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The Eastern Spotted Skunk (*Spilogale putorius*) at the Ouachita Mountains Biological Station, Polk County, Arkansas

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Running Title: Eastern Spotted Skunk (*S. putorius*) at the OMBS, Polk County, AR.

Abstract

A population of the eastern spotted skunk (*Spilogale putorius*) has been discovered at the Ouachita Mountains Biological Station in the Ouachita Mountains of Polk County, Arkansas. In 2010 a motion camera recorded a very brief infrared video of an animal that, after much study and conversation with other biologists, was concluded to be an eastern spotted skunk. Since that time the identification has been confirmed with at least 6 still photographs and one additional video that have been obtained from 2 other locations on the station. At least 2 or 3 individuals are present. All were photographed at night in mountainous terrain that contains mixed hardwood/pine forest. The photos are the first documented records with a specific locality and date of the eastern spotted skunk in the Ouachita Mountains of Polk County, Arkansas.

Introduction

The eastern spotted skunk (*Spilogale putorius*) is a small member of the Mephitidae (skunks) that is uncommon and localized in Arkansas. This strictly nocturnal species is solitary, except during the breeding season, and is very active, inquisitive, and arboreal. It is primarily insectivorous, taking small mammals when insects are unavailable, but it will also eat many other kinds of small animals. The preferred habitat in Arkansas appears to be upland oak-hickory forests with abundant ground litter or brush piles and den sites (which must be completely dark, protected from extremes of weather, and protected from natural predators) include hollow logs, standing hollow trees, rock outcrops and burrows. One of their most interesting traits is the unique hand-stand done during their defensive display.

Gates (1937) reported an incident between an adult bobcat and a litter of young eastern spotted skunks that

suggests that skunks and bobcats are not natural enemies. Crabb (1944) was able to study a litter of eastern spotted skunks born in captivity and monitored carefully to adult size at 3 months of age. The gestation period of the western spotted skunk was longer in New Mexico (Constantine, 1961), than for the eastern spotted skunk (Mead 1968a, Sealander and Heidt 1990). An ecological study of the eastern spotted skunk in Iowa by Crabb (1948) included much information about movements, activity patterns, and den sites; however, no mention is made of the life span. The lens weight, several osteological characters, and the presence of placental scars were used by Mead (1967) to identify ages of spotted skunks; he determined that sexual maturity is achieved in about 1 year, but there was no mention of the expected or maximum life span for spotted skunks.

Sealander (1956) examined 4 specimens and listed 5 others at the Museum of Vertebrate Zoology (University of California, Berkeley) and many literature and sight records from the state, including Polk County, and later (1979) summarized the biology of the eastern spotted skunk in the state (both references without details for Polk County).

In his generic revision of *Spilogale*, Van Gelder (1959) reviewed the geographic distribution and taxonomy, but did not comment on reproduction or other aspects of their biology.

Manaro (1961) observed some aspects of behavior on captive individuals from Florida. His live-trapping data, 38 skunks from 1½ acres (=0.61 ha) in 16 months, indicated that spotted skunks were not active on nights with even a minimum of moonlight. On suitable nights there were 2 peaks of activity, 1 shortly after sunset and 1 shortly before sunrise. Manaro commented on the secretive nature, curiosity, and excellent climbing ability of this species. All of the dens he studied were in the burrows of gopher tortoises (*Gopherus polyphemus*). The defensive hand-stand posture and the discharge of musk was described in detail.

The recognition of the specific distinctness of the eastern spotted skunks from the western populations was solidified by Mead's (1968b) report that the western populations exhibit delayed implantation, breed at about 4-5 months of age, and have a gestation period of 210-230 days, whereas the eastern populations do not exhibit delayed implantation, breed at about 9-10 months of age, and have a gestation period of only 50-65 days (Mead 1968a). These 2 species are unusual among mammals because the more obvious documented characteristics that provide reproductive isolation and inhibit gene flow are physiological and behavioral and morphological differences are less distinctive.

A radio telemetry study of eastern spotted skunks on the Ozark Plateau of Missouri by McCullough and Fritzell (1984) concerned only males and demonstrated nocturnal activity periods from 1900 to 0400 h, home ranges of 55-4359 ha, an average nightly movement of 1622 m (summer) to 2807 m (spring), 86% of locations were in upland oak-hickory forest with high levels of ground litter, and den sites were in hollow logs or rocky outcrops.

