Recent Detections of *Spilogale putorius* (Eastern Spotted Skunk) in South Carolina

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Abstract - *Spilogale putorius* (Eastern Spotted Skunk), once a fairly common furbearer across the eastern and mid-western US, is estimated to have undergone a >90% population decline across its range since the 1950s. In South Carolina, only 17 sightings of the Eastern Spotted Skunk have ever been reported, with the most recent sighting in 1998. The objective of our study was to investigate whether this species still occurs in South Carolina. We set camera traps at 56 locations on public land in the Appalachian region of South Carolina during January–March 2015, including sites of historic records. We detected 5 individual Eastern Spotted Skunks at 5 sites between the hours of 20:00 and 03:00 during 1326 trap nights in February and March. Our findings highlight the potential for Eastern Spotted Skunks to persist in other portions of their range despite a lack of recent records, and the need for future monitoring to address whether this species is cryptic or rare throughout portions of its historic range.

Introduction

Spilogale putorius (L.) (Eastern Spotted Skunk) is a small, nocturnal mesocarnivore with a historic range from Pennsylvania to Florida and west to Wyoming (Kinlaw 1995). The species has been described as containing 3 subspecies: *Spilogale putorius ambarvalis* (Bangs), in Florida; *Spilogale putorius interrupta* (Rafinesque), found from Texas north to Minnesota; and *Spilogale putorius putorius* (L.), distributed from Pennsylvania to Florida and Louisiana (Kinlaw 1995, Van Gelder 1959). Few studies have been conducted on this species, and much of our current knowledge is based on research carried out in Arkansas, where Eastern Spotted Skunks are associated with closed-canopy forests with dense understory and have a mean annual survival rate of 35% (Lesmeister et al. 2008, 2009, 2010).

Rangewide, this species was once a relatively common furbearer, with over 100,000 individuals harvested in multiple states each year. However, starting in the 1940s, harvest rates showed a steep decline to about 1% of previously recorded numbers (Gompper and Hackett 2005). A return to previous population sizes has not yet been observed, leading Gompper and Hackett (2005) to estimate that the species has undergone a >90% decline across its range. Several states list the Eastern Spotted Skunk as rare or imperiled (AL, NC, TN, and VA), and though little is known about its population status in any state in the Appalachian region, some states list the species as apparently secure (GA, KY, MS, and SC; Bullock 2008, Legrand and Howard 2013, Van Gelder 1959, Withers 2009).

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Manuscript Editor: Andrew Edelman

In South Carolina, only 17 sightings of the subspecies *Spilogale putorius putorius* have ever been reported, with the most recent sighting in 1998 (J. Holling, South Carolina Heritage Trust Program Database, unpubl. data). It is currently listed as a species of moderate priority on South Carolina's Priority Species list as a part of the state's wildlife action plan (SCDNR 2015), but no dedicated survey or study of the Eastern Spotted Skunk has been conducted in the state. With so little information about its status in South Carolina, it is unknown whether conservation efforts need to be focused on this species or not. Therefore, the objective of our study was to determine if Eastern Spotted Skunks still persist in South Carolina.

Methods

We selected study sites using a 3-step approach. All 12 of the confirmed, historical sightings reported to the South Carolina Heritage Trust Program Database within the past 35 years occurred within the Blue Ridge and piedmont physiographic regions of upstate South Carolina, particularly near high-elevation habitats along the Georgia and South Carolina border. Accordingly, we used those 12 historical records to predict where the species likely persisted, and we incorporated elevation and slope in our maximum entropy models (MaxEnt; Phillips et al. 2006). Although coarse in scale, the MaxEnt approach allowed us to use presence-only data to predict Eastern Spotted Skunk distribution across the upstate region. We defined our study area as the area that contained a >50% Eastern Spotted Skunk predicted distribution based on model output. We limited our study to federal and state-managed lands where we were sure to have access and permission to conduct the study. These areas were generally dominated by *Quercus* (oak)–*Carya* (hickory) forests with patchy understory vegetation that was typically composed of *Rhododendron* spp. (rhododendron) and *Kalmia latifolia* L. (Mountain Laurel). We limited our sampling to areas within 200 m of a public road to accommodate the logistics of deploying, checking, and moving 26 cameras at regular intervals. While this induced a sampling bias, the effect was somewhat limited given the extensive network of public roads across our study area.

