

**RECOVERY PLAN FOR THE EASTERN SPOTTED
SKUNK (*SPILOGALE PUTORIUS*)
IN KANSAS**



©Roger A. Barbour

Prepared by

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for

Kansas Department of Wildlife and Parks

February 2008

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512 SE 25th Avenue
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DISCLAIMER

The actions outlined in the Proposed Recovery Plan for the Eastern Spotted Skunk (*Spilogale putorius*) in Kansas are intended to meet recovery objectives and recovery criteria, such that the delisting of the eastern spotted skunk will be possible. Some internal processes by KDWP will be required yet to formalize this into a final recovery plan for the species. The recovery actions and recovery criteria were developed based on our current understanding of the biology, ecology and distribution of the eastern spotted skunk and may require modification as new information becomes available. Several decades of consistent recovery efforts might be necessary to observe results.

SUGGESTED CITATION

Nilz, S. K., and E. J. Finck. 2008. Proposed recovery plan for the eastern spotted skunk (*Spilogale putorius*) in Kansas. Kansas Department of Wildlife and Parks, Pratt, KS. 51 pp.

EXECUTIVE SUMMARY

Historically, the eastern spotted skunk was a common species in Kansas with economic value as a furbearer. In response to a decline in the eastern spotted skunk population in Kansas, the Kansas Department of Wildlife and Parks permanently closed the trapping season for the species in 1977 and the species was designated as threatened in the state in 1982. The decline of the species might have been a result of conversion to agriculture, drought, widespread use of pesticides, overharvest, disease, or a combination of factors. The limited amount of information about the basic ecology of the eastern spotted skunk presents a challenge to the development of specific recovery actions. The Proposed Recovery Plan for the Eastern Spotted Skunk in Kansas outlines the history of the species in the state, the known biology of the species, the current status in Kansas, additional data needs, and the strategies and tasks for recovery of the species.

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I. INTRODUCTION

Historically, the eastern spotted skunk (*Spilogale putorius*) was a furbearer within the state of Kansas. Between 1928 and 1934, the number of eastern spotted skunk pelts purchased by Kansas fur buyers in Kansas ranged from 93,216 to 117,309 pelts annually, and in each of those years, the eastern spotted skunk ranked third in pelts purchased, after the opossum (*Didelphis virginiana*) and the striped skunk (*Mephitis mephitis*) (Cockrum 1952). The number of eastern spotted skunk pelts purchased began to decline during the late 1930's and had diminished to less than 1,000 pelts sold annually by 1955 (Cockrum 1952, KDWP 1976, Roy 1997, Figure 1). The low volume of eastern spotted skunk pelt purchased persisted into the late 1970's (Figure 2) and the eastern spotted skunk season was permanently closed in Kansas in 1977. In 1982, the eastern spotted skunk was designated as a threatened species in Kansas and remains designated as threatened under K.A.R. 115-15-1¹.

Similar declines occurred elsewhere in the central United States including: Arkansas (Sasse and Gompper 2006), Iowa (Gompper and Hackett 2005), Missouri (Gompper and Hackett 2005), Nebraska (Gompper and Hackett 2005, Landholt and Genoways 2000), and Oklahoma (Gompper and Hackett 2005). Although the harvest and purchase records do not provide direct population assessments, they do suggest that a significant decline occurred throughout the region. The absence of substantial data has presented a challenge for the initiation of conservation efforts. Direct evaluations of the ecology, status, and distribution of the eastern spotted skunk are necessary to develop conservation policies and actions. In the 1994 Animal Candidate Review for Listing as Endangered or Threatened Species (Code of Federal Regulations 1994), the "plains

¹ K.A.R. 115-15-1 refers to the eastern spotted skunk as spotted skunk.

spotted skunk” was listed as a category two species and not proposed as a candidate for listing because insufficient data were available to support a ruling to federally list the species. Federal listing for the eastern spotted skunk might be appropriate; however, additional information is necessary to support a ruling in favor of federally listing the eastern spotted skunk.

In Kansas, the declining harvest and pelt purchases of the eastern spotted skunk prompted the initial conservation measures of season closure and state listing, but actions to recover the eastern spotted skunk populations were not taken. Prior to a study conducted by Nilz and Finck (2008), only 32 occurrence reports for the eastern spotted skunk were on official record between 1990 and 2005. The limited number of occurrence reports, a general perception of rarity, permitting issues and a concern for the persistence of the species within the state evidenced a need to develop conservation and recovery actions for the eastern spotted skunk in Kansas. The Proposed Recovery Plan was developed based on the information available concerning the ecology, status and distribution of the eastern spotted skunk. The success of conservation and recovery efforts will benefit from continued investigations that seek to improve our understanding of the eastern spotted skunk in Kansas.

Figure 1. Moving average trend lines of pelt purchases in Kansas for the opossum, striped skunk, spotted skunk and raccoon from 1928 – 1980. Data from Cockrum 1952, KDWP 1976 and Roy 1997.

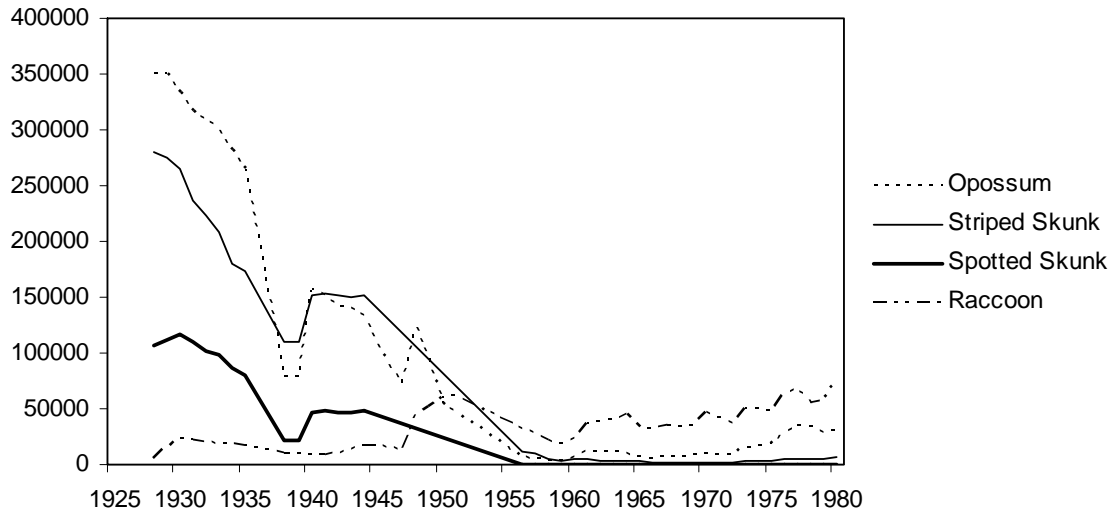
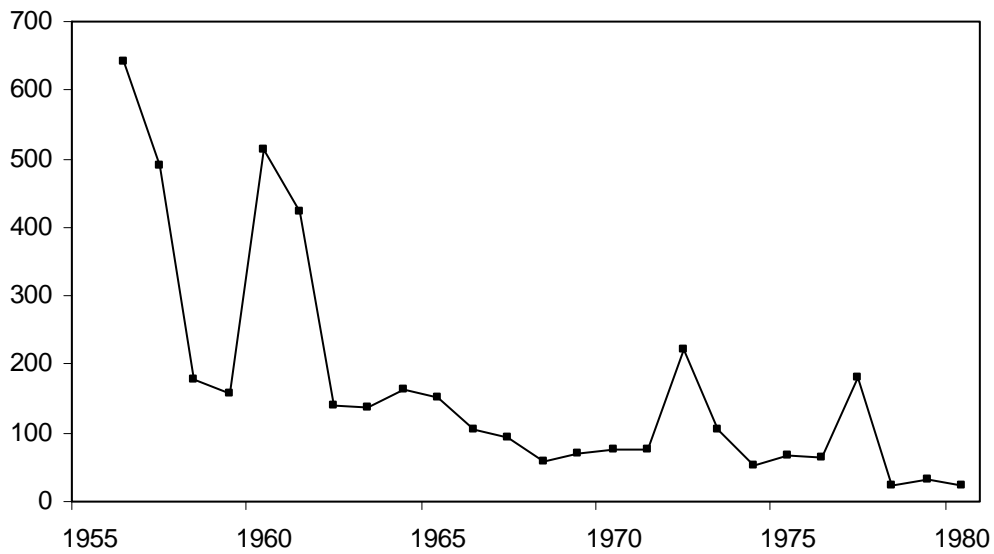


Figure 2. Spotted skunk pelts purchased in Kansas from 1956 – 1980. Data from KDWP 1976 and Roy 1997.



