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✓ HERPETOFAUNA OF THE KONZA PRAIRIE RESEARCH NATURAL AREA IN THE FLINT HILLS  
REGION OF KANSAS WITH RESPECT TO HABITAT SELECTION

by

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## INTRODUCTION

Ecological study of many species of amphibians and reptiles has been rather limited even though approximately 30% of North American vertebrates (excluding fish) north of Mexico are herpetiles (Bury et al. 1980). This lack of study has been due in part to the secretive habits of many species coupled with the lack of suitable techniques for assessment of numbers, microhabitat selection and activity by secretive forms. Lack of ecological study of herpetiles is also true for the Great Plains region of central North America even though a few species have been studied in detail, e.g., the five-lined skink, collared lizard, six-lined racerunner, copperhead and ringneck snake (Fitch 1954, 1956b, 1958a, 1960, 1975). For most herpetiles of the Great Plains available information consists of distributional ranges and general natural history (e.g., Collins 1982, Hudson 1942, Webb 1970, Wheeler and Wheeler 1966).

Recently, investigators interested in habitat relationships, the role of herpetiles in native habitats and nongame wildlife management have studied habitat distribution and collected natural history data on herpetiles in prairie preserves of the central United States. For example, the herpetofauna of preserves was examined in North Dakota (Hopkins 1983), Nebraska (Ballinger et al. 1979, Jones et al. 1981), Iowa (Platt 1973, 1975), and Kansas (Fitch, collective references in Literature Cited). Study of herpetiles, in such preserves, should provide important insights into ecological requirements since these sites often contain vegetation conditions that resemble native habitats rather than habitats created by livestock grazing and agriculture practices. Native prairies recently or

presently being set aside by conservation organizations offer considerable potential for the continued study of herpetiles under ecological conditions that more closely match natural habitats than the habitats created by intensive agriculture and other human disturbances of native ecosystems. The *Konza Prairie Research Natural Area* (KPRNA) in the Flint Hills region of eastern Kansas offers the opportunity to study the ecological requirements of herpetiles in native habitats of the tallgrass prairie. As a first phase, the present study was initiated to compile a species list as well as to gather information on habitat distribution and natural history of herpetiles on the KPRNA.

## MATERIALS AND METHODS

Reptiles and amphibians were collected from 1 March to 15 October 1983 on the Konza Prairie Research Natural Area (KPRNA) located ten kilometers south of Manhattan, Kansas. Supplemental nighttime searches for anurans were also carried out on this site in the spring of 1984. KPRNA, located in Riley and Geary counties, was purchased in two units, one in 1971 and the other in 1977, by the Nature Conservancy to establish an experimental tallgrass prairie research site in the Flint Hills region of eastern Kansas. KPRNA contains 3487 ha and consists primarily of tallgrass prairie (>90% of the site), a limited amount of woodland, especially along streams, and less than 100 ha of cultivated fields. The site managed by Kansas State University is one of eleven Long-Term Ecological Research sites supported by the National Science Foundation (Callahan 1984).

Tallgrass prairie on the KPRNA is dominated by big bluestem (Andropogon gerardi), little bluestem (Andropogon scoparius), and indian grass (Sorghastrum nutans; plant names from Freeman and Hulbert 1983). Shrubby habitats, dominated by rough-leaved dogwood (Cornus drummondii) and some smooth sumac (Rhus glabra), occur along portions of limestone outcrops. The two large creeks, Kings and Shane Creeks, support gallery forest habitat dominated by common hackberry (Celtis occidentalis) and bur and chinquapin oaks (Quercus macrocarpa and Q. muhlenbergii). Additionally, Kings creek, Shane creek, smaller spring fed streams and 12 man made ponds provide habitats for aquatic herpetiles.

Three terrestrial areas served as primary collecting sites, an upland limestone outcrop dominated by native grasses with a few patchy areas of

shrubs; a limestone outcrop dominated by shrubs with a few trees; and a limestone outcrop associated with the gallery forest along Kings creek with approximately two-thirds of this outcrop in forest edge habitat and one-third in the forest proper.