We conducted baited camera-trap surveys during winter months (January–March) 2015. Previous evidence suggested detection probability is highest for Eastern Spotted Skunks during the winter breeding season when food is scarce (Hackett et al. 2007). To limit the risk of detecting a single skunk at more than 1 site, we based our camera-trap placement on the reported average size (175 ha) of the male Eastern Spotted Skunk home range during winter because male home ranges are generally larger than those of females (Lesmeister et al. 2009). Although no home range is perfectly circular, we calculated the diameter of a 175-ha circular home range to be 1.5 km, and placed 26 Trophy Cam (HD Model 119537, Bushnell, Overland Park, MO) and HC600 HyperFire HO Covert IR (Reconyx, Holmen, WI) cameras at random locations at least 1.5 km apart and within 200 m of roadways. We attached each camera to a tree trunk located 2–3 m away from another tree where we had nailed a can of sardines (unflavored but stored in soybean oil) ~0.5 m from the ground. We selected sardines as our

bait because other researchers had success with them in attracting Eastern Spotted Skunks to track plates and camera traps (Hackett et al. 2007, Lesmeister et al. 2013). Using data from a baited camera trap in West Virginia where Eastern Spotted Skunks were incidentally photographed (Jachowski et al. 2015), we calculated their detection probability at baited camera traps in the Appalachian region to be 0.15 (MacKenzie 2006). We used this value to determine that a camera left out for at least 14 days would have an estimated 90% probability of detecting an Eastern Spotted Skunk if the site was occupied. Therefore, we deployed a camera at a site for at least 14 days, although due to logistical reasons, some cameras remained in place for over a month, with an average deployment of 23 d (± 9; range = 27 d). We sampled 56 sites for a total of 1326 trap nights from January 2015 to March 2015 (Fig. 1).

Results

We detected a total of 5 individual Eastern Spotted Skunks (Fig. 1) at 5 different sites. All detections occurred in February and March between the hours of 20:00 and 3:30. Initial detection occurred 2–31 d (mean 19.6 d) after we set the camera trap. The average elevation of sites where we detected Eastern Spotted Skunks was 632.02 m asl. Average understory cover was 80%, dominated by Mountain Laurel; 2 sites also contained *Ilex opaca* Soland. ex Ait. (American Holly), and rhododendron. Four of the 5 sites were located in mixed softwood–hardwood forests, and 1 site had a softwood-dominated canopy.

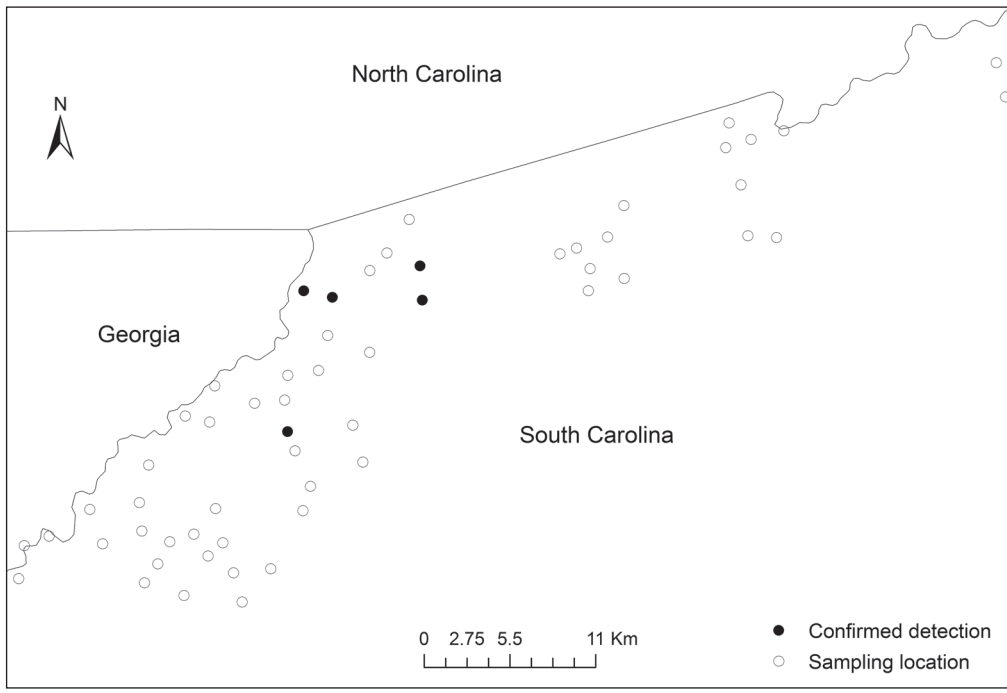

Figure 1. Eastern Spotted Skunks were detected at 5 of the 56 sites where camera traps were set in the Appalachian region of South Carolina from January to March 2015.

