The Masked Shrew, *Sorex cinereus* (Insectivora: Soricidae), and Red-backed Vole, *Clethrionomys gapperi* (Rodentia: Muridae), in the Blue Ridge Province of South Carolina

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**ABSTRACT**—The first records of *Sorex cinereus* Kerr are documented from South Carolina. Pitfall surveys throughout the Blue Ridge Province resulted in captures from two localities in markedly mesic, relict, boreal habitats. Additional records of *Clethrionomys gapperi* (Vigors) were documented including the most southeastern record. Both *S. cinereus* and *C. gapperi* are rare in South Carolina, largely because of limited areas of appropriate habitats.

The masked shrew, *Sorex cinereus* Kerr, has the largest range and exhibits the greatest geographic variation of any North American *Sorex* (Hall 1981, Junge and Hoffmann 1981, van Zyll de Jong and Kirkland 1989). It ranges throughout the transcontinental coniferous forests from the Canadian Arctic south to the extreme northern portions of the United States with significant extensions south into the...
montane forests of the Rocky and Appalachian mountains. In the southeastern United States including Virginia and West Virginia, eastern Kentucky and Tennessee, North Carolina and Georgia, *S. cinereus* is restricted primarily to high elevation montane communities of the Appalachian Highlands (van Zyll de Jong and Kirkland 1989). To date, however, there have been no records from South Carolina (Golley 1966, Mengak et al. 1987).

Previously, the southernmost records of *S. cinereus* have been reported from Georgia based upon three specimens reported by Wharton (1968) from Beech Creek near its confluence with the Talulla River, Towns County, at an elevation of 807 m. More recently, Ford et al. (In press) have reported *S. cinereus* from numerous, widely scattered localities throughout the Blue Ridge Province of Georgia, including localities in close proximity to the South Carolina state line. Similarly, *S. cinereus* has been reported from several Blue Ridge Province counties in North Carolina (Polk, Henderson, Transylvania, Jackson, Macon, and Clay) which are contiguous to South Carolina (Lee et al. 1982 and unpublished University of Georgia, Museum of Natural History records). Because *S. cinereus* is known to occur in immediately adjacent areas of Georgia and North Carolina and because seemingly appropriate areas of high elevation habitat exist in the Blue Ridge Province of South Carolina, we surveyed the mountainous portions of Oconee, Pickens, and Greenville counties specifically for *S. cinereus*.

**METHODS**

From 23 January to 1 May 1994 pitfall trap surveys were conducted throughout the Blue Ridge Province of extreme northwestern South Carolina including, from east to west, portions of Greenville, Pickens, and Oconee counties. We totalled 14,000 trap nights at 17 individual sites. At each site twenty, 32-ounce, plastic containers (14-cm lip diameter and 17-cm depth) were placed below ground level adjacent to forest floor debris including stumps, fallen logs, rocks, etc, for a minimum of 60 days. Approximately 0.14L of preservative was placed in the bottom of each pitfall. General habitat features, including dominant overstory and understory vegetation, aspect, and approximate stand age, of each site were recorded and elevations estimated from topographic maps. Traps were checked on a biweekly basis. Specimens were preserved in alcohol for subsequent reproductive and gut content analysis. Standard body measurements were taken, and skulls were prepared for confirmation of identifica-
RESULTS AND DISCUSSION

We recovered 15 *S. cinereus* at two of 17 Blue Ridge Province sites. Both *S. cinereus* localities were in the northwestern portion of Oconee County. Seven individuals were recovered from the grounds of the Walhala Fish Hatchery in a hemlock (*Tsuga canadensis*) and rhododendron (*Rhododendron maximum*) streamside community which grades upslope into a yellow poplar (*Liriodendron tulipifera*), mixed oak (*Quercus* spp.), hickory (*Carya* spp.), and white pine (*Pinus strobus*) community. Elevation was approximately 760 m. The second *S. cinereus* locality (eight captures) was approximately 1.3 km east of the Walhala Fish Hatchery site in a moderate to mesic mixed oak and yellow poplar hardwood community at approximately 800 m.

*Sorex cinereus* was the dominant small mammal recovered in the Walhala Fish Hatchery site. Fifteen small mammals were recovered in 1,960 trap nights: seven *S. cinereus*, two *S. fumeus*, one *Sorex hoyi*, one *Blarina brevicauda*, two *Peromyscus maniculatus*, and one *Clethrionomys gapperi*. The recovery of *S. cinereus* was fairly evenly distributed over the trapping period with one or two captured during each sampling period.