II. SPECIES ACCOUNT

A. Taxonomy and Description

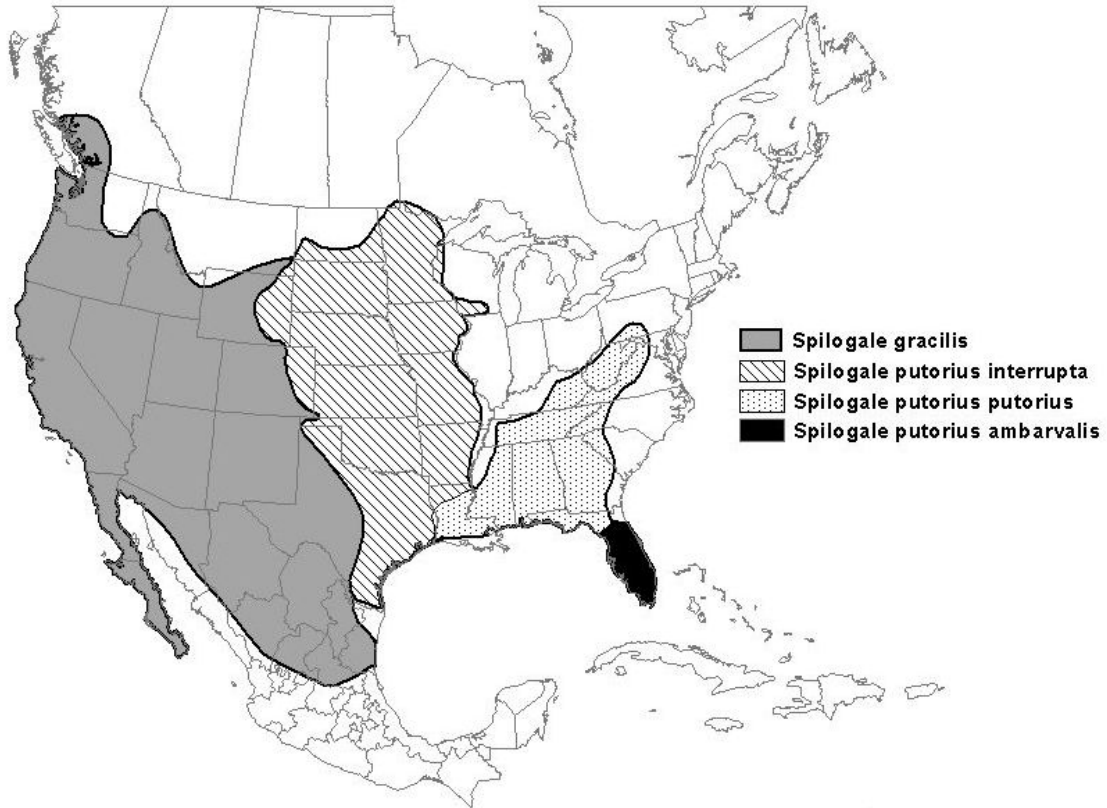
The eastern spotted skunk is a medium-sized mammal belonging to the order Carnivora, family Mephitidae, genus *Spilogale* Gray, 1865, and species *Spilogale putorius* (Linnaeus, 1758). The subspecies *Spilogale putorius interrupta* Rafinesque, 1820 occurs in Kansas (Figure 3). Van Gelder (1959) considered the western spotted skunk *Spilogale gracilis* a subspecies of the eastern spotted skunk, *S. putorius*.

Investigations into the reproduction (Mead 1968a and Mead 1968b) and genetics (Dragoo et al. 1993) of the western and eastern variants supported the validity of two distinct species, which was recognized by others (Ferguson and Larivière 2002, Kinlaw 1995 Larivière and Ferguson 2003, Wozencraft 2005). The taxonomy of the eastern spotted skunk was treated in Kinlaw (1995) and Wozencraft (2005). Wozencraft (2005) designated the common name of eastern spotted skunk to members of the species *Spilogale putorius*. In Kansas, other common names are used including spotted skunk, polecat, and civet cat.

The eastern spotted skunk has black fur with white markings, which include 4 or more broken stripes that extend down the back and sides, a white patch in front of each ear and one on the forehead. The tail is white tipped or has only a few white hairs. The ears and eyes are small. The body of the eastern spotted skunk is elongate and weasel shaped. Van Gelder (1959) reported that males of the subspecies *S. p. interrupta* weighed between 501 to 885 g and females 453 to 475 g, the total length of males was between 423 to 585 mm and females 410 to 532 mm, the tail length of males was

between 138 to 280 mm and females 140 to 210 mm, and the hind foot length of males was between 38 to 55 mm and females 39 to 59 mm.

Figure 3. Range map of the species *Spilogale gracilis*, and subspecies *Spilogale putorius interrupta*, *S. p. putorius* and *S. p. ambarvalis*. Species' geographic range from Patterson et al. 2005; subspecies boundaries redrawn from Kinlaw (1995).



B. Historic and Current Distribution

The first records of the genus *Spilogale* in Kansas were recovered from Pliocene (Hibbard 1941b & 1941c) and Pleistocene (Hibbard 1941a, 1955 & 1960 and Getz 1960) deposits in Mead County. Bone fragments from the species *S. rexroadi* were preserved in an upper Pliocene deposit and described as an intermediate between *S. marylandensis* from Maryland and *S. pygmaea australis* from Mexico (Hibbard 1941b & 1941c). Deposits from the middle Pleistocene held bone fragments that were assigned to *S. putorius ambarvalis* (Hibbard 1941a, Getz 1960, Figure 3), and those from the late

Pleistocene held fragments similar to or indistinguishable from *S. putorius interrupta* (Hibbard 1955 & 1960, Figure 3). Hibbard (1960) defined the geologic range of *Spilogale putorius interrupta* as late Pleistocene to recent and the distribution as: “Southern Minnesota and eastern South Dakota, south to southwestern Oklahoma and the northern part of eastern Texas.”

Carter (1939; reviewed by Choate 1987) reported on the abundance and distribution of the eastern spotted skunk in western Kansas between 1840 and 1939. His survey of the original settlers in Kansas and other supporting documents found that the eastern spotted skunk was present in all western counties and common in most counties as early as 1840 (Figures 4, 5, 6, 7, and 8). Published reports of the occurrence of the eastern spotted skunk in Kansas began in 1858 (Coues 1877) and continued after the European settlement of the state (Table 1). A specimen from Coffey County in 1865 (USNM 008131) is presumably the earliest museum record of the species in Kansas. Museum records were the primary source of distributional information for the eastern spotted skunk between 1865 to 1948 and in the 1970's, but observation reports to the Kansas Biological Survey and the Kansas Department of Wildlife and Parks became the primary source of information during the 1980's and 1990's. Nilz and Finck (2008) evaluated the statewide distribution of the eastern spotted skunk from 1930 to 2007 by requesting observation reports from Kansas fur harvesters. Those data gave new insights to the likely distribution of the species between 1950 and 2007. The information from museum records, published accounts, and sighting reports are summarized in Figures 9, 10, 11, 12, 13, and 14.

Some inconsistencies have emerged regarding the historic distribution of the eastern spotted skunk in Kansas. For example, Van Gelder (1959; reviewed in Choate et al. 1973) hypothesized that the eastern spotted skunk expanded into the Midwest coincident with the European settlement; whereas, Carter (1939) documented reports of “the little spotted skunk (*Spilogale interrupta*)” as common throughout most of western Kansas, as given in accounts from the earliest settlers in the region. Choate (1987) hypothesized that the species reported in Carter’s (1939) work might have been the western spotted skunk; whereas, Mead (1955 & 1960) described late Pleistocene specimens from Meade County in southwestern Kansas as similar to or indistinguishable from the eastern spotted skunk. In light of these incongruent accounts, three scenarios could describe the pre-settlement distribution of the eastern spotted skunk in Kansas: 1) the species was present throughout the state prior to settlement, 2) the species was absent throughout the state prior to settlement, and 3) the species was present in the eastern portions of the state and absent in the western parts of the state. Because a major thrust to document the biodiversity of Kansas did not begin until the late 1800’s and Van Gelder (1959) did not have the tools to evaluate the molecular systematics of the genus *Spilogale*, it is plausible that the eastern spotted skunk was distributed statewide prior to the settlement of Kansas. A study of the molecular biogeography and molecular systematics of the genus *Spilogale* might reveal further insights into the historic distribution of the species.

Figure 4. Distribution and abundance of the "little spotted skunk *Spilogale interrupta* (Rafinesque)" in western Kansas from 1840 to 1884, data from Carter 1939.

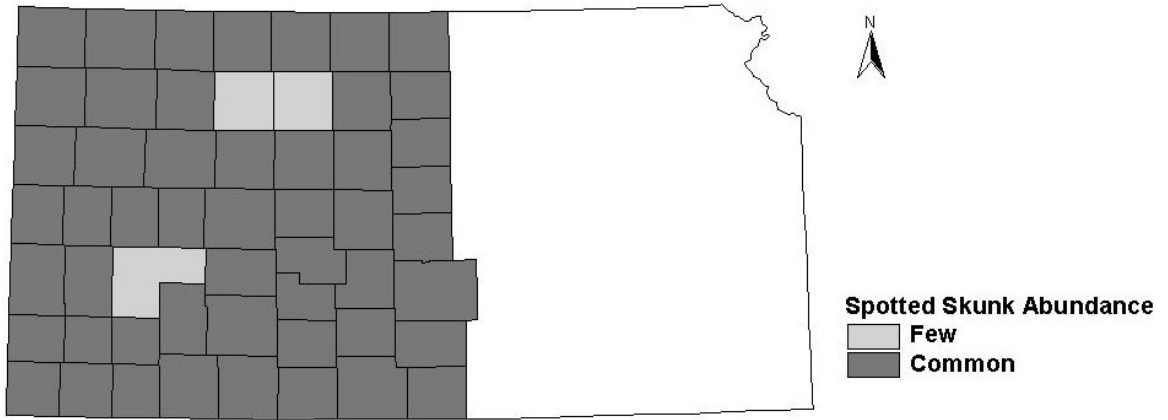


Figure 5. Distribution and abundance of the "little spotted skunk *Spilogale interrupta* (Rafinesque)" in western Kansas from 1885 to 1889, data from Carter 1939.

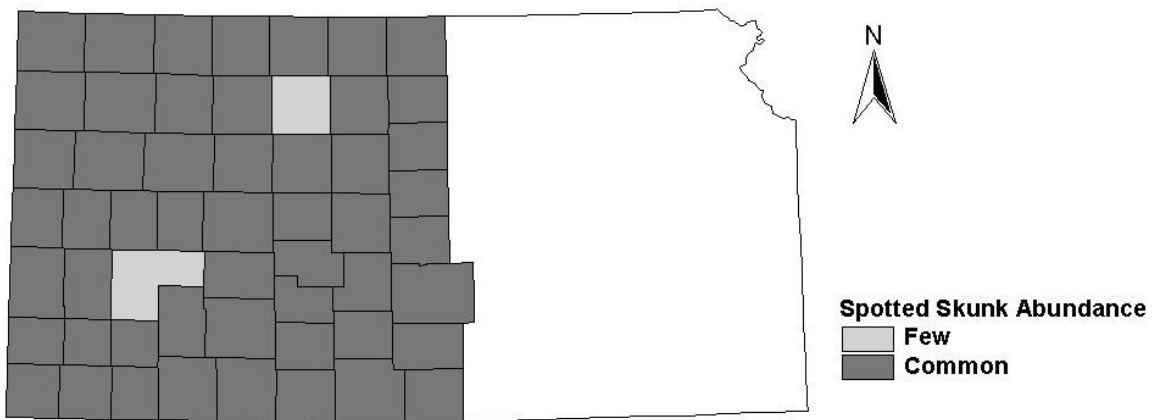


Figure 6. Distribution and abundance of the "little spotted skunk *Spilogale interrupta* (Rafinesque)" in western Kansas from 1890 to 1899, data from Carter 1939.

