landing ($n = 13$). Considering the specimens reported herein and in the literature (Appendix 1 and Fig. 1), *S. hoyi* exhibits a fairly continuous distribution across the eastern three-fourths of Tennessee (ranging from the Appalachian Mountains in the east to the Tennessee River Valley in the west). The Tennessee River Valley currently appears to be the western distributional boundary for this species. This physiographic region also is considered important in the distribution of other species of shrews; *Blarina carolinensis* and *Blarina brevicauda* have been reported to come into contact in this region in Tennessee (Braun and Kennedy, 1983) and Kentucky (Bryan, 1991).

Habitat description for selected capture sites—Specimens of *S. hoyi* from Tennessee generally have been obtained from areas

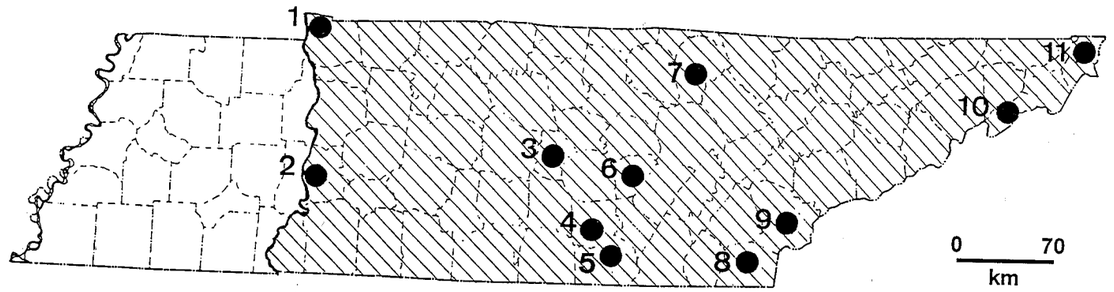

FIG. 1. Proposed distribution of *Sorex hoyi winnemana* (indicated by shaded area) in Tennessee. The line bordering the western limit of this range represents the Tennessee River. Counties containing sites of capture are: 1) Stewart, 2) Perry, 3) Cannon, 4) Grundy, 5) Marion, 6) Van Buren, 7) Fentress, 8) Polk, 9) Monroe, 10) Unicoi, and 11) Johnson. Details of capture sites (precise localities, sample sizes, and collections of deposition), are detailed in Appendix 1.

of at least moderate geographic relief. Habitat at these sites varies widely from fairly cool and moist situations to rather warm and dry ones. Unless accompanied by a citation, the following habitat descriptions are for specimens housed in The University of Memphis Biological Collections.

Shady Valley (Johnson County) and Whigg Meadow (Monroe County) are within the Appalachian Mountains in the Unaka Mountains physiographic region. Mixed mesophytic vegetation was common throughout the area surrounding Shady Valley with eastern hemlock (*Tsuga canadensis*), rhododendron (*Rhododendron* spp.), mosses, and ferns being prominent near the collection site. At Whigg Meadow (Kennedy et al., 1979), capture sites were in forest of beech (*Fagus grandifolia*), maple (*Acer* spp.), yellow buckeye (*Aesculus octandra*), and hawthorn (*Crataegus* spp.). Ground cover of ferns, mosses, grasses, rotten logs, and stumps was common to the area. The capture sites reported by Harvey et al. (1991) and Harvey et al. (1992) are in this physiographic region of Tennessee and exhibit similar habitat characteristics.

Capture sites at Savage Gulf (Grundy County), Northrup Falls (Fentress County), Sequatchie Valley (Marion County), Fall Creek Falls (Van Buren County), and Short Mountain (Cannon County) were within the Cumberland Plateau physiographic region. The sites at Savage Gulf, Northrup Falls, and Sequatchie Valley were situated along gorges or valleys with streams or rivers. At Savage Gulf and Northrup Falls, sites of capture were islands of mesophytic vegetation surrounded by drier, deciduous forest. One capture site at Savage Gulf was along a stream at the bottom of a gorge in mature forest characterized by eastern hemlock, magnolia (*Magnolia* spp.), and rhododendron. The second site of capture at Savage Gulf was along a stream in young forest (secondary growth) surrounded by well-established rhododendron. At Northrup Falls, *S. hoyi* was taken from a narrow strip of mesophytic vegetation in which hemlock and huckleberry (*Gaylussacia* spp.) were prominent, that bordered the rim of the gorge near the head of the falls. The capture site from Sequatchie Valley was adjacent to the Sequatchie River in a thicket of young trees that also had shrubs, weeds, and grasses present. The capture sites at Fall Creek Falls and Short Mountain were characterized by conditions that were drier than those previously described. The site at Fall Creek Falls was within Fall Creek Falls State Park, outside the gorge of Fall Creek. The area of capture exhibited little topographic relief. While there were temporary runoff channels in the vicinity, no permanent water was observed nearby. The vegetation had been previously burned and was shrubby, secondary growth in which pine (*Pinus* spp.), oak (*Quercus* spp.), and grasses were frequent. The pygmy shrew from the site at Short Mountain was taken at the top of the mountain in a stand of sugar maple (*Acer saccharum*) in moderately heavy and dry leaf litter. Mixed mesophytic vegetation occurred on the north- and south-facing slopes of the mountain, but no permanent water was nearby.

