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Geographic Distribution and Harvest Dynamics of the Eastern Spotted Skunk in Arkansas

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Abstract.—The eastern spotted skunk (*Spilogale putorius*) is a small carnivore found across much of the central and southeastern United States, and while once common, this species has become rare in most of its range. We used harvest records collected by the Arkansas Game and Fish Commission from 1941-2004 to examine historic and current distribution and long-term harvest dynamics of this species in Arkansas. Eastern spotted skunks have historically been most common in the Ozarks and the Ouachitas though the species appears to have been present, but uncommon, in the Gulf Coastal Plain and in some counties in southeastern Arkansas near the Mississippi River. Annual harvests declined precipitously during the 1940s and 1950s, from >1,800 animals in 1942 to <10% of that number by 1958. During the early 1960s and especially during the late 1970s, there were multi-year increases in the harvest that co-occurred with increases in pelt price. However, across the broader period used for data analyses, pelt price alone was a poor predictor of harvest. Harvest was best predicted by the number of furbuyers in the state, which likely correlates with the number of trappers. By the mid-1980s annual harvests dropped to <50/year, a level at which they have since remained. While harvest levels for spotted skunks in Arkansas were considerably lower than other midwestern states, trends in both annual harvests as well as demand for pelts (as assessed by pelt price) are closely correlated with those in other states.

Key words:— *Spilogale putorius*, harvest, biogeography.

Introduction

The eastern spotted skunk (*Spilogale putorius*) is a small carnivore found in the Great Plains and the southeastern United States ranging up the Appalachian Mountains to Pennsylvania (Kinlaw 1995). At one time the species was a commonly harvested furbearer with annual harvests in some midwestern states measured in tens of thousands (Gompper and Hackett 2005). By the 1940s however, annual harvests of the species began to precipitously decline. Analyses of long-term datasets indicate that capture rates per unit of effort declined sharply and thus that the drop in harvest reflects a real decline in spotted skunk populations although the causes of this decline remain unclear (Gompper and Hackett 2005). These datasets were most complete for states that had high historic harvests of skunks. In some states, however, historic harvests were never greater than a few thousand individuals, and the incomplete nature of the harvest datasets for these states limited insight into the changes in the harvest of the species outside of the central and upper Midwest (e.g. Missouri, Iowa, Nebraska) and especially in states like Arkansas in which most of the harvest is derived from forested habitats.

The first known occurrences of spotted skunks in Arkansas were reported by Black (1936) based on about 20 skins that a dealer who bought furs from Washington and Madison counties had purchased during the first part of the 1934-1935 season. A few years later specimens had been obtained from Washington and Boone counties, and Dellinger and Black (1940) reported

that this skunk was common near Hot Springs, which was said to apparently be the eastern limit of the species distribution in the state. However, soon thereafter it was described as primarily a prairie animal that was not found in large numbers anywhere in its range, but that it was more common in counties that make up the Grand Prairie in eastern Arkansas and that its range was expanding westward from those areas (Roberts et al. 1942, Holder 1951). Sealander (1956) stated that spotted skunks were “fairly common” on the prairies of western Arkansas and the Grand Prairie, that they had recently invaded several unnamed eastern Arkansas counties, and that they had been established in parts of the eastern half of the state prior to Dellinger and Black’s (1940) project. Based on museum specimens, literature records, and reports from Arkansas Game and Fish Commission personnel, in 1956 the spotted skunk was known from 36 of 75 (48%) counties across most of the state except extreme southwestern Arkansas and the northeastern portion of the Arkansas Delta (Sealander 1956).

Sealander (1979) reported that the spotted skunk was historically found in the Interior Highlands and the counties bordering this region comprising the Ozark and Ouachita Mountains and the intervening Arkansas River Valley. There was an apparent range expansion into most of the Gulf Coastal Plain in the 1950s and 1960s with the possible exception of extreme southwestern Arkansas, although this expansion may have been followed by a range contraction in the 1970s. Additional expansions occurred in the 1970s with the occupation of Clay, Greene, and Craighead counties in northeastern Arkansas.

Simultaneous to these 1970s range shifts was an apparent decline in the population of spotted skunks, which was putatively attributed to rabies, canine distemper, or to land use changes. Trapping was not thought to be a factor in the declines due to low fur prices (Sealander 1979). These Arkansas declines may, however, have well predated the 1970s (Gompper and Hackett 2005).