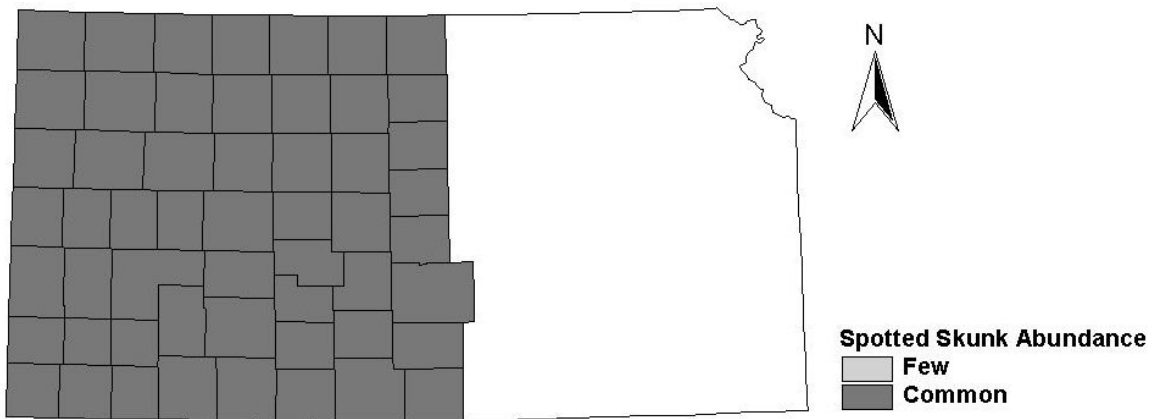


Figure 7. Distribution and abundance of the "little spotted skunk *Spilogale interrupta* (Rafinesque)" in western Kansas from 1900 to 1904, data from Carter 1939.

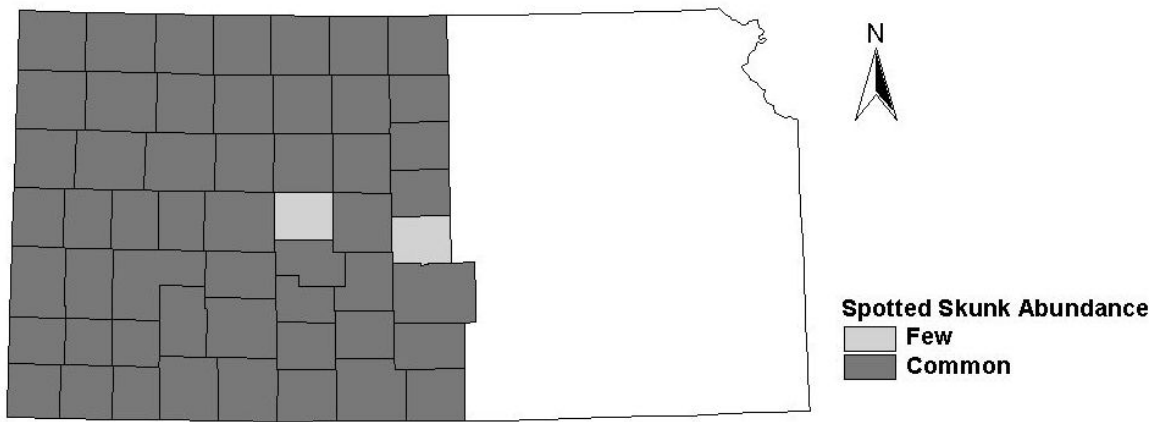


Figure 8. Distribution and abundance of the "little spotted skunk *Spilogale interrupta* (Rafinesque)" in western Kansas from 1905 to 1939, data from Carter 1939.

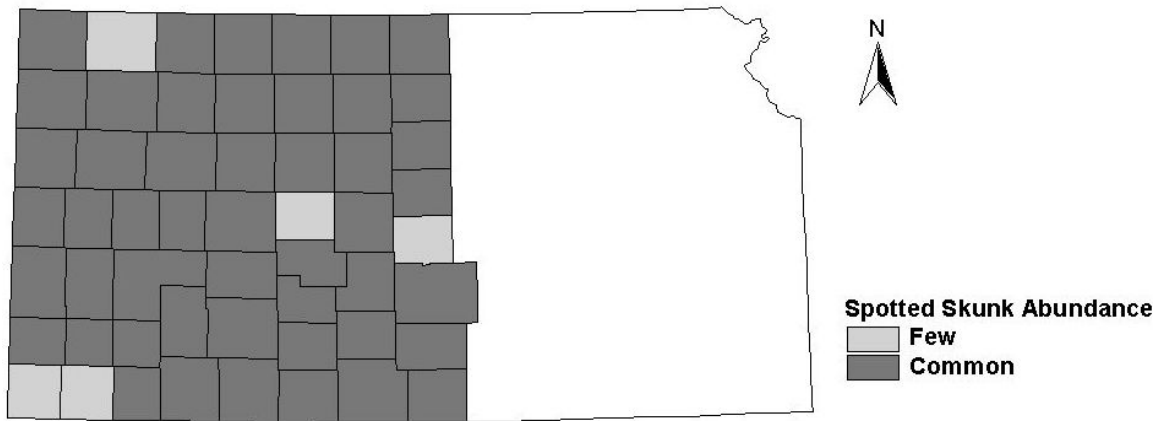


Table 1. Published accounts of the occurrence of the eastern spotted skunk in Kansas. * = reviewed in Choate 1987; † = reviewed in Choate et al. 1973; and ‡ = occurrence report was included in county distribution maps.

Date Observed	Location	Distribution or Abundance	Source
1840-1939	Western Kansas	Common or few in all western counties	Carter 1939*
ca 1858	Kansas, possibly Shawnee County	-----	Coues 1877
ca 1875	-----	"More frequent than the common Skunk."	Knox 1875†
1887	vicinity of Wakeeney, Kansas	"Of twenty skunks taken..., one-third were of this species."	Baker 1888†
1894‡	Long Island, Phillips County, Kansas (AMNH 9130, 9131, 9132)	-----	Allen 1895†
1904	-----	"Abundant in eastern Kansas."	Lantz 1904†
1904	-----	"Common in most parts of the state."	Lantz 1905†
1916-1917	Riley County	"...common on the prairie, in the meadows, and in the timber."	Dice 1923
1922‡	Doniphan County, "...within one mile of old townsite of Geary..."	-----	Linsdale 1928
1933	-----	"...common throughout most of the State."	Hibbard 1933†
1937	-----	"Common throughout the state."	Black 1937†
1940	-----	Statewide	Allen 1940†
1943	-----	"...common throughout most of the State."	Hibbard 1944†
1955‡	Cowley County (KU 64559)	-----	Anderson and Nelson 1958†
1956‡	Lyon County	Scarce	Clarke et al. 1958†
1970-1975‡	Cheyenne County	Scarce	Walker 1978
1973‡	Ellis (MHP 10480, 10481), Douglas, Lane (MHP 10449), Rush (MHP 10482), and Trego (MHP 10459) counties	"...not commonly seen in Kansas..."	Choate et al. 1973
1980s	Fort Riley, Kansas	Uncommon	Pitts et al. 1987

Figure 9. Records of occurrence for the eastern spotted skunk in Kansas between 1800 and 1939.

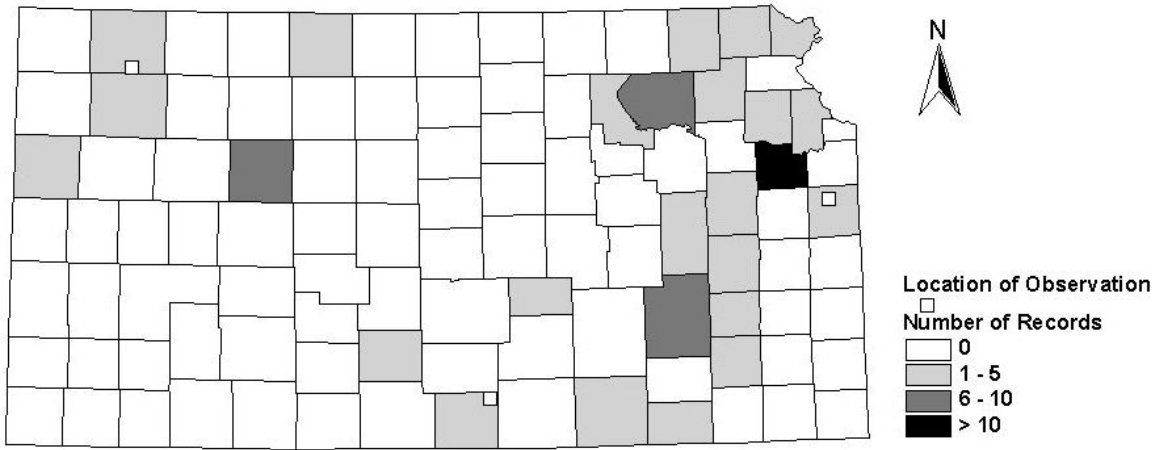


Figure 10. Records of occurrence for the eastern spotted skunk in Kansas between 1940 and 1969.

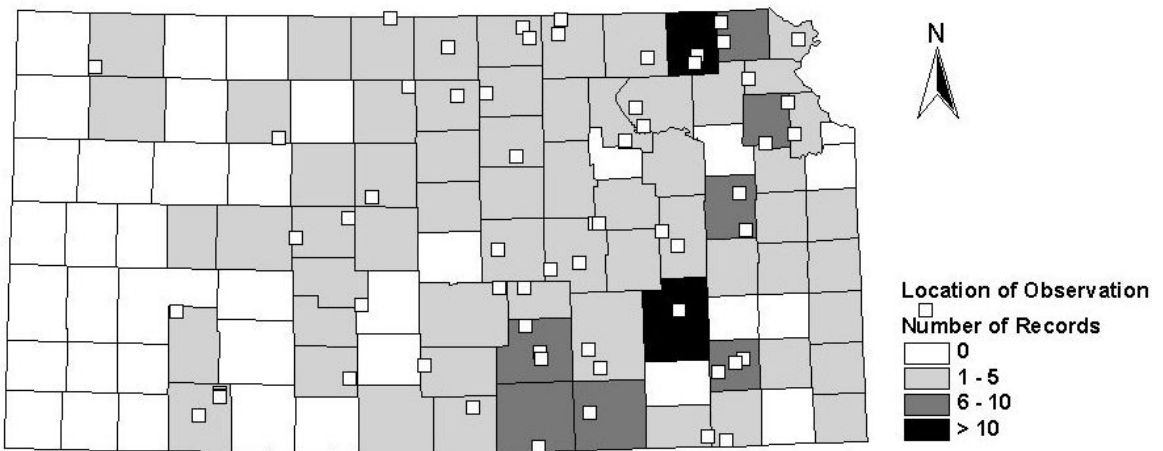


Figure 11. Records of occurrence for the eastern spotted skunk in Kansas between 1970 and 2007.