At the second site, also with 1,960 trap nights, 12 *S. fumeus*, four *S. hoyi*, two *Peromyscus leucopus*, one *P. maniculatus*, two *Blarina brevicauda*, and one *Clethrionomys gapperi* were captured in addition to the eight *S. cinereus*. Here all the cinereus were captured between 20 March and 3 April; six of which were taken in a single pitfall trap beneath a large, heavily rotted log.

The breadth and intensity of our collection efforts indicate a restricted distribution of *S. cinereus* in South Carolina. *Sorex cinereus* is regarded as having a boreomontane distribution (Junge and Hoffman 1981). In the southern Appalachians it has been documented by Odum (1949), Johnston (1967), Gentry et al. (1968), Linzey and Linzey (1971), Whitaker et al. (1975), and Lee et al. (1982) in western North Carolina; Conaway and Howell (1953), Smith et al. (1974), and Harvey et al. (1991, 1992), in the mountainous regions of eastern Tennessee; and Pagels and Tate (1976), Pagels and Handley (1989), Pagels (1991), Kalko and Handley (1993), and Pagels et al. (1994) in southwestern Virginia. It has not been recorded from elevations below 610 m in southwestern Virginia (Pagels and Handley 1989) or North Carolina (Linzey and Linzey 1971, Lee et al. 1982). Similarly,
in Georgia, *S. cinereus* is restricted to high elevation (790–1,370 m) in markedly mesic habitats with northern affinities (Ford et al. 1994).

Kirkland (1985, 1991) indicated that soricids, in general, are most diverse in regions characterized by cool moist forests, possibly by supporting an abundant, stable, and diverse soil invertebrate fauna upon which shrews depend. Pagels et al. (1994) have shown that the presence of *S. cinereus* was significantly correlated with soil moisture holding capacity and total understory vegetation, and that habitat features that promote shaded, moist habitats were particularly important in relict, boreal forest habitats throughout the southern Appalachians.

Although considerable areas of the Blue Ridge Province in South Carolina meet or exceed the minimum elevations at which *S. cinereus* is found elsewhere in the southern Appalachians, boreomontane habitats are limited there. At the southern limit of the Appalachian Mountains, much of the mountain habitat in South Carolina is characterized by south-facing aspects with more xeric, mixed oak and pine communities. Similar xeric south-facing or ridgeline habitats in Georgia yielded few, if any, *S. cinereus* in recent studies (Ford et al. 1994). In Georgia we encountered *S. cinereus* primarily at very high elevations (over 1200 m) or in rich, moist, streamside communities dominated by hemlock and rhododendron on the Rabun Bald Massif. West of the Little Tennessee River in Georgia, *S. cinereus* is restricted to higher (over 1000 m) elevations, and then they only occur in restricted habitats with marked northern affinities such as those described by Wharton (1968).

Our collection site at the Walhala Fish Hatchery is located in a relatively narrow, steep-walled gorge of the East Fork of the Chattooga River. Wharton (1977) noted that similar streamside forest communities on the Georgia side of the Chattooga were kept cool and moist due to complete shading by the hemlock overstory and rhododendron shrub layer as well as by steep-walled gorges. He noted that such areas were refugia of more typical northern forest communities. The Walhala Fish Hatchery, and its associated upslope northern aspect cove hardwood habitat, might represent a limited finger or refugia in South Carolina for boreal species such as *S. cinereus*.

The region of the Walhala Fish Hatchery is one of the few sites in South Carolina that has yielded other small mammals with a typical boreal distribution including *Clethrionomys gapperi* (Pivorun et al. 1984) and *Peromyscus maniculatus*. Other high elevation sites in the Blue Ridge Province including Sassafrass Mountain, Jones Gap at Caesar's Head State Park, Saluda Mountain and Hogback Mountain were trapped but yielded no *S. cinereus*. *Peromyscus maniculatus* has
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have been recorded at many of these sites (Golley 1966), and we recovered several specimens at most of these localities. However, *Clethrionomys gapperi* was not reported beyond the Walhalla Fish Hatchery site until we recovered one in the region of Sassafrass Mountain (Pickens County, US Hwy 178, 7.4 m north of State Hwy 11). This is most southeastern record for the species and, like *S. cinereus*, it apparently has a very limited distribution in South Carolina.

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**LITERATURE CITED**


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