An updated review of Arkansas mammal distribution in 1990 reported that the spotted skunk occurred statewide, although their status in the Gulf Coastal Plain was questionable due to a lack of sightings and records (Sealander and Heidt 1990). After a reanalysis of museum records and existing range maps, Heidt et al. (1996) agreed that the species was found in the Ozarks and Ouachitas and that it was possibly distributed statewide. Mail surveys of trappers and state wildlife biologists provided evidence that the species was still found in the Gulf Coastal Plain but was absent from the Delta region and for the first time reported their presence in extreme southwestern Arkansas in the Red River bottomlands (Majors et al. 1996).

Thus, based on work carried out throughout the 20th century, Arkansas spotted skunk populations experienced subtly shifting geographic ranges and apparent declines in harvests or population sizes or both. In addition, recent analysis of a partial Arkansas dataset on spotted skunk harvests suggests a decline in the species that mirrors the declines observed in other states (Gompper and Hackett 2005). Therefore, to better understand the current status of spotted skunk populations in Arkansas, and to gain more detailed insights into historic changes in harvest and geographic range we compiled over 6 decades of harvest records so as to gain more detailed insights into historic changes in harvest and geographic range.

Materials and Methods

Spotted skunk harvest and pelt price information was gathered from licensed furdealers by the Arkansas Game and Fish Commission from 1941-2004 using report forms that were required to be submitted to the Commission at the end of each season. For 1943-2004, the data is also subdivided by region (Delta, Gulf Coast Plain, Ouachitas, Ozarks) and county-level information was available for the 1943-1944, 1977-1985, and 1995-2004 seasons. Annual harvest for any given year represents the total capture value for a single season that typically runs from about November through January or February and thus incorporates data from two different years. For example, the value for 1962 is derived from captures made during the 62 day season that ran from 20 November 1962 through 20 January 1963.

Annual proportional harvests were calculated to compare the current-year harvest with the previous year harvest ($\text{harvest}_t / \text{harvest}_{t-1}$), and for both raw harvest annual values and proportional values, 3-yr moving averages were calculated. For regionally subdivided data, the percent of the total statewide harvest

attributable to each region was calculated. For comparison of Arkansas harvests to those of other states, long-term data sets from Missouri, Iowa, and Nebraska were obtained from the literature (Bennitt and Nagel 1937, Sampson 1980, Novak et al. 1987, Iowa Department of Natural Resources 2002, Gompper and Hackett 2005). Together with the Arkansas data, data sets from these states represent the most complete long-term harvest records available for spotted skunks.

To assess variance in demand for spotted skunk pelts, data were obtained on annual pelt prices in Arkansas and Missouri. A consumer price index inflation calculator (U.S. Dept. of Labor, Bureau of Labor Statistics) was used to adjust the price of pelts for inflation to a 2004 baseline; all pelt price analyses used only the inflation-adjusted values. To partially correct for biases in harvest effort, we also collected data on the length of the trapping season (although data were lacking for this parameter for 1943-1955 as well as for several other shorter periods) to generate harvest per day. Data on the number of trappers operating on the Arkansas landscape were unavailable but as a surrogate of the number of Arkansas trappers, we used annual data on the number of licensed fur-buyers in Arkansas.

Annual harvest levels per region and for the entire state were graphed, and linear regression techniques were used to identify relationships between pelt price (current year and previous year) and annual harvest in Arkansas, as well as the relationship between Arkansas harvest and Arkansas pelt price and those values from other states. We also used multiple regression (stepwise forward and backward) to examine the predictive relationships between number of Missouri trappers, the number of Arkansas fur-dealers, the price paid for pelts in Arkansas, and the annual Arkansas harvest. Given the assumptions inherent in using the Missouri trapper population or the Arkansas fur-dealers population as a surrogate for the Arkansas trapper population and the assumption that much of the spotted skunk harvest may be incidental during efforts to capture other furbearers except during periods of high spotted skunk pelt prices (Gompper and Hackett 2005), we assume independence between the predictor variables and therefore do not include interaction terms in the regressions.