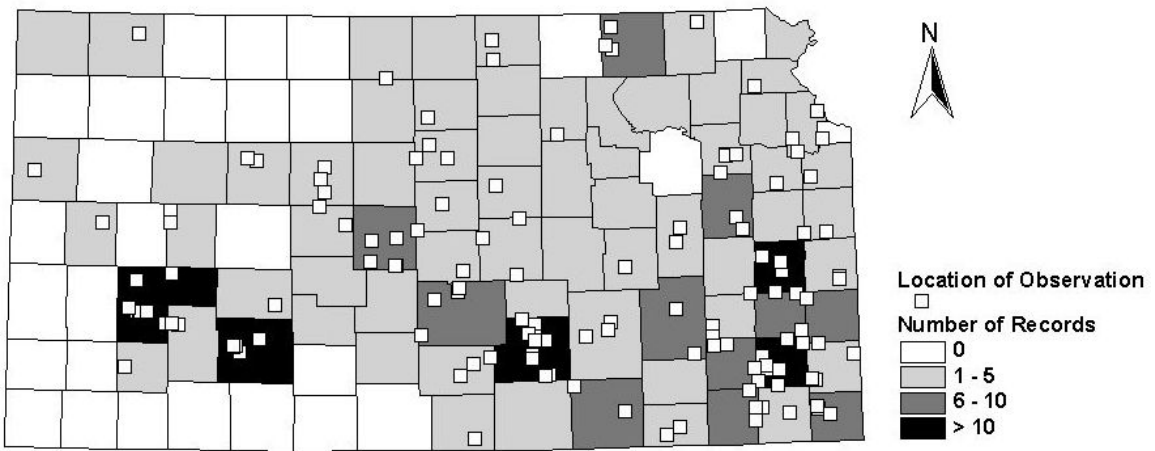


Figure 12. Records of occurrence for the eastern spotted skunk in Kansas between 1980 and 2007.

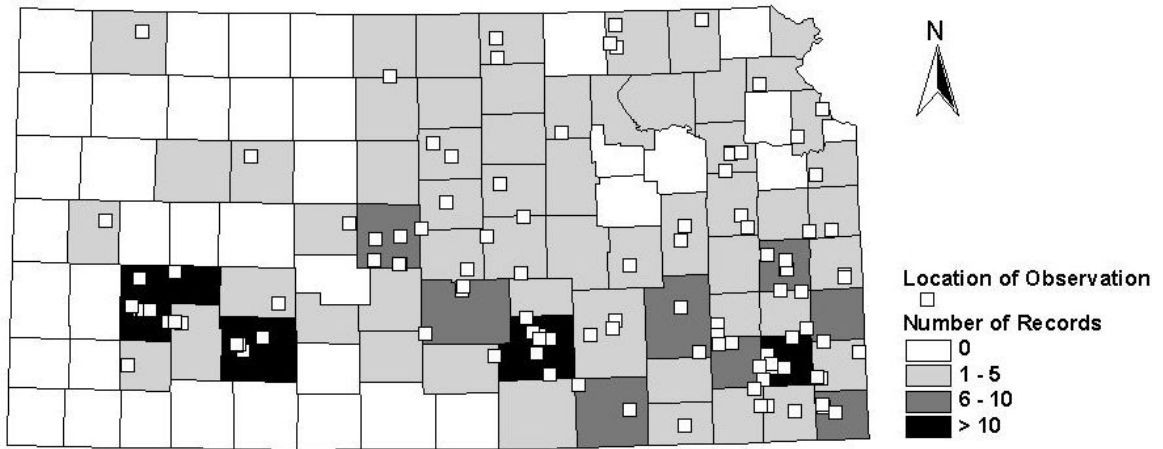


Figure 13. Records of occurrence for the eastern spotted skunk in Kansas between 1990 and 2007.

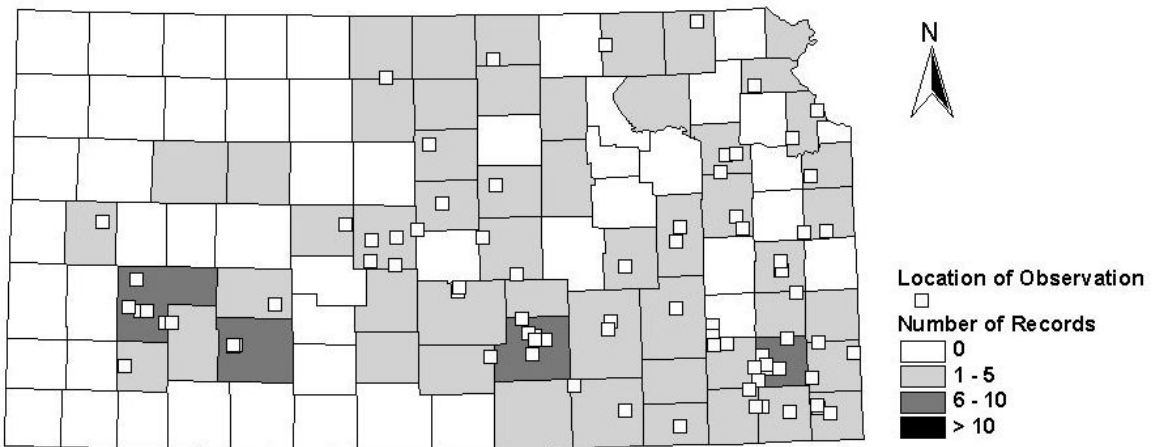
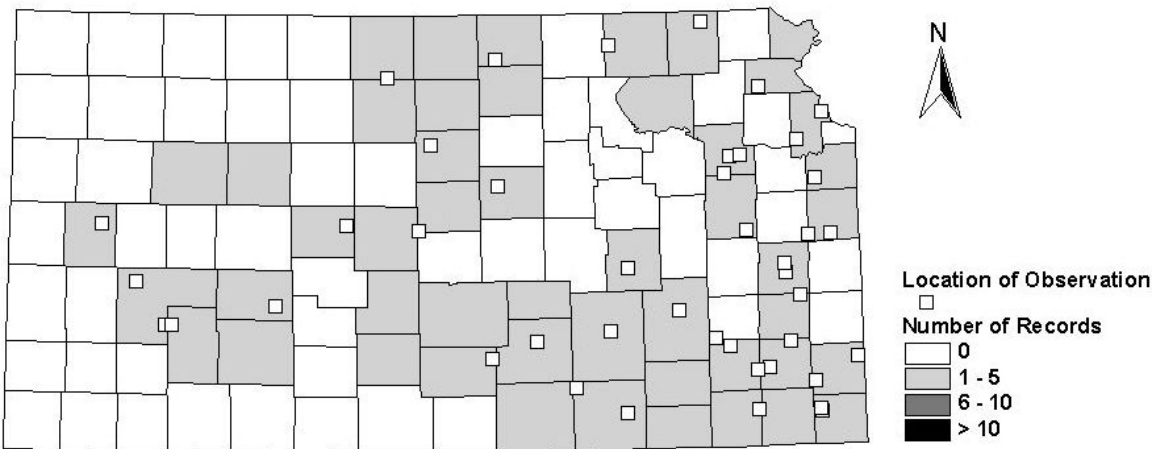


Figure 14. Records of occurrence for the eastern spotted skunk in Kansas between 2000 and 2007.



C. Life History

1. *Reproduction*

Males of the eastern spotted skunk appear to be reproductively inactive during November and early December (Mead 1968a). The onset of spermatogenesis varies regionally, beginning as early as mid-December, and Mead (1968a) found all males examined in his study to be reproductively active by April. Most mating likely occurs in April (Mead 1968a) By late April and into May, males appear to exhibit degenerative changes in the quality and quantity of sperm cells (Mead 1968a). Females of the eastern spotted skunk are reproductively inactive between August and early March, and were observed in estrus in mid-March through the end of May (Mead 1968a). Implantation of the embryos occurred in late April and May, or 14 to 16 days after mating (Mead 1968a). Parturition likely occurs in late May and June (Mead 1968a). Females apparently spontaneously ovulate and breed for the first time at 10 months of age (Mead 1968a). Although direct evidence of the gestation period of the eastern spotted skunk is unavailable, Mead (1968a) deduced that the period of gestation was likely 50-65 days. The litter size ranges from 4 – 9 kittens with an average litter size of 5.5 (Mead 1968a). The sex ratio of males to females in Iowa during 1941 and 1942 was 1.81:1 (Crabb 1948).

2. *Diet*

The diet of the eastern spotted skunk is known to fluctuate with season and the availability of resources. Few published studies documented the diet of the eastern spotted skunk which makes an assumption of regional food preferences difficult. The primary food item for the eastern spotted skunk in Iowa during the fall of 1936 was

mammals (*Microtus* spp), secondarily arthropods, and less frequently birds and plant material (Selko 1937). Crabb (1941) studied the seasonal fluctuations in the diet of the eastern spotted skunk in Iowa between 1939 and 1940 and found that the eastern spotted skunk consumed mammals, birds, arthropods and plant material (Figure 9). The diet of the eastern spotted skunk seems to include species that are at least seasonally dominant or opportunistically procured. The predominant species that were consumed included voles (*Microtus* spp.), field mice (*Peromyscus* spp), common pigeons (*Columba livia*), domestic chickens (*Gallus gallus*), domestic corn (*Zea mays*), and numerous species of arthropods (Crabb 1941). In Missouri in 1981, McCullough (1983) and McCullough and Fritzell (1984) found the summer diet of the eastern spotted skunk to be comprised of arthropods, mammals, birds, and plant material and the fall diet to be comprised of arthropods, mammals, plants, and birds, in descending order of utilization, respectively (Figure 10). Field observations indicated that the eastern spotted skunk might cache the carcasses of prey items (Crabb 1941 and McCullough 1983), which would reduce the need to forage on a nightly basis. Because winter activity patterns are restricted, despite declines in the availability of food items, the eastern spotted skunk likely exhibits some degree of winter lethargy (McCullough 1983).