Five collecting stations, 150 m apart, were placed along each of the three limestone outcrops. At each station, three funnel traps (Fitch 1951) placed along natural barriers, were used to collect herpetiles. Drift fences, 1/4 inch metal screen, 5 feet long and 2 feet high, were employed at stations without sufficient large rock or fallen log barriers. Traps were set from 19 May to 1 August. The traps were reset 9 August but trapping was terminated three days later due to high temperatures. Traps were visited daily with occasional one to two day intervals between visits. During each trap check, an area of approximately 100 m<sup>2</sup> near each station was searched for herpetiles. These searches were carried out in the open as well as under rocks, logs and plant debris. Herpetiles seen while walking census transects were pursued for identification and capture when possible.

General sampling of herpetiles, including hand collecting and noosing (lizards), was carried out in other areas across KPRNA. Ponds, streams, marshy areas, and temporary rain pools were also visited in search of aquatic herpetiles. Additionally, five ponds on KPRNA were seined for aquatic species on 15 August, 1983.

Records made for sightings and captures included species, time of capture or sighting, air temperature (from LTER weather station data) and type of record (sighting or capture and if a capture whether the individual was caught in a trap, in the open, or under an object). Larger species of snakes were marked by clipping ventral scutes while lizards were toe

clipped and turtles were notched on marginal plates. Amphibians were not marked. A voucher specimen was preserved for each species captured.

## RESULTS AND DISCUSSION

Twenty-nine of the 49 herpetile species recorded for Riley and Geary Counties (Collins 1982) were found on the KPRNA (Table 1). The species found included 1 salamander, 8 frogs and toads, 3 turtles, 4 lizards and 13 snakes. Many of the 20 species not found probably do not occur on KPRNA due to the lack of suitable habitat, whereas others may be rare because suitable habitat is patchy and rare in occurrence or because this region contains only marginal habitat at the extreme edge of the distributional range of the species (Table 1, see Notes of Species Not Found). Activity data with regard to temperature ranges and first and last observation dates are summarized in Table 2 and Figure 1 respectively. Due to unusually high temperatures and lack of rain, a severe drought occurred during the summer of 1983. As a result, observation numbers of herpetiles are probably lower than one would expect from a more typical, less harsh summer season.

### LIMESTONE OUTCROPS

Sampling efforts at the three limestone outcrop sites yielded a total of 15 species of herpetiles, 2 amphibians and 13 reptiles (Table 3). Reptile species ranged from 7 at the grass outcrop to 8 at the shrub outcrop to 10 at the forest outcrop. One amphibian species was recorded at the shrub outcrop and another at the forest outcrop. Total numbers of observations of herpetiles varied considerably among the three sites with 22 at the grass outcrop, 98 at the shrub outcrop and 119 at the forest outcrop (Table 3). Even though some sightings were probably new individuals, they were not recorded as such unless the individual was captured and marked. Therefore, numbers of known individuals rather than

Table 1. Species list of herpetofauna from Riley and Geary Counties (Collins 1982) designating relative occurrence (based on number of observations) of species on the Konza Prairie Research Natural Area (KPRNA).

Species	Occurrence <sup>1</sup>	Species	Occurrence
<b>AMPHIBIA</b>			
<u>Ambystoma tigrinum</u>	K C	<u>Cnemidophorus sexlineatus</u>	N I
<u>Scaphiopus bombifrons</u>	K R	<u>Ophisaurus attenuatus</u>	K R
<u>Bufo cognatus</u>	N I	<u>Heterodon nasicus</u>	N H
<u>Bufo woodhousei</u>	K C	<u>Heterodon platyrhinus</u>	N I
<u>Acris crepitans</u>	K C	<u>Carphophis amoenus</u>	K R
<u>Pseudacris triseriata</u>	K C	<u>Diadophis punctatus</u>	K C
<u>Hyla chrysoscelis</u>	K R	<u>Tantilla gracilis</u>	K R
<u>Rana blairi</u>	K C	<u>Tantilla nigriceps</u>	N D
<u>Rana catesbeiana</u>	K C	<u>Coluber constrictor</u>	K C
<u>Gastrophryne olivacea</u>	K C	<u>Elaphe guttata</u>	K C
		<u>Elaphe obsoleta</u>	K C
<b>REPTILIA</b>			
<u>Chelydra serpentina</u>	K U	<u>Pituophis melanoleucus</u>	K R
<u>Terrapene ornata</u>	K C	<u>Lampropeltis calligaster</u>	N P
<u>Graptemys pseudogeographica</u> <sup>2</sup>	N H	<u>Lampropeltis getulus</u>	K U
<u>Chrysemys picta</u>	K R	<u>Lampropeltis triangulum</u>	K C
<u>Chrysemys scripta</u>	N H	<u>Thamnophis proximus</u>	N P
<u>Trionyx muticus</u>	N H	<u>Thamnophis radix</u>	N P
<u>Trionyx spiniferus</u>	N H	<u>Thamnophis sirtalis</u>	K U
<u>Crotaphytus collaris</u>	K C	<u>Tropidoclonion lineatum</u>	K R
<u>Sceloporus undulatus</u>	N H	<u>Storeria dekayi</u>	N P
<u>Phrynosoma cornutum</u>	K R	<u>Nerodia erythrogaster</u>	N D
<u>Scincella lateralis</u>	N D	<u>Nerodia rhombifera</u>	N H
<u>Eumeces obsoletus</u>	K C	<u>Nerodia sipedon</u>	K R
<u>Eumeces septentrionalis</u>	N D	<u>Agkistrodon contortrix</u>	K R
		<u>Sistrurus catenatus</u>	N I
		<u>Crotalus horridus</u>	N D