Results

Statewide harvest of spotted skunks peaked at 1,830 animals in 1942 during the second year of data collection, and declined steadily thereafter (Fig. 1). While brief multi-year increases in the harvest occurred in the 1960s and especially in the 1970s, by the late 1980s the annual harvest dropped below 50 animals, a level that has not been exceeded in the ensuing 2 decades. The decline in the harvest was greatest in the 1940s and early 1950s, such that by the late 1950s the 3-year moving average of annual harvest had stabilized at approximately 215 animals (1955-1959 range: 205-222) or 15% of the peak 3-year moving average of 1,445 animals harvested from 1941-1943 (Fig. 1).

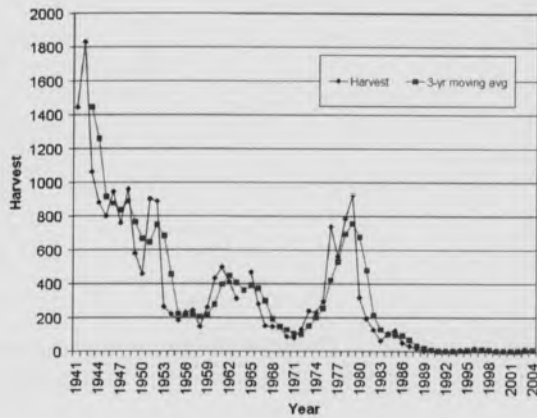


Fig. 1. Annual harvest (diamonds) and 3-year moving average (squares) of annual harvest for spotted skunks in Arkansas.

The decline was not steady, as annual increases over previous year harvests occurred in 7 of 18 years between 1942 and 1959, but when examined as 3-year moving averages, annual change relative to the previous years 3-year average was <1 in 12 of 16 intervals through 1959 (Fig. 2). Harvest increased sharply in the early 1960s relative to the late 1950s, but the peak 1960s harvest (498 animals in 1961) was less than all but one year prior to 1954, and by the late 1960s annual harvest had declined to <150 individuals. A second harvest peak occurred for 4 years in the late 1970s, with annual harvests similar to those observed in the mid-to-late 1950s and early 1960s. Following this brief increase, however, annual harvests steadily declined thereafter; from 1989-2004, annual harvest was <10 animals in all but 2 years (Fig. 1).

During the 1943 and 1944 furbearer seasons, the majority of spotted skunks were taken in the Ozarks and Ouachitas and counties bordering those regions with a small number of animals being reported from 4 counties in the southeastern part of the state and from Bradley County in the Gulf Coastal Plain (Fig. 3a). From 1977-1985, most of the harvest again came from the Ozarks and Ouachitas, however, there were a few harvested from Gulf Coastal Plain and Delta counties from which they were not taken in 1943-1944 (Fig. 3b). From 1995-2004 the small number of spotted skunks taken originated from counties in all ecological regions, though the majority were from the Ozarks (Fig. 3c). The total harvest is dominated by harvests from the Ozark and Ouachita regions with both regions showing temporal trends similar to the broader state harvest trends (Fig. 4). Until 1987, at which point state-wide harvest levels became quite low, harvests from the Ozark, Ouachita, Delta, and Gulf Coastal Plain regions make up on average 76, 17, 5 and 2%, respectively, of the total harvest. Since the 1940s, the relative contribution of the Ozark harvest to the broader statewide harvest has increased

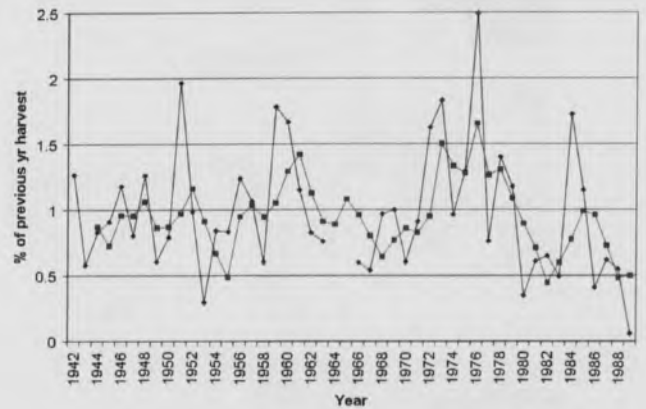


Fig. 2. Year-to-year proportional change in the harvest of spotted skunks throughout Arkansas (1942-1989). A value of 1 indicates no change in harvest, while a value <1 or >1 indicates a decrease or increase, respectively, in the annual harvest. Annual change relative to previous year harvest is shown in diamonds. Annual change in the 3-year moving average of annual harvest relative to previous year's 3-year moving average is shown in squares. Annual harvest is unknown for 1964, and thus 1964-1966 values represent 2-yr moving averages.

significantly ($r = 0.31$; $P = 0.017$).