Figure 15. Seasonal fluctuation in prey items found in scat samples of the eastern spotted skunk in Iowa from 1939 to 1940 (adapted from Crabb 1941).

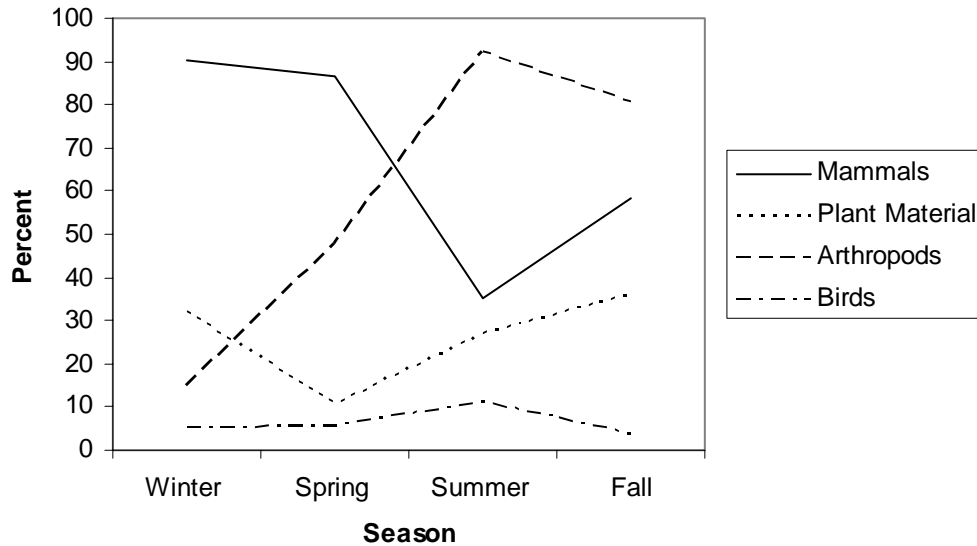
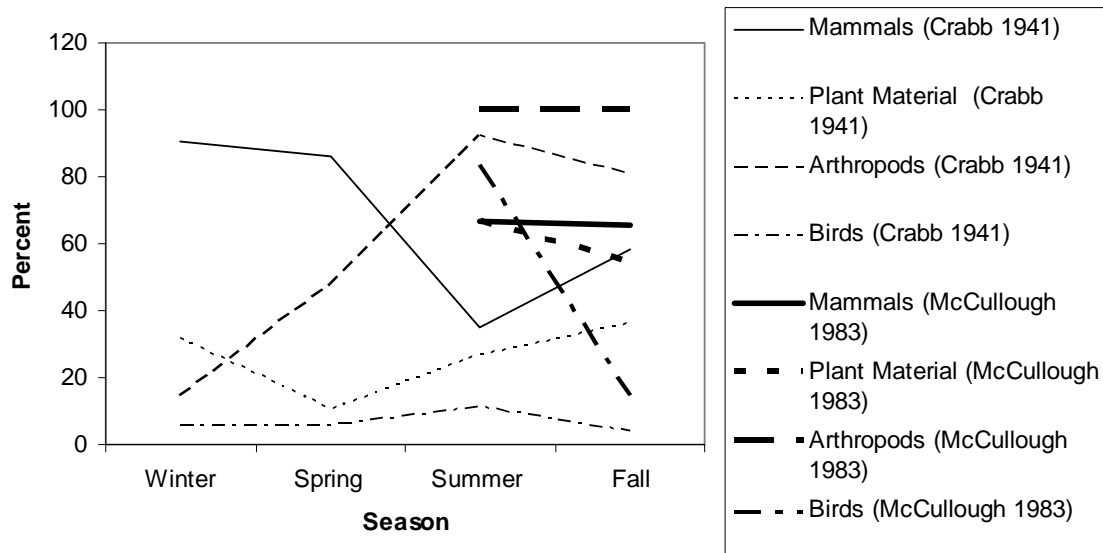


Figure 16. Comparison of the findings of Crabb (1941) and McCullough (1983) on the composition of the diet of the eastern spotted skunk in Iowa in 1939 and 1940 and in Missouri in 1981, respectively.



3. Habitat Requirements

The eastern spotted skunk seems to require some form of vertical structure in the environment to provide cover and den sites, including vegetative structure, outbuildings and sheds, ground debris, or a combination of structure types. Van Gelder (1959)

asserted that human activities contributed to the expansion of the subspecies *Spilogale putorius interrupta* into much of the Central Plains region; however, other accounts (Carter 1939, Coues 1877, Hibbard 1955, and Hibbard 1960) suggest that the eastern spotted skunk was present in the Central Plains prior to the European expansion, and, therefore, not an organism that relies on human activities for persistence in an area.

Reed and Kennedy (2000) reported the capture of four spotted skunks in Tennessee “in traps placed in relatively dense rhododendron thickets” near streams, and the animals were captured in locations that were at least one kilometer from a human dwelling. Eastern spotted skunks were present in a predominately oak-hickory forest in Missouri between 1981 and 1982 and seemed to prefer locations with fallen logs and brush piles (McCullough 1983). In Iowa between 1925 and 1957, the eastern spotted skunk seemed to associate with tall grasses, such as *Andropogon* spp and *Spartina* spp, forbs, legume hayfields and pasture, and a “weed-grass-shrub-bramble cover” and seemed to have less association with areas in which the vegetative cover was low (Polder 1968), such as overgrazed pastureland. In Missouri, seven males of the eastern spotted skunk occupied a home range of 55 to 4359 hectares between 1981 and 1982 which varied seasonally and was largest during the spring (McCullough 1983). The population density of the eastern spotted skunk in Iowa between 1939 and 1942 was 5.6 individuals per square mile (Crabb 1948).

Den selection and use for the eastern spotted skunk seems to involve existing structures and burrows of other animals. Polder (1968) reported his observations of den use by the eastern spotted skunk in Iowa between 1925 and 1957, and found the eastern spotted skunk to use existing burrows of other mammals, including ground squirrels

(*Spermophilus* spp), pocket gophers (*Geomys* spp), woodchucks (*Marmota monax*), badgers (*Taxidea taxus*), muskrat (*Ondatra zibethicus*), Norway rats (*Rattus norvegicus*), and striped skunks (*Mephitis mephitis*), and structures in the environment, including hollowed trees and logs, culverts, farm buildings, debris piles, straw or hay stacks, corn shocks, drain tiles, and limestone fissures. Similarly, Crabb (1948) studied the ecology of the eastern spotted skunk in Iowa between 1939 and 1942, and observed the eastern spotted skunk denning in farm buildings (especially those used for crop storage), straw and hay stacks, hollowed trees and logs, piles of debris, drain tiles, and wells. Additionally, Crabb (1948) documented the eastern spotted skunk using the ground den of a ground squirrel (*Spermophilus* spp), long tailed weasel (*Mustela frenata*), striped skunks (*Mephitis mephitis*), and woodchucks (*Marmota monax*). In a predominately oak-hickory forest in Missouri between 1981 and 1982, the eastern spotted skunk used fallen hollow logs, standing hollow trees, and rocky outcrops as den sites (McCullough 1983). The eastern spotted skunk has primary and secondary den sites (Crabb 1948 and Polder 1968), and appears to lack a definite and permanent home range (Crabb 1948). The observations of Crabb (1948) revealed that the eastern spotted skunk is quite nomadic with respect to its “area of familiarity” by moving from one area to another and potentially back to the original area without display of territory defense. McCullough (1983) referred to the dens of the eastern spotted skunk as diurnal rest sites, which is probably a more appropriate term because of the lack of den fidelity that the eastern spotted skunk often exhibits.

4. Mortality

In Kansas, recent causes of direct mortality for the eastern spotted skunk included

vehicle collisions, incidental take by trappers and killing of nuisance animals. Additionally, the eastern spotted skunk is likely killed by predators, such as coyotes and the great horned owl (*Bubo virginianus*), domestic dogs, diseases, such as rabies, distemper and high parasite load, and natural causes. Undocumented but likely causes of direct mortality include: heavy metal toxicity, and primary or secondary exposure to rodenticides and pesticides. Causes of indirect mortality of the eastern spotted skunk in Kansas likely include habitat loss and degradation, the loss of food resources due to the use of rodenticides and pesticides, and environmental pressures, such as drought. The degree to which each cause impacts the persistence of the species in Kansas will require further evaluation.

III. CONSERVATION STATUS

A. Status Overview

The eastern spotted skunk once had economic value in Kansas as a furbearer; however, decades of decline in the number of pelts sold in Kansas prompted the Kansas Department of Wildlife and Parks to permanently close the harvest season for the eastern spotted skunk in 1977. Subsequently, the eastern spotted skunk was declared a threatened species within the boundaries of Kansas by K.A.R. 115-15-1 in 1982. Elsewhere in the Central Plains region, the eastern spotted skunk is listed as endangered in Missouri, unlisted in Nebraska with no open season, unlisted in Arkansas with an open season, unlisted in Oklahoma with no open season, and endangered in Iowa. In 1994, the eastern spotted skunk was ineligible for federal candidacy because limited data were available to support the need for federal protection for the species. Based on several decades of few observations, unsuccessful attempts by biologists to verify the population

status of the species, and a general perception of rarity the uplisting of the species in Kansas from threatened to endangered is probably warranted.

B. Causes of the Decline and Limiting Factors

The decline of the eastern spotted skunk has been attributed to many different factors. There are no studies that documented the change in population densities of the eastern spotted skunk during the decline. Thus, assigning a specific cause or time to the decline is impossible. Additionally, several factors in combination were likely the cause of the decline of the eastern spotted skunk. The best available estimate for the onset of the decline of the eastern spotted skunk was derived from the number of eastern spotted skunk pelts that were purchased in Kansas (Figure 1). Environmental changes in the 1930's were attributed to the decline of the species, and included large scale conversion to agriculture (Choate et al. 1973, and Polder 1968) and drought (Choate et al. 1973). Subsequently, the use of certain pesticides, such as DDT and toxaphene (Landholt and Genoways 2000), in agriculture likely reduced the availability of prey items and potentially led to disruptions in the reproductive capabilities of the eastern spotted skunk. Harvest pressures on the eastern spotted skunk during the 1930's have received little attention as a factor that contributed to the decline of the species within the Central Plains, but might have been a contributing factor. Gompper and Hackett (2005) suggested disease, possibly rabies, parvovirus, or mink enteritis virus, as a cause for the decline of the eastern spotted skunk.