All sites where we documented Eastern Spotted Skunks also showed the presence of 4–7 additional mammal species. We observed *Urocyon cinereoargenteus* (Schreber) (Gray Fox) at all 5 sites with Eastern Spotted Skunks detections, *Lynx rufus* (Schreber) (Bobcat) at 2 sites, and *Canis latrans* Say (Coyote) at 3 sites. We did not document any species directly interacting with an Eastern Spotted Skunk. We also captured the following animal species at our camera traps: *Dasypus novemcinctus* L. (Nine-banded Armadillo), *Ursus americanus* Pallus (Black Bear), *Thryothorus ludovicianus* (Latham) (Carolina Wren), *Canis lupus familiaris* L. (Domestic Dog), *Tamias striatus* (L.) (Eastern Chipmunk), *Sciurus carolinensis* Gmelin (Eastern Gray Squirrel), *Peromyscus maniculatus* (Deer Mouse), *Didelphis virginiana* Kerr (Virginia Opossum), *Sylvilagus floridanus* (J.A. Allen) (Eastern Cottontail), *Procyon lotor* (L.) (Raccoon), *Glaucomys* sp. (flying squirrel), *Mephitis mephitis* (Schreber) (Striped Skunk), *Meleagris gallopavo* L. (Wild Turkey), *Cathartes aura* (L.) (Turkey Vulture), and *Cardinalis cardinalis* (L.) (Northern Cardinal).

Discussion

After over 16 years with no sightings in the state, our study confirmed the presence of Eastern Spotted Skunks in South Carolina. Our 5 sightings have brought the total confirmed count of detections in the state to 22. These detections are particularly important because little is known about Eastern Spotted Skunks in South Carolina, even though they are included in the state's wildlife action plan (SCDNR 2015). Therefore, it is important to collect further data on the population status in order to know whether the Eastern Spotted Skunk is cryptic and maintains healthy populations in the region, or if this species is becoming increasingly rare and in danger of extirpation as has been suggested in other portions of its range (Gompper and Hackett 2005). We also encourage other states within the species' historic range to conduct similar studies to better understand the status of Eastern Spotted Skunk populations. Further, if any population is indeed experiencing a decline, it is important to determine the causes in order to inform management decisions to effectively manage the species.

Our findings suggest that current camera-trap technology has likely advanced to the point of providing a reasonable monitoring tool for Eastern Spotted Skunks. Hackett et al. (2007) compared camera trapping to track-plate surveys and found that probability of detection was generally 40–60% greater using track plates compared to camera traps. While further comparative studies are needed, our findings along with results from the Appalachian Eagle Monitoring Program (Jachowski et al. 2015) suggest that modern, and likely more sensitive, camera traps are useful in monitoring small carnivores such as the Eastern Spotted Skunk. However, given the important role that probability of detection plays in study design, the relatively high (average 19.6 days) and variable (2–31 days) number of days a baited site needed to be established prior to first detection indicates further research is needed on how different bait types, camera models and settings, locations (e.g., state, county, habitat type), and season of sampling influence detection probability.

Similar to reports in previous studies, the sites where we detected Eastern Spotted Skunks contained dense understory cover. In Arkansas, Lesmeister et al. (2009) found that the species selected for young *Pinus echinata* (Mill) (Shortleaf Pine) stands with a dense understory. Further, in comparison to sites with open understory, these areas had a lower risk of predation (Lesmeister et al. 2009, 2010). Researchers in the Appalachian region of Tennessee (Reed and Kennedy 2000) and Virginia (Diggins et al. 2015) have found Eastern Spotted Skunks in both hardwood and softwood forests, but consistently amid dense thickets of rhododendron and Mountain Laurel, which matches the undergrowth vegetation at sites where we detected Eastern Spotted Skunks. Thus, while our study area was dominated by mixed-hardwood–softwood forests, detection of Eastern Spotted Skunks in both hardwood- and pine-dominated forests further suggests that forest composition may not be as important as the availability of dense canopy and understory cover. We encourage further research and monitoring directed at how management of early successional forests can influence Eastern Spotted Skunk occurrence and demography in the Appalachian region.

Although our study had a limited sample size, our findings highlight the potential for extensive home-range overlap and interactions between Eastern Spotted Skunks and larger carnivores that deserves further research. One hypothesis for the decline of the Eastern Spotted Skunk is an increase in mammalian predators and competitors (Legrand and Howard 2013). On the California Channel Islands, *Urocyon littoralis* (Baird) (Island Fox) were found to impact *Spilogale gracilis amphiala* Dickey (Island Spotted Skunk); a serious decline in the Island Fox population resulted in a major increase in the Island Spotted Skunk population (Jones et al. 2008, Roemer et al. 2002). Thus, complex and nuanced inter-specific interactions likely exist that could impact Eastern Spotted Skunk populations, and further research is needed on the potential for mammalian and avian predators to influence the distribution and occurrence of Eastern Spotted Skunks.

Acknowledgments

This project was undertaken and supported through the Clemson University Creative Inquiry Program. We also thank Jay Butfiloski and Mark Hall of the South Carolina Department of Natural Resources and Jeff Magneiz of the US Forest Service for additional financial and logistical support.

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