Kaplan and Mead (1994) demonstrated that serum concentration of testosterone, testis size, volume of ejaculate, and number of sperm was higher in the eastern spotted skunk during their spring breeding season, but was low in September and October, the breeding season of the western spotted skunk, reducing the likelihood of interbreeding in those areas where sympatry might occur.

The excellent review of the literature of *S. putorius* by Kinlaw (1995) also includes a good summary of the biology of this poorly known species. They are unique among skunks by being very agile climbers, having highly subdivided pads on the soles of their feet, and by having very long front claws; both of these morphological traits probably assist them in climbing. Insects are the preferred food, followed by small mammals when insects are unavailable. Eastern spotted skunks occur in brushy, rocky, and wooded habitats, especially with extensive vegetative cover. Dens are in any natural cavity or crevice in rock piles, hollow logs, or stumps, or even in cavities in standing trees. Den requirements include darkness, protection from weather, and protection from natural enemies.

Kinlaw et al. (1995) studied several aspects of eastern spotted skunk ecology in Florida, including documentation of a dispersing juvenile female that moved 4,640 m away from the original capture site in 5 months. Their study confirmed that spotted skunks prefer well-vegetated areas.

The mail survey of Majors et al. (1996) included reports from 54 counties (about 74%) in Arkansas, including part of the coastal plain. These results cast doubt on the traditional concept of spotted skunks being distributed statewide in Arkansas. However, the survey indicated that spotted skunks were common to abundant in Polk County. Another survey done by Sasse and Gompper (2006) was based on annual harvest data from commercial trappers. Their more objective data confirmed that only 11 Arkansas counties (Ashley, Cleveland, Columbia, Crittenden, Greene, Lafayette, Lee, Miller, Mississippi, Prairie, and St. Francis), mostly in major river drainages, are without confirmed evidence of the presence of the eastern spotted skunk. Their data indicate a serious population decline, almost statewide, with only 3 spotted skunks being reported from Polk County during the period 1999-2004.

A summary of the biogeography of Arkansas mammals (Heidt et al. 1996) includes a brief review of the physiography and of Sealander and Heidt's (1990) analysis of the mammal fauna. Even though the Ouachita Mountains region contained a high diversity (61 species), that region alone lacks any unique species. They concluded that *S. putorius* was austral in origin, present in the Ozark and Ouachita Mountains, and possibly not statewide in its distribution. They also commented on 13 species of questionable status and reported no documented records of *S. putorius* from Polk County.

A study of population trends of furbearers in Nebraska (Landholt and Genoways 2000) examined the relationship between harvest numbers and fur prices. *Spilogale putorius* was a puzzle because it was 1 of only 3 species (beaver, badger, and spotted skunk) with a strong relationship (R -values of +0.453, +0.670, and -0.542, respectively) between harvest numbers and fur prices. Landholt and Genoways showed that populations of the eastern spotted skunk and 4 other species were decreasing in Nebraska and that *S. putorius* had decreased since the 1940's, with the major decrease in 1944-46 and had not yet shown an increase. They thought that the eastern spotted skunk was the first furbearer to decline in Nebraska, probably because of habitat decline and susceptibility to environmental contaminants. Of the pesticides used, the primary targets are insects and because of that the biological collateral damage is concentrated on insect-eaters and egg-eaters.

Habitat fragmentation due to urban development was a major cause of decline for some species of carnivores in California, based on track surveys

Eastern Spotted Skunk (*S. putorius*) at the OMBS, Polk County, AR

(Crooks 2002). Western spotted skunks (*S. gracilis*) were not detected in any urban habitat fragment and were found in only the larger habitat blocks. The probability of occurrence across all sites was positively related to the size and location of the fragment area. Six species, including spotted skunks, appeared to be the most sensitive to fragmentation.

An examination of the range-wide decline of *S. putorius* populations by Gompper and Hackett (2005) determined that the decline is biologically real and not an artifact of a decline in the number of trappers or a decline in demand for spotted skunk pelts. They further suggest that the use of DDT (Dichlorodiphenyl-trichlorethane) and large-scale changes in agricultural practices may have contributed to the slower, but steady decline in spotted skunk harvests. However, there was no evidence to support a parvovirus or other pathogens (such as rabies or distemper) as cause of the population crash.