Because arthropods are a primary food source for the eastern spotted skunk throughout much of the year and much of the Central Plains region was converted to agriculture, the application of pesticides likely reduced the primary food source for the

eastern spotted skunk. Dietary preference, competition with other species for an alternative food source, or both would limit the foraging opportunities for the eastern spotted skunk and result in low densities of the species. Cleaner agricultural practices might have reduced the abundance of rodents associated with human activities, and limited the rodents as a food resource for the eastern spotted skunk. Water resources might be limiting to populations of the eastern spotted skunk in western Kansas. The distance between permanent water sources and recurrent drought in the western part of the state has the potential to directly limit the population density of the eastern spotted skunk and indirectly limit the population density by suppressing the density of prey species. The loss of farm buildings as den sites might have limited the population density of the eastern spotted skunk in some localized areas; however, regionally, the loss of hedge stands and natural debris might have had a greater impact on the need for denning structures. Likely, habitat conversion to agriculture, degradation by overgrazing, and loss to urbanization had a significant impact on limiting the population densities of the eastern spotted skunk. Large scale conversion to agriculture, coupled with the use of pesticides and herbicides, reduced the amount of space and food resources available to the eastern spotted skunk. Polder (1968) observed that the eastern spotted skunk did not seem to associate with overgrazed areas, which lacked the vertical structure that the eastern spotted skunk seems to prefer. Low densities of the eastern spotted skunk might have prevented genetic exchange between populations and reduced the number of encounters of males and females during the breeding season. Loss of genetic diversity can reduce the ability of the species to recover from environmental disturbances, such as drought and habitat conversion, and genetic abnormalities, due to population bottlenecks or

inbreeding depression, might inhibit the reproductive capabilities of males in the population.

C. Additional Data Needs

A large amount of information concerning the basic biology, ecology and conservation needs of the eastern spotted skunk is lacking; therefore, numerous opportunities exist for future investigations of the species. The information that will be critical to early recovery efforts of the eastern spotted skunk includes an evaluation of the population status of the species within the state. Because the species appears to show seasonality in detection success (M. E. Gompper, pers. comm.) and probably occurs in low densities, long term, multi-season and large scale detection efforts are necessary. Such studies should focus on an area of conservation priority for the eastern spotted skunk. Because a low detection success for the eastern spotted skunk is likely, companion studies of the flora or fauna of an area could be conducted concurrent with the evaluation of the population status of the eastern spotted skunk in an area. Investigations of the population status of the eastern spotted skunk in Kansas might seek to answer the following questions: where do populations of the eastern spotted skunk occur in Kansas, how many populations of the eastern spotted skunk occur in Kansas, and how large are the populations of the eastern spotted skunk that occur in Kansas. By documenting and evaluating the populations of the eastern spotted skunk in Kansas, additional studies that will improve our understanding of the conservation needs of the species can be implemented. Because limited information exists for the eastern spotted skunk, our understanding of the species would improve by conducting evaluations of the population genetics, population dynamics, and home range dynamics. Additionally, access to stable

populations would provide opportunities for the study of the behavioral and reproductive ecology of the species.

At the time Van Gelder (1959) prepared his taxonomic revision of the genus *Spilogale*, only morphometric tools were available. With the arrival of new and powerful genetic tools and GIS, an evaluation of the taxonomy and molecular biogeography of the genus is possible. An understanding of the molecular taxonomy of the species will aid in the planning of future relocation efforts in Kansas and other states. Similarly, by evaluating the molecular biogeography of the eastern spotted skunk, new information might become available concerning the historic aspects of the distribution and decline of the species.

Data are lacking concerning the community associations and interactions of the eastern spotted skunk. Understanding the community associations of the eastern spotted skunk will enable wise selection of conservation areas and critical habitat. The studies of community associations of the eastern spotted skunk might include evaluations of the interactions with predators, the use of vegetative cover to escape predators and acquire prey items, habitat composition and use, the density and diversity of prey items, and interactions with competitors. Additionally, an investigation of environmental contaminants, such as heavy metals and toxicants, present in areas inhabited by the eastern spotted skunk and the impact of contaminants on the persistence and health of the eastern spotted skunk and the community with which it is associated is needed.

D. Critical Habitat

Critical habitat currently designated: All suitable habitat in Barton, Anderson, Woodson, Wilson, Chautauqua, Montgomery, and Labette counties; all suitable habitats

within the Cowskin Creek and Big Slough drainage basins in Sedgwick and Sumner counties; all suitable habitat within a riparian corridor along the main stem Arkansas River (the corridor's outermost boundary is along a line 0.5 mi landward from the named stream's ordinary high water mark on each bank) in Finney, Ford and Gray counties; all suitable habitats within the Big Creek drainage basin in Ellis and Trego counties (Figure 17).

Critical habitat with recent documentation of the species: Since 1980, the eastern spotted skunk was documented in Barton, Anderson, Woodson, Wilson, Chautauqua, Montgomery, and Labette counties; within the Cowskin Creek and Big Slough drainage basins in Sedgwick County; within the riparian corridor along the main stem Arkansas River in Finney, Ford and Gray counties; and, the Big Creek drainage basin in Trego County (Figure 18).

Critical habitat lacking recent documentation of the species: Since 1980, the eastern spotted skunk was not documented in the Cowskin Creek drainage basin in Sumner County or the Big Creek drainage basin in Ellis County (Figure 18).

Undesignated critical habitat with recent documentation of the species: Since 1980, the eastern spotted skunk was documented in Allen (n = 1), Atchison (n = 3), Bourbon (n = 2), Butler (n = 3), Chase (n = 1), Cherokee (n = 5), Clay (n = 1), Cowley (n = 3), Crawford (n = 3), Ellsworth (n = 2), Greenwood (n = 2), Haskell (n = 1), Hodgeman (n = 1), Johnson (n = 1), Kingman (n = 1), Leavenworth (n = 3), Lincoln (n = 2), Linn (n = 2), Lyon (n = 2), Marshall (n = 3), McPherson (n = 3), Miami (n = 2), Nemaha (n = 1), Neosho (n = 7), Osage (n = 2), Rawlins (n = 1), Reno (n = 3), Republic (n = 2), Rice (n =

1), Rush (n = 1), Saline (n = 1), Shawnee (n = 4), Smith (n = 1), and Wichita (n = 1) counties (Figure 18).

Figure 17. Counties and drainage basins currently designated as critical habitat in Kansas.

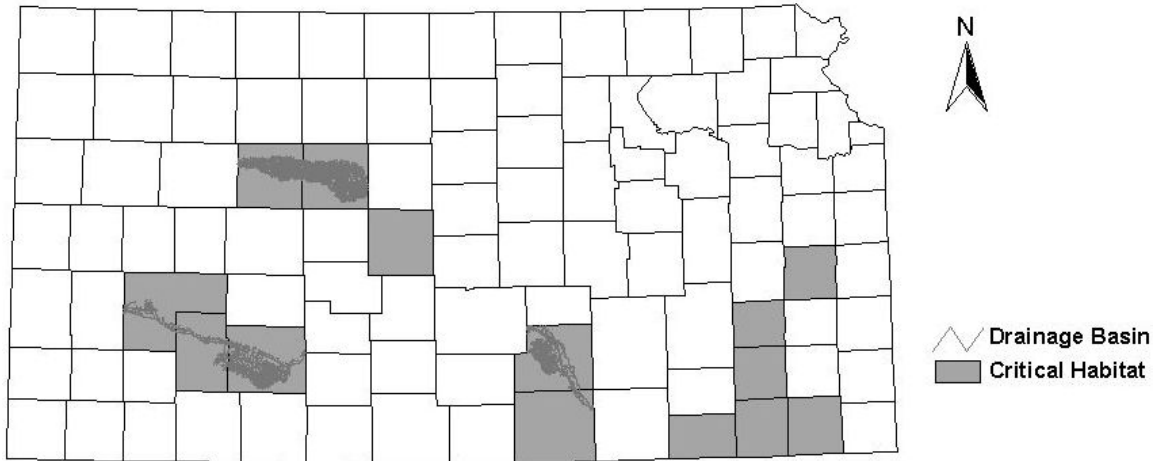
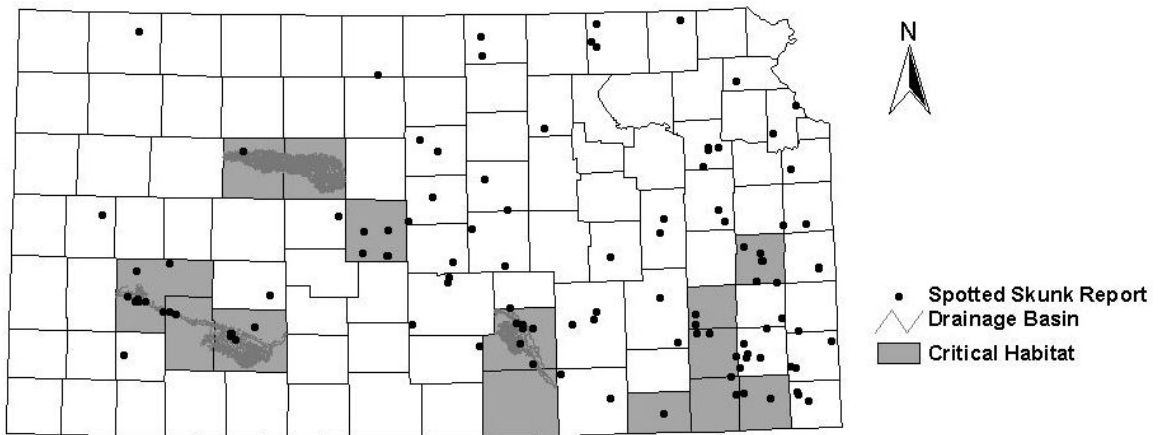


Figure 18. Records of eastern spotted skunk occurrence in Kansas between 1980 and 2007.



IV. RECOVERY

A. Recovery Objective

The primary objective is to reestablish self-sustaining populations of the eastern skunk in Kansas within remaining suitable habitats such to allow persistence into the foreseeable future. Additionally, the strategies and tactics herein aim to prevent the

extinction of the eastern spotted skunk from Kansas and recover or reestablish self-sustaining populations within its former range where habitat remains suitable, such that delisting is possible.