Annual harvests in Arkansas closely correlate with harvests in Missouri ($r = 0.78$), Iowa ($r = 0.81$), and Nebraska ($r = 0.70$), suggesting that harvest declines in Arkansas track those observed in other states despite the larger historic harvests from those other states. The Missouri harvest, for example, peaked at $>55,000$ in 1940 but declined in a similar time frame to Arkansas (Fig. 5). Missouri pelt price was also closely correlated with Arkansas pelt price ($r = 0.88$). Demand for spotted skunk pelts has resulted in considerable fluctuation of price. Arkansas spotted skunk pelts have varied in price from $<\$1.00$ (inflation adjusted) in the early 1990s to over $\$30.00$ in 1978 (Fig 6a). A one-year peak of $\$62$ in 2002 should be considered suspect given the low number of pelts (2) harvested that year. This demand may have driven harvest per day (Fig 6b), although a lack of data on season length throughout most of the 1940s and 1950s hinders further analyses of the relationship.

There was a strong correlation between Arkansas harvests and the total number of fur-dealers ($r^2 = 0.709$; $P < 0.001$). Across all years (1941-2004), there was also no relationship between price and harvest ($P = 0.721$) or between previous-year price and harvest ($P = 0.398$). These analyses were also carried out for data sets limited to 1941-1990 and 1941-1985 and in no cases were a significant relationship identified. For the period 1941-1990 the relationship with previous year price approached significance ($P = 0.057$), but only a small amount of variance in

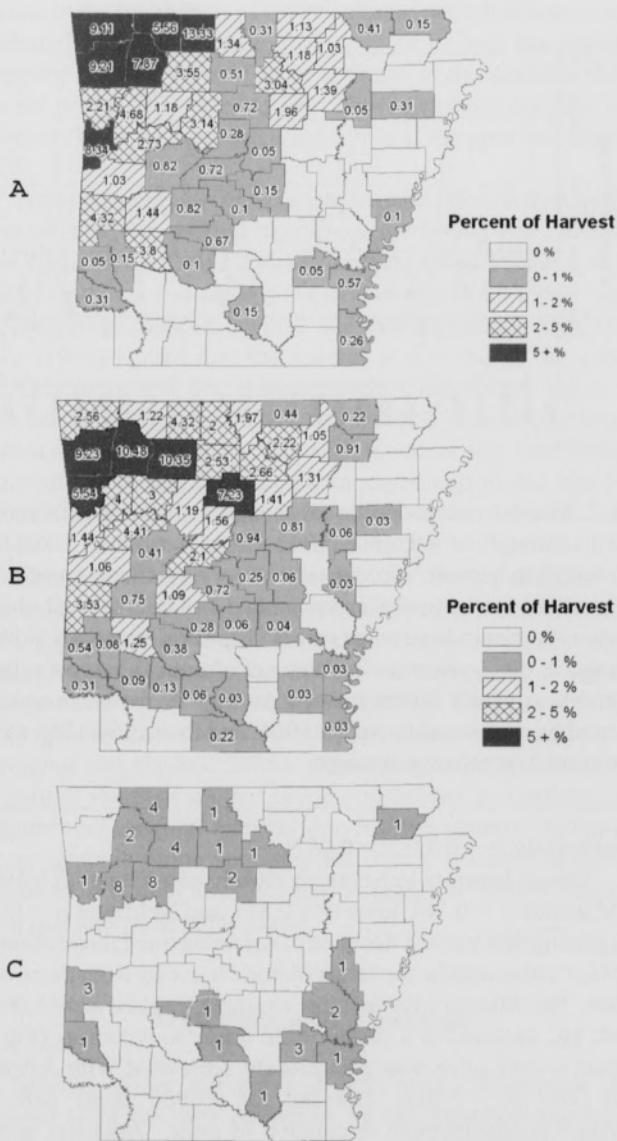


Fig 3. Harvest of spotted skunks in Arkansas, subdivided by county. A) 1943-1944 harvest as a percent of statewide harvest. B) 1977-1985 harvest as a percent of statewide harvest. C) 1999-2004 harvest per county. Given low total harvest, data are not converted to percentage.