<sup>1</sup> K = Found on KPRNA; C = Common (10 or more observations); U = Uncommon (5-9 observations); R = Rare (1-4 observations).

N = Not found on KPRNA; H = Habitat not present; I = species may occur in isolated habitats; P = species possibly exist, habitat requirements seem appropriate; D = KPRNA at extreme margin of species distributional range (see Notes of Species Not Found).

<sup>2</sup> Occurrence in Riley County based on records in KSU Herpetology Collection, H. E. Klaassen, Instructor.



Table 2. Air temperature ranges of herpetile observations on the KPRNA. Temperatures were taken from weather station located near KPRNA headquarters.

Species 1983 (1 March-15 October)	Air Temperature Ranges (C)	
	UO <sup>1</sup>	IO <sup>2</sup>
<u>Bufo woodhousei</u>	---	24.9-26.3
<u>Acris crepitans</u>	---	13.4-40.7
<u>Pseudacris triseriata</u>	---	4.2-21.2
<u>Rana blairi</u>	---	4.2-40.7 39-105
<u>Rana catesbeiana</u>	---	13.4-40.7
<u>Gastrophryne olivacea</u>	14.3-17.7	---
<u>Chelydra serpentina</u>	---	24.5-40.0*
<u>Terrapene ornata</u>	---	19.6-29.5
<u>Chrysemys picta</u>	---	40.0*
<u>Crotaphytus collaris</u>	14.3-27.2	21.3-38.6
<u>Phrynosoma cornutum</u>	---	---
<u>Eumeces obsoletus</u>	14.0-31.0	17.4-30.5
<u>Ophisaurus attenuatus</u>	---	25.9
<u>Carphophis amoenus</u>	13.1-18.2	---
<u>Diadophis punctatus</u>	13.1-27.8	25.9
<u>Tantilla gracilis</u>	29.6	---
<u>Coluber constrictor</u>	21.4	19.2-28.3
<u>Elaphe guttata</u>	11.7-29.4	36.2
<u>Elaphe obsoleta</u>	17.2	25.6-29.8
<u>Pituophis melanoleucus</u>	---	---
<u>Lampropeltis getulus</u>	28.7	27.1-30.4
<u>Lampropeltis triangulum</u>	12.9-29.7	27.0
<u>Thamnophis sirtalis</u>	---	18.8-29.5
<u>Tropidoclonion lineatum</u>	18.6-27.3	24.7
<u>Nerodia sipedon</u>	---	28.3-34.8
<u>Agkistrodon contortrix</u>	---	---
1984 (Spring)		
<u>Scaphiopus bombifrons</u>	---	19.0
<u>Hyla chrysoscelis</u> - <u>Hyla versicolor</u> complex	---	19.0

<sup>1</sup>Species observed under an object, e.g. rock, log or other plant material.

<sup>2</sup>Species observed in the open.

\*Species observed in water.

Figure 1. Observed activity range of herpetiles on the KPRNA.