Hackett et al. (2007) compared box traps, track plates, and camera traps for effectiveness in detecting spotted skunks in Missouri and Arkansas. They concluded that track plates were the most effective method; however, none of the methods were reliable between mid-May and mid-September. They also commented that their camera sensors were not appropriate for detecting small mammals such as spotted skunks. In the Ouachita Mountains (Poteau Ranger District, Scott County, Arkansas) eastern spotted skunks preferred both den and rest sites to be in locations with more canopy cover, exclusion of light, better thermal regulation, more rocks, better protection from predators, and structurally complex vegetative cover with vines (Lesmeister et al. 2008). In that study the radio-collared adult and juvenile spotted skunks preferred immature shortleaf pine stands with more understory or hardwood forests and exhibited a low survival rate. Based on a relatively large sample size (33) from the same study area cited above from Scott County, a radiotelemetry study demonstrated that males have a larger home range in spring and, except for autumn, a larger home range than females (Lesmeister et al. 2009). In the same study area 63% of predation events were by birds (probably Great Horned Owls), all in mature shortleaf pine forests (Lesmeister et al. 2010). They also confirmed earlier studies that eastern spotted skunks prefer habitats with thick understory such as that found in young shortleaf pine forest or hardwood stands.

With our greatly increased understanding of the biology and geographic distribution of the eastern spotted skunk as summarized above, it now becomes

very important to elucidate the details of habitat requirements, behavior, reproduction, predators, prey, preferred den sites, weather conditions pertinent to activity patterns, and any other aspect of the biology of Arkansas populations that will allow us to make informed decisions concerning conservation strategies. How do the populations in the Ouachita Mountains compare to those in other areas, including populations central to the geographic distribution and those that are peripheral?

Materials and Methods

No baiting was used. We used Moultrie Digital Game Cameras, model I-40 (infrared) and model MFH-DGW-5.0 (flash). Each camera was aimed at a target such as a hollow log, burrow, or other site that might reveal an animal; there was never a plan to target spotted skunks. Cameras were checked infrequently, from about 2 weeks to about 3 months between checks, in order to reduce human activity in the area. Still cameras were set for a burst of 3 photos per event with 15 seconds between photos; there was a 1 minute delay after each event. The video mode was at high resolution and produced one still photo following the video. All still photos contained the date and time on the photo. No other sampling methods were used. All images are stored at and available from the Ouachita Mountains Biological Station.

OMBS includes 243 hectares (600 acres), consisting mostly of mixed pine-hardwood forest/woodland on the slopes and creek bottom forest along the major streams (see MacRoberts, et al. 2005, for more detail on the vegetation). All of the spotted skunk observations were on mixed pine-hardwood forest/woodland slopes from approximately 400 (location V1) to about 600 meters elevation (location S). Each of the locations is near spring-fed, temporary streams in the watershed that drains into Butcherknife Creek.

Results and Discussion

The photographic records reported here represent the first published records with specific localities and dates of the eastern spotted skunk in Polk County. All of the other records for Polk County did not contain any detailed locality or observation date information. These details are necessary for any correct interpretation of biogeographical or ecological data. The eastern spotted skunk was recorded on 4 different

Table 1. Photographic data for eastern spotted skunks (*S. putorius*) at the Ouachita Mountains Biological Station (OMBS).

Date	Documentation	Location
June 21, 2010	1 Infrared Video	V1 on Fig. 1 – Quad D3
Aug. 30, 2012	3 Color Still Photos	S on Fig. 1 – Quad C3
Sep. 12, 2012	3 Color Still Photographs	S on Fig. 1 – Quad C3
Oct. 30, 2012	1 Infrared Video	V2 on Fig. 1 – Quad C3

occasions on the OMBS (Table 1) from 21 June 2010 to 30 October 2012.

The first observation, an infrared video, consisted of a 1-2 second glimpse of an animal moving rapidly out of view about 20-30 feet from the camera. Based on the size, gait, tail shape, and body posture, I suspected a spotted skunk from the first time I saw the video. I did not think the spots showed well enough to rule out a striped skunk, and, since the infrared image did not distinguish blacks and whites well and spotted skunks had not been previously documented in our area, I decided to err on the conservative side and not call it a spotted skunk. Dr. Bradley McPherson (Centenary College, Shreveport) agreed with my conclusion. Then a little over 2 years later we had the first color still photographs that confirmed the spotted skunk (Figure 1). Comparison of the color image with the enhanced infrared image (we increased the contrast to visualize the pattern) from 2010 gave us confirmation of the 2010 image as that of an eastern spotted skunk. Within about 2 weeks we obtained 3 more color photographs and then in October of 2012 a much better infrared image.