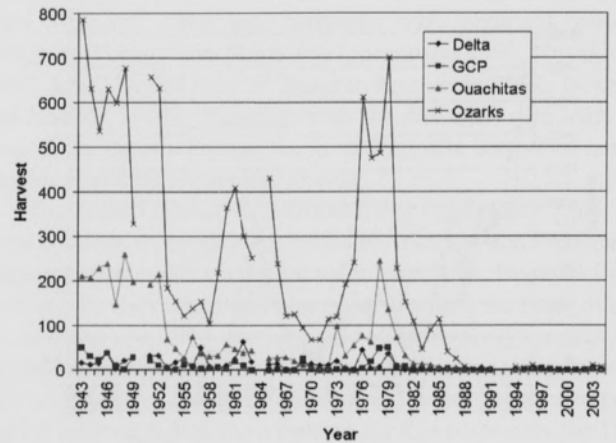


Fig. 4. Regional harvests of Arkansas spotted skunks.

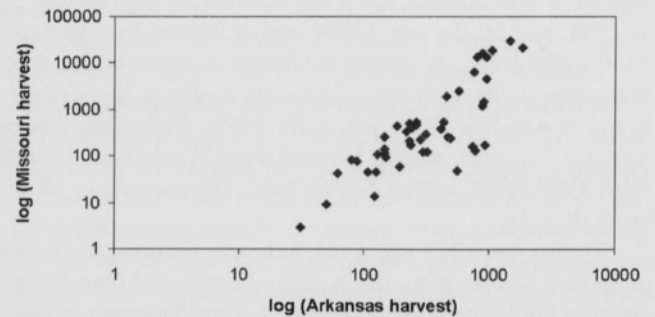


Fig 5. Relationship between Arkansas and Missouri harvests (1941-1987).

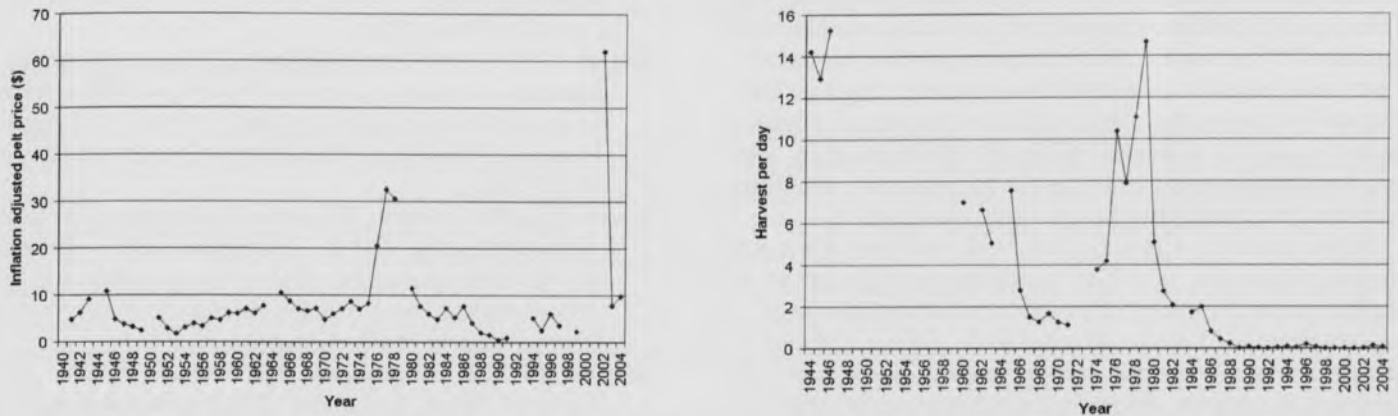


Fig. 6. Annual inflation-adjusted pelt price for spotted skunks in Arkansas (a; 1941-2004) and annual daily harvest (total harvest/season length) of spotted skunks (b; 1944-2004).

harvest was explained ($r^2 = 0.084$) by the relationship. Using all data (1941-2004) and both backwards and forwards stepwise regression, however, harvest was best predicted by the number of fur dealers and the current-year price ($df = 2, 48$; $F = 68.582$; $P < 0.001$) with these two parameters explaining (adj. r^2) 73% of the variance in harvest.