B. Recovery Criteria

Because the population status and conservation needs of the eastern spotted skunk are unconfirmed, only provisional recovery criteria can be established. These criteria should be evaluated every 5 years and updated with the best available information. A provisional goal of five or more statewide metapopulations, each comprised of three or more source populations and minimum of 20 reproductive females in each population would deem the species recovered in Kansas.

The provisional stages of recovery for the eastern spotted skunk in Kansas are as follows: Delist, a minimum of five or more statewide metapopulations, each comprised of three or more source populations and a minimum of 20 reproductive females in each population; Downlist to SINC, three to four statewide metapopulations, each comprised of three source populations and a minimum of 20 reproductive females in each population; Downlist to Threatened, two statewide metapopulations, each comprised of three or fewer source populations and 20 reproductive females in each population; and List as Endangered, fewer than two statewide metapopulations, each comprised of fewer than three populations and fewer than 20 reproductive females in each population.

C. Recovery Strategies and Tasks

1. Document and verify the occurrence of the eastern spotted skunk in Kansas.
 - 1.1. Develop a standard procedure for documenting observation reports of the eastern spotted skunk.

- 1.1.1. Distribute annually a memorandum that outlines the procedure for documenting observations of the eastern spotted skunk.
 - 1.1.2. Include a map with a notation of where the observation was made.
 - 1.1.3. Deposit data for eastern spotted skunk observations with the Kansas Biological Survey.
 - 1.2. Collect carcasses that are found dead on the road, surrendered by trappers, or from animal control, and document the location. Deposit these specimens in a museum of natural history.
 - 1.3. Request sighting information from non-agency personnel.
 - 1.3.1. Request sighting information from licensed furharvesters in Kansas by sending a questionnaire survey every three years.
 - 1.3.2. Request sighting information from city and county animal control officers by sending a questionnaire survey every three years.
 - 1.3.3. Request sighting information from personnel at academic institutions and non-governmental organizations every three years.
 - 1.4. Conduct live trapping in areas where reliable observations were made or in areas where several observations were reported.
2. Locate and monitor populations of the eastern spotted skunk.
 - 2.1. Develop a sampling schedule for areas of conservation priority, within areas of critical habitat, or in areas where the eastern spotted skunk was reported to occur.
 - 2.1.1. Conduct sampling throughout the year, in a variety of habitats, and over a large area.

- 2.1.2. Coordinate with private landowners to gain permission to trap on private lands near the area where population sampling is to occur.
 - 2.2. Establish long-term sampling programs in areas where populations of the eastern spotted skunk are found.
 - 2.3. Facilitate and encourage university and private sector involvement with population monitoring.
3. Investigate the ecology of the eastern spotted skunk in Kansas.
 - 3.1. Evaluate the composition of the diet of the eastern spotted skunk.
 - 3.1.1. Conduct an analysis of scat samples found on eastern spotted skunk sampling areas.
 - 3.1.2. Evaluate seasonal and regional variation in dietary composition.
 - 3.1.3. Evaluate the abundance of prey items within the sampling areas.
 - 3.2. Evaluate microhabitat associations of the eastern spotted skunk.
 - 3.2.1. Evaluate the denning ecology of the eastern spotted skunk in native versus non-native habitats and density of potential den sites within a sampling area.
 - 3.2.2. Evaluate associations of the eastern spotted skunk with native versus non-native habitats and document the use of structural components as den sites, corridors, and cover.
 - 3.2.3. Evaluate home range dynamics and habitat use by conducting telemetry based investigations.
4. Evaluate the health, viability, and sustainability of eastern spotted skunk populations in Kansas.

- 4.1. Perform toxicological tests on animals that are live trapped on a sampling area, and, when possible, on carcasses that are submitted with an observation report.
- 4.2. Evaluate seasonal variation in external parasite load.
- 4.3. Evaluate disease ecology within and among populations of the eastern spotted skunk and document transmission patterns and virulence.
- 4.4. Evaluate the genetic composition of populations of the eastern spotted skunk to identify patterns of gene flow, and populations with decreased heterozygosity (adaptive potential) due to isolation or inbreeding.
5. Enhance quality and quantity of suitable habitat for the eastern spotted skunk.
 - 5.1. Initiate state level tax incentives for maintaining or enhancing eastern spotted skunk habitat on private lands that support a population of the eastern spotted skunk, directly or indirectly.
 - 5.2. Enhance spotted skunk habitat by leaving natural piles of debris and built structures.
 - 5.3. Increase connectivity of suitable habitats.
 - 5.3.1. Maintain a buffer of tall and dense vegetation or trees along stream and river courses.
 - 5.3.2. Maintain an edge of tall and dense vegetation along or near and parallel to fence rows.
 - 5.4. Cooperate with private landowners who own land that supports or could potentially support a population of the eastern spotted skunk, directly or indirectly.

- 5.4.1. Provide information about habitat improvement incentives.
 - 5.4.2. Assist private landowners with the technical aspects of developing a management plan for their property that is consistent with recovery efforts and the needs of the participating landowner.
6. Buffer the negative impacts of competition, if found to be a limiting factor for a population of the eastern spotted skunk.
- 6.1. Identify the limiting resource.
 - 6.1.1. Selectively eliminate individuals of the competing species, if current densities of the competing species threaten the persistence of a population of the eastern spotted skunk in an area.
 - 6.1.2. Install artificial burrows, structures, or debris piles, if den sites are found to be the limiting resource in a recovery area.
 - 6.1.3. Employ alternatives to chemical based pest management to augment the abundance of arthropods and small mammals.
 - 6.1.4. Provide temporary food supplements to populations of the eastern spotted skunk that mimic the spatial patterns and practices of historic crop storage.
7. Establish recovery areas for the eastern spotted skunk.
- 7.1. Develop a procedure for monitoring and maintenance of the eastern spotted skunk within each recovery area.
 - 7.2. Advocate the relocation of nuisance animals to recovery areas as an alternative to random relocation to an area that potentially does not support a population of the eastern spotted skunk and killing.

- 7.2.1. Conduct genetic screening of individuals in the recovery area and individuals that are relocated to the recovery area.
- 7.2.2. Distribute annually informational memorandums to state and federal agency personnel, city and county animal control officers, academic institutions, and non-governmental organizations that describe the relocation procedures.
- 7.3. Require relocation of individuals of the eastern spotted skunk and enhancement of habitat quality on a recovery area as a component of mitigation for development permits.
- 8. Promote awareness of recovery efforts and education.
 - 8.1. Incorporate information about the eastern spotted skunk recovery efforts into furharvester and hunter education courses.
 - 8.2. Include information about the eastern spotted skunk recovery efforts in the hunting and furharvesting regulations.
 - 8.3. Designate a centralized contact person or office for receiving information and inquiries about the eastern spotted skunk.
- 9. Communicate with neighboring states and sister agencies about opportunities for public outreach and collaboration of management efforts.
- 10. Employ consistent and sound science.
 - 10.1. Designate a recovery coordinator to oversee projects and benchmarks of recovery efforts.

- 10.2. Implement the best available technologies and techniques in recovery efforts and rely on modeling techniques to aid in planning when field observations are lacking.
11. Provide financial support for research and actions that contribute to the recovery of the eastern spotted skunk.

D. Implementation Schedule

Actions necessary to recover the eastern spotted skunk in Kansas area are ranked as follows:

Priority 1 – an action that must be taken to prevent a species from irreversible decline or extinction from Kansas.

Priority 2 – an action that must be taken to prevent further decline in the range or abundance of the eastern spotted skunk.

Priority 3 – all other actions necessary to meet recovery objectives.

Table 2. Implementation schedule for the recovery of the eastern spotted skunk in Kansas.

Priority	Task	Description	Duration	Cost estimate (in \$1,000 units)					Comments	
				Total cost	FY09	FY10	FY11	FY12		FY13
1	1	Document and verify occurrence	Ongoing	TBD						
1	1.1	Develop procedure to document reports	Ongoing	TBD						
3	1.1.1	Distribute a memorandum of the procedure to document observations	Ongoing	TBD						
1	1.1.2	Map the location where observation was made	Ongoing	TBD						
1	1.1.3	Deposit observation data with Kansas Biological Survey	Ongoing	TBD						
1	1.2	Collect carcasses and deposit with natural history museum	Ongoing	TBD						
1	1.3	Request sighting information	Ongoing	TBD						
1	1.3.1	Send sighting survey to Kansas furharvesters	Ongoing	TBD						
1	1.3.2	Send sighting survey to animal control officers	Ongoing	TBD						
1	1.3.3	Request sighting information from academic and non-governmental biologists	Ongoing	TBD						
1	1.4	Conduct live trapping to verify occurrence	Ongoing	TBD						
1	2	Locate and monitor populations	Ongoing	TBD						

1	2.1	Develop sampling schedule for priority areas	Ongoing	TBD						
1	2.1.1	Conduct sampling throughout the year, in variety of habitats, and over large area	Ongoing	TBD						
1	2.1.2	Coordinate with private landowners to obtain permission to trap	Ongoing	TBD						
1	2.2	Establish long-term sampling programs	Ongoing	TBD						
1	2.3	Involve universities and private sector in monitoring programs	Ongoing	TBD						
1	3	Investigate ecology	Ongoing	TBD						
1	3.1	Evaluate diet	Ongoing	TBD						
1	3.1.1	Conduct analysis of scat samples	Ongoing	TBD						
1	3.1.2	Evaluate seasonal and regional variation in diet	Ongoing	TBD						
1	3.1.3	Evaluate abundance of prey items	Ongoing	TBD						
1	3.2	Evaluate microhabitat associations	Ongoing	TBD						
1	3.2.1	Evaluate denning ecology	Ongoing	TBD						
1	3.2.2	Evaluate association with native versus built habitat	Ongoing	TBD						
1	3.2.3	Evaluate home range dynamics	Ongoing	TBD						
1	4	Evaluate health, viability, and sustainability of populations	Ongoing	TBD						