A number of specimens of pygmy shrew have been obtained, comparatively recently, from within or near the Tennessee River Valley at the western extent of the range of this species in Tennessee. The specimen reported by Tims et al. (1989) from Perry County was captured ca. 6.4 km (4 miles) east of the Tennessee River at the bottom of a hillside beside a dry creek bed. Soil at this site was dry and had an abundance of decomposing cherty limestone. Vegetation included elm (*Ulmus* spp.), oak, hickory (*Carya* spp.), yellow poplar (*Liriodendron tulipifera*), and maple with an understory of ferns, honeysuckle (*Lonicera japonica*), and poison ivy (*Toxicodendron radicans*). The capture site for the 13 new specimens from Perry County that are reported herein was ca. 200 m from the Tennessee River where the floodplain joined a bluff of rock outcroppings. Habitat was characterized by a mixture of mesic and xeric vegetation consisting of grasses, blackberry (*Rubus* spp.) thickets, red cedar (*Juniperus virginiana*), and a number of hardwoods including hickory, oak, beech, and dogwood (*Cornus florida*) on the bluff and sycamore (*Platanus occidentalis*), birch (*Betula nigra*), and locust (*Robinia* spp.) on the adjacent floodplain. Eighty-nine pygmy shrews were reported by Feldhamer et al. (1993) as captured from Land-Between-The-Lakes. This facility is an outdoor recreational and educational area bordered on its west by the Tennessee River in southern Kentucky and northern Tennessee. Type of habitats from which specimens were obtained varied widely (old field, lowland conifer, upland conifer, lowland hardwood, and upland hardwood) and are described in detail by Feldhamer et al. (1993). Some of these sites had water nearby, but others were comparatively dry. The majority of these shrews were catured at upland-hardwood-forest sites located on ridge tops or slopes. Vegetation was dominated by oak and hickory with a variety of hardwoods and understories including elm, blackgum (*Nyssa sylvatica*), dogwood, maple, sassafras (*Sassafras albidum*), huckleberry, grape (*Vitis* spp.), and poison ivy.

Microhabitat preferences and biogeographic history—Over the majority of its geographic distribution, *S. hoyi* generally has been portrayed in the literature as occupying boreal habitats, riparian routes extending from such habitats, drainage basins, and closely associated wet-dry situations. The pygmy shrew is sometimes found during late summer on the dry soils of uplands, but, even in these instances, it has been captured within 100 m of water (Long, 1972*a*, 1974). Habitat, discussed herein, for most capture sites for *S. hoyi* in Tennessee was similar to the previously mentioned range of conditions. Specimens from Shady Valley, Marion County, Polk County, and Unicoi County were obtained from extensive areas of mixed mesophytic forest. Animals from Savage Gulf, Northrup Falls, and Sequatchie Valley were captured in islands of such habitat surrounded by drier vegetation.

In contrast, pygmy shrews from Fall Creek Falls and Short Mountain were collected at comparatively dry sites at some distance from permanent water. These animals were captured during the summer, which is the season in which pygmy shrews have been most frequently found on dry, upland sites. However, these sites lack permanent water nearby and are drier than previously described localities for the species. The records from Fall Creek Falls State Park and Short Mountain plus results reported for pygmy shrews captured in Kentucky (Caldwell and Bryan, 1982), Indiana (Cudmore and Whitaker, 1984), and Tennessee (Tims et al., 1989; Feldhamer et al., 1993) indicate a wider array of habitat tolerance by *S. hoyi* than previously considered. Occupation of drier situations by some populations of this shrew may be the result of their localized adaptation to more xeric environmental conditions. Long (1972*b*) speculated that the small size of the two southern races of pygmy shrews (*S. h. montanus* in the western United States and *S. h. winnemana* in the eastern United States) might be evidence for their adaptation to less favorable habitats which developed in these regions as the environment warmed and dried following the Wisconsinan glacial maximum.

Sorex hoyi is known to have occurred in central Tennessee during the height of Wisconsinan glaciation (Guilday et al., 1969; Parmalee and Klippel, 1981). During that time, the region probably supported mixed coniferous-deciduous forests (Delcourt, 1979). As this glacier receded, it would have been followed by boreal and mesophytic vegetational elements, and the main distribution of the pygmy shrew likely moved north with these habitats. With the northward retreat of such environments, drier, deciduous forest extended from the west (Wright, 1968). As these environmental alterations occurred, some populations of *S. hoyi* apparently remained in isolated pockets of favorable habitat, such as mountains, valleys, and gorges, that were comparatively cooler and moister. With continued fragmentation and isolation of southern *S. hoyi,* some of its populations seem to have adapted to warmer and drier conditions. Such adjustments have resulted in a species with a wide tolerance of habitat types.

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