Careful scrutiny of all of the images strongly supports the presence of at least 2 individuals at location S, based on the shapes and sizes of the lateral white stripes. Although, there is no direct evidence concerning the maximum life span in nature for the eastern spotted skunk, the body size, length of gestation, age at reproduction, and many aspects of population demography would suggest a life span in nature of only a few years. Thus, it is reasonable that if the 2010 individual was a mature adult it might not have survived for another 2 years to be represented in the 2012 images.

The weather conditions for the above dates were normal for the season. The lack of precipitation could be coincidental. The weather data for dates relative to the photographic data are given in Table 2.

Table 2. Weather data for the preceding and documentation days for the photographs of *S. putorius*.

Date	Temperature °C		Precipitation.
	Max	Min	
June 20, 2010	31.7	22.2	0
June 21, 2010	32.8	22.8	0
Aug. 29, 2012	31.7	18.9	0
Aug. 30, 2012	29.4	20.6	0
Sep. 11, 2012	28.9	14.4	0
Sep. 12, 2012	27.2	14.4	0
Oct. 29, 2012	13.3	2.2	0
Oct. 30, 2012	17.2	8.3	0

The 2010 observation was in a drier month; no rain was recorded during June 16-28. The only rainfall was 8.4 cm on June 11 and 0.36 cm on June 15, about 6 days before the photograph on June 21; cloud cover was 2%. All of the 2012 observations were preceded by rain either 3 days (September 8, August 27) or 4 days (October 26) before the photographs. Little or no cloud cover was recorded on the observation days and October 30 was a full moon. Activities of other animals are often triggered by preceding rain events so rain events might stimulate spotted skunk activity 3 or 4 days later.

The Ouachita National Forest has a 5.23 km border with the Ouachita Mountains Biological Station and private land-owners make up 2.82 km of border on the north and northeast. The portion (65%) of the OMBS bordered by national forest is the most rugged part and provides many kilometers of uninhabited terrain which could harbor spotted skunks.

Figure 1. The first confirmed photograph (original is in color) of an eastern spotted skunk at the Ouachita Mountains Biological Station at location S (see Figure 2).

Eastern Spotted Skunk (*S. putorius*) at the OMBS, Polk County, AR

Figure 2. Map of the Ouachita Mountains Biological Station showing the locations of motion cameras that captured the photographs of eastern spotted skunks. V1, first infrared video location; V2, second video; S, still photographs. Each square is 402.3 m (1/4 mile) on a side and contains its quad name in the upper right corner. North is at the top.

The population decline suggested by previous studies might be a reflection of the decline in commercial trapping due to reduced fur prices (Sealand 1979), the inconvenience of processing the small spotted skunks, and the reduced catch due to reduced populations (resulting from trapping pressure), and not a reflection only of true population changes.

The cameras have done an excellent job at recording animal activity at the OMBS. The camera sensitivity is high enough to trigger an image of animals as small as two cm or so. The success of recording small animals is related to the placement of the camera so that the subject-to-camera distance is short enough to result in an useable photo of the animal in question. These cameras have produced good photos at a subject-to-camera distance of about 1 m for small animals (spiders and salamanders) and up to 50-

100 m for larger animals (humans, coyotes, or deer).

Even though the eastern spotted skunk is rare in Arkansas and apparently declining in abundance, the ICUN red listing (Schipper et al. 2008) for the species is of Least Concern. However, it should be noted that Arkansas and especially the OMBS populations (Figure 2) are very close to the western edge of the species' geographical distribution and, therefore, probably more vulnerable to population declines or extirpation because of the limited gene flow, smaller population density, marginal environmental requirements, and ecological stress due to less than optimum ecological factors, all related to the dynamics of a peripheral population.

In the Ouachita Mountains Biological Station pines are not dominant and are concentrated in upland situations and intermixed with hardwoods. All of the

pinces are from natural regeneration and of uneven age distribution. The lowlands are dominated by hardwoods (*Quercus*, *Carya*, *Liquidambar*, *Acer*, and *Ilex*). Tangles or vines and woody undergrowth are mostly found along the edges of creeks and in the bottoms. Exposed rocky outcrops are mostly found along the ridges.

Conclusions

This photographic evidence of the eastern spotted skunk (*Spilogale putorius*) at the Ouachita Mountains Biological Station represents the first precise localities and dates for the eastern spotted skunk in the Ouachita Mountains in Polk County, Arkansas. The presence of 2 or 3 individuals over a period of 26 months suggests that a population of this rare mammal exists in the vicinity. Details of habitat preferences and the possibility of reproduction and den site details on the OMBS are yet to be discovered.

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