1	4.1	Perform toxicological tests	Ongoing	TBD						
1	4.2	Evaluate seasonal variation in parasite load	Ongoing	TBD						
1	4.3	Evaluate disease ecology	Ongoing	TBD						
1	4.4	Evaluate genetic composition of populations	Ongoing	TBD						
1	5	Enhance quality and quantity of suitable habitat	Ongoing	TBD						
3	5.1	Initiate state level tax incentives	Ongoing	TBD						
1	5.2	Enhance habitat with debris piles and built structures	Ongoing	TBD						
1	5.3	Increase connectivity of suitable habitat	Ongoing	TBD						
1	5.3.1	Maintain buffer along water courses	Ongoing	TBD						
1	5.3.2	Maintain an edge along or near fence rows	Ongoing	TBD						
1	5.4	Cooperate with private landowners	Ongoing	TBD						
3	5.4.1	Provide information about habitat improvement incentives	Ongoing	TBD						
2	5.4.2	Assist with technical aspects of developing a management plan	Ongoing	TBD						
1	6	Buffer the impacts of competition	Ongoing	TBD						
1	6.1	Identify the limiting resources	Ongoing	TBD						

1	6.1.1	Eliminate individuals of the competing species	Ongoing	TBD						
1	6.1.2	Install more den sites	Ongoing	TBD						
1	6.1.3	Employ alternatives to chemical based pest management	Ongoing	TBD						
1	6.1.4	Provide temporary food supplements	Ongoing	TBD						
1	7	Establish recovery areas	Ongoing	TBD						
1	7.1	Develop procedure for monitoring and maintenance in recovery area	Ongoing	TBD						
1	7.2	Advocate relocation of nuisance animals to recovery areas	Ongoing	TBD						
1	7.2.1	Conduct genetic screening	Ongoing	TBD						
1	7.2.2	Distribute information about relocation procedures	Ongoing	TBD						
1	7.3	Require relocation of individuals and recovery area enhancement as part of mitigation	Ongoing	TBD						
3	8	Promote awareness of recovery efforts and education	Ongoing	TBD						
3	8.1	Incorporate information into hunter and furharvester education courses	Ongoing	TBD						
3	8.2	Include information in hunting and furharvesting regulations	Ongoing	TBD						

3	8.3	Designate a centralized contact person or office	Ongoing	TBD						
3	9	Communicate with other states and agencies about education and collaboration	Ongoing	TBD						
1	10	Employ consistent and sound science	Ongoing	TBD						
3	10.1	Designate a recovery coordinator	Ongoing	TBD						
2	10.2	Implement best technologies and techniques	Ongoing	TBD						
1	11	Provide financial support for research and recovery actions	Ongoing	TBD						

LITERATURE CITED

- Allen, J. A. 1895. List of mammals collected in the Black Hills region of South Dakota and in western Kansas by Mr. Walter W. Granger, with field notes by the collector. *Bulletin of the American Museum of Natural History* 7:259-274.
- Allen, P. Kansas mammals. *Kansas State Teachers College of Emporia, Bulletin of Information* 19:1-57.
- Anderson, S., and B. C. Nelson. 1958. Additional records of mammals in Kansas. *Transactions of the Kansas Academy of Science* 61:302-312.
- Baker, A. B. 1887 – 1888. Mammals of western Kansas. *Transactions of the Annual Meetings of the Kansas Academy of Science* 11:56-58.
- Black, J. D. 1937. Mammals of Kansas. In: *Kansas State Board of Agriculture, 30th Biennial Report, Topeka, KS.* p 116-217.
- Carter, F. L. 1939. A history of the changes in population of certain mammals in western Kansas. MS Thesis, Fort Hays Kansas State College, Hays, 78pp.
- Choate, J. R. 1987. Post-settlement history of mammals in western Kansas. *The Southwestern Naturalist* 32:157-168.
- Choate, J. R., E. D. Fleharty, and R. J. Little. 1973. Status of the spotted skunk, *Spilogale putorius*, in Kansas. *Transactions of the Kansas Academy of Science* 76:226-233.
- Clarke, R. F., J. Breukelman, and T. F. Andrews. 1958. An annotated check list of the vertebrates of Lyon County, Kansas. *Transactions of the Kansas Academy of Science* 61:165-194.

- Cockrum, E. L. 1952. Mammals of Kansas. University of Kansas Publications, Museum of Natural History 7:1-303.
- Code of Federal Regulations. 1994. Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species. Title 50, Part 17, 1994 ed.
- Coues, E. 1877. Fur-bearing animals: a monograph of North American Mustelidae. United States Geological Survey of the Territories, Miscellaneous Publications 8:xiv+348, 20 plates.
- Crabb, W. D. 1941. Food habits of the prairie spotted skunk in southeastern Iowa. Journal of Mammalogy 22:349-364.
- Crabb, W. D. 1948. The ecology and management of the prairie spotted skunk in Iowa. Ecological Monographs 18:202-232.
- Dice, L. R. 1923. Notes on some mammals of Riley County, Kansas. Journal of Mammalogy 4:107-112.
- Dragoo, J. W., R. D. Bradley, R. L. Honeycutt, and J. W. Templeton. 1993. Phylogenetic relationships among the skunks: a molecular perspective. Journal of Mammalian Evolution 1:255-267.
- Ferguson, S. H., and S. Larivière. 2002. Can comparing life histories help conserve carnivores? Animal Conservation 5:1-12.
- Getz, L. L. 1960. Middle Pleistocene carnivores from southwestern Kansas. Journal of Mammalogy 41:361-365.

- Gompper, M. E., and H. M. Hackett. 2005. The long-term, range-wide decline of a once common carnivore: the eastern spotted skunk (*Spilogale putorius*). *Animal Conservation* 8:195-201.
- Hibbard, C. W. 1933. A revised checklist of Kansas mammals. *Transactions of the Kansas Academy of Science* 36:230-249.
- Hibbard, C. W. 1941a. The Borchers fauna, a new Pleistocene interglacial fauna from Mead County, Kansas. *State Geological Survey of Kansas, Bulletin* 38:197-220.
- Hibbard, C. W. 1941b. Mammals of the Rexroad fauna from the upper Pliocene of southwestern Kansas. *Transactions of the Kansas Academy of Science* 44:265-313.
- Hibbard, C. W. 1941c. New mammals from the Rexroad fauna, upper Pliocene of Kansas. *The American Midland Naturalist* 26:337-368.
- Hibbard, C. W. 1944. A checklist of Kansas mammals, 1943. *Transactions of the Kansas Academy of Science* 47:61-88.
- Hibbard, C. W. 1955. The Jinglebob interglacial (Sangamon?) [*sic*] fauna Kansas and its climatic significance. *Contributions from the Museum of Paleontology, University of Michigan* 12:179-228.
- Hibbard, C. W., and D. W. Taylor. 1960. Two late Pleistocene faunas from southwestern Kansas. *Contributions from the Museum of Paleontology, University of Michigan* 16:1-223.
- Kansas Department of Wildlife and Parks. 1976. Furbearer population and harvest summary. Kansas Department of Wildlife and Parks, Unpublished report, 39 pp.
- Kinlaw, A. 1995. *Spilogale putorius*. *Mammalian Species* 511:1-7.

- Knox, M. V. B. 1875. Kansas Mammalia. Transactions of the Kansas Academy of Science 4:19-22.
- Landholt, L. M., H. H. Genoways. 2000. Population trends in furbearers in Nebraska. Transactions of the Nebraska Academy of Science 26:97-110.
- Lantz, D. E. 1904. A list of Kansas mammals. Transactions of the Kansas Academy of Science 19:171-178.
- Lantz, D. E. 1905. Kansas mammals in their relations to agriculture. Experiment Station, Kansas State Agricultural College Bulletin, 129:331-402.
- Larivière, S., and S. H. Ferguson. 2003. Evolution of induced ovulation in North American carnivores. Journal of Mammalogy 84:937-947.
- Linsdale, J. 1928. Mammals of a small area along the Missouri River. Journal of Mammalogy 9:140-146.
- McCullough, C. 1983. Population status and habitat requirements of the eastern spotted skunk on the Ozark Plateau. University of Missouri, Columbia, 63pp.
- McCullough, C. R., and E. K. Fritzell. 1984. Ecological observations of eastern spotted skunks on the Ozark Plateau. Transactions of the Missouri Academy of Science 18:25-32.
- Mead, R. A. 1968a. Reproduction in eastern forms of the spotted skunk (genus *Spilogale*). Journal of Zoology 156:119-136.
- Mead, R. A. 1968b. Reproduction in western forms of the spotted skunk (genus *Spilogale*). Journal of Mammalogy 49:373-390.

- Nilz, S. K., and E. J. Finck. 2008. Distribution and status of the eastern spotted skunk (*Spilogale putorius*) in Kansas. Kansas Department of Wildlife and Parks, Pratt, KS. 47 pp.
- Patterson, B. D., G. Ceballos, W. Sechrest, M. F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B. E. Young. 2005. Digital distribution maps of the mammals of the Western Hemisphere, version 2.0. NatureServe, Arlington, VA.
- Pitts, R. M., M. J. Levalley, and S. Klinger. 1987. Mammals of Fort Riley, Kansas. Transactions of the Kansas Academy of Science 90:75-80.
- Pizzimenti, J. J. 1971. List of karyotypes of mammals from the northern plains region. Transactions of the Kansas Academy of Science 74:67-75.
- Polder, E. 1968. Spotted skunk and weasel populations den and cover usage by northeast Iowa. The Proceedings of the Iowa Academy of Science 75:142-146.
- Reed, A. W., and M. L. Kennedy. 2000. Conservation status of the eastern spotted skunk *Spilogale putorius* in the Appalachian Mountains of Tennessee. American Midland Naturalist 144:133-138.
- Roy, C. C. 1997. 1995 – 1996 Kansas furbearer surveys and investigations project summary. Kansas Department of Wildlife and Parks, Unpublished report, 70 pp.
- Sasse, D. B., and M. E. Gompper. 2006. Geographic distribution and harvest dynamics of the eastern spotted skunk in Arkansas. Journal of the Arkansas Academy of Science 60:119-124.
- Selko, L. F. 1937. Food habits of Iowa skunks in the fall of 1936. The Journal of Wildlife Management 1:70-76.

Van Gelder, R. G. 1959. Taxonomic revision of the spotted skunks (genus *Spilogale*).

Bulletin of the American Museum of Natural History 117:229-392.

Walker, J. R. 1978. The mammals (exclusive of the bats) of Cheyenne County, Kansas.

Transactions of the Kansas Academy of Science 81:185-229.

Wozencraft, W. C. 2005. Order Carnivora. Pp. 532-628 in Mammal species of the world: a taxonomic and geographic reference. Third edition (D. E. Wilson and D. M. Reeder eds.). The John Hopkins University Press, Baltimore, MD.