Discussion

General accounts of the distribution of this species in the 1940s and the early 1950s offer contradictory statements on whether the species was confined to the northwest part of the state and was moving east or was a species of the Grand Prairie and was expanding westward (Dellinger and Black 1940, Roberts et al. 1942, Holder 1951). However, records of the 1943 and 1944 furbearer seasons clearly indicate that the spotted skunk was well established in the Ozark and Ouachita mountains and nearby counties though they do not indicate its habitat preferences. And though only a few animals were taken in southeastern Arkansas in this period, it seems likely that the animal was already widely dispersed through southern Arkansas prior to Sealander's (1956) survey of Arkansas Game and Fish Commission personnel.

The continual harvest from areas outside the Ozarks and Ouachitas suggests that despite the decline in spotted skunk harvests and the possible decline in spotted skunk population size in Arkansas, the species remains widely distributed across the state. There has, however, been an increase in the relative portion of skunks harvested from the Ozarks, although the small post-1990 harvest sizes tend to obfuscate this pattern. Even though spotted skunks continue to be found in southern Arkansas they appear to be very rare, if present at all, in similar eco-regions in Mississippi, Louisiana, and Texas (Wolfe 1971, Lowery 1974, Schmidly 2004).

There was a strong decline in the harvest of spotted skunks in Arkansas beginning in the early 1940s – a pattern also seen in other states (Gompper and Hackett 2005). Peak harvest was 1,830 animals in 1942, and 3-year moving averages declined for 12 of 15 years from 1944-1958. Novak et al. (1987) gave harvest values of 2,166, 1,582, and 1,605 for the three years prior to the start of our dataset, but we have excluded these values from our analyses as we were unable to identify the source of the values as well as because values given by Novak et al. (1987) for several other years were seemingly either incorrect or listed for the incorrect season. Nonetheless, it appears that the decline in the spotted skunk harvests began with the 1943-1944 season when harvest was just 58% of the previous season's harvest.

The long-term Arkansas spotted skunk harvest is closely correlated with those of other states with far greater historic harvest levels. Thus, despite the relatively small absolute harvest values from Arkansas, the relative patterns for the state are similar to those for this species from other states. The spotted skunk pelt prices of Missouri and Arkansas also correlate closely. During particular periods, Missouri and Iowa pelt prices closely correlate with the harvest of spotted skunks from those states (Gompper and Hackett 2005), a pattern also observed in Arkansas based on 1965-1983 data (Clark et al., 1985). In Arkansas, increases in harvests did occur during the 1960s and 1970s when pelt prices increased, but over the broader (1941-2004) time frame, few patterns were identified between pelt price and spotted skunk harvest.

Perhaps more important than pelt price are the number of trappers and the length of the season (together giving the number of trapper-days). In Missouri, these variables together with pelt price strongly predict harvest, implying that spotted skunk captures are generally incidental to the capture of other more desirable species (Gompper and Hackett 2005). For Arkansas, data on the number of trappers were not available, and as potential

surrogates for this measure, the number of Missouri trappers and the number of Arkansas furbuyers were utilized. The former was of little value in predicting harvest, but the latter parameter alone explained 71% of harvest. In a multiple regression, the addition of pelt price enhanced predictive power slightly. Together these relationships suggest that, like in Missouri, harvest of Arkansas spotted skunks is primarily driven by incidental take, with occasional targeting of the species (or perhaps active avoidance or discard of captured animals) mediated by pelt price.

Given the lack of historic data on the number of trappers per year in Arkansas, as well as limited data on the length of the trapping season for important periods covered in these analyses, the data presented here are insufficient to indicate a decline in spotted skunk populations (versus spotted skunk harvests). However, all patterns observed for Arkansas mirror those of other states where population declines have been documented. Therefore, continued conservation concern for this species is warranted.

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