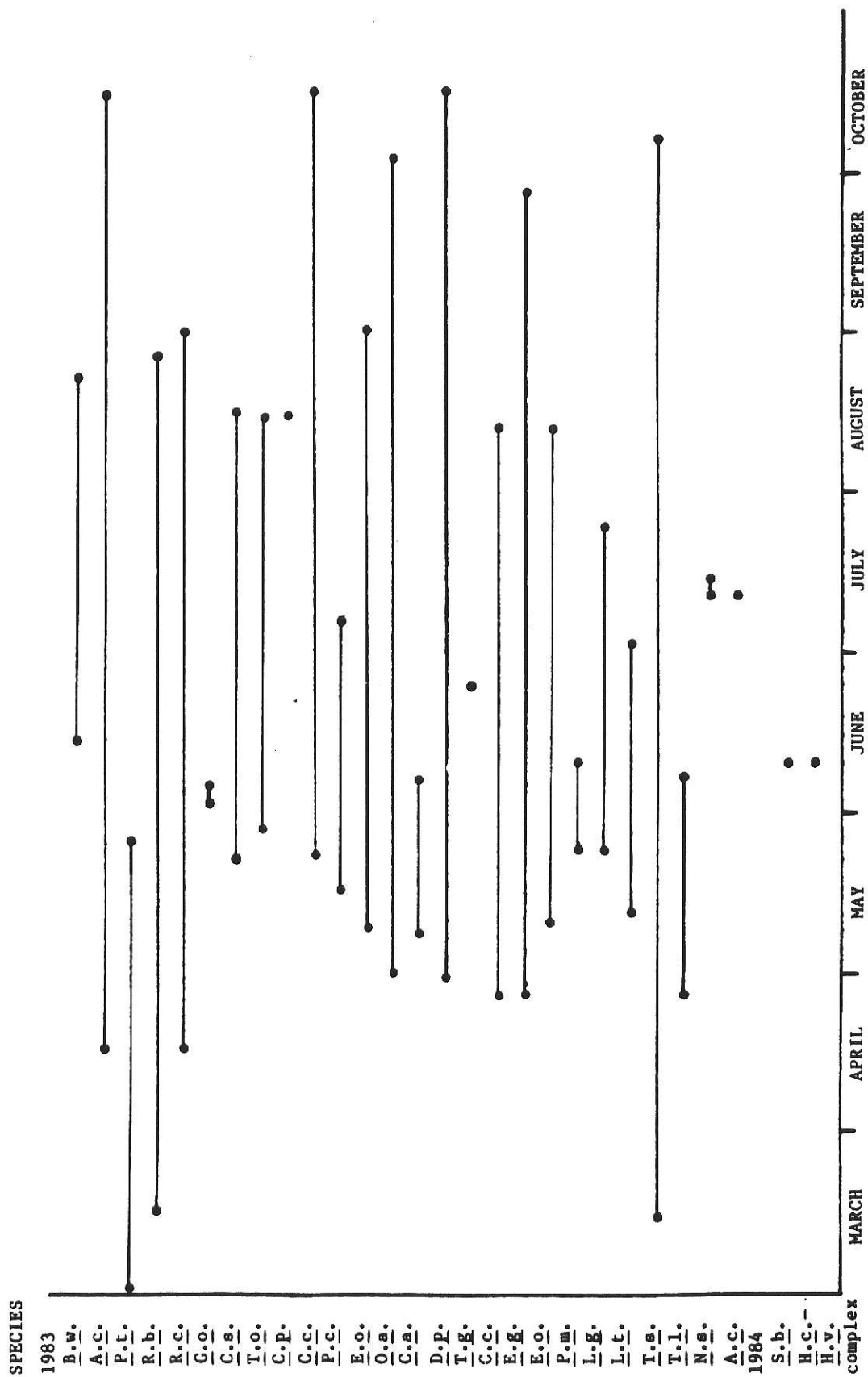


Table 3. Herpetiles observed at specific outcrop sites on the KPRNA.

Species	Grass outcrop		Shrub outcrop		Forest outcrop	
	minimum individuals	total observations	minimum individuals	total observations	minimum individuals	total observations
<u>Bufo woodhousei</u>	0	0	1	1	0	0
<u>Gastrophryne olivaceae</u>	0	0	0	0	2	2
<u>Terrapene ornata</u>	1	1	0	0	0	0
<u>Crotaphytus collaris</u>	1	1	6	23	4	32
<u>Eumeces obsoletus</u>	7	9	19	46	20	52
<u>Ophisaurus attenuatus</u>	0	0	0	0	2	2
<u>Carphophis amoenus</u>	0	0	0	0	3	3
<u>Diadophis punctatus</u>	2	3	9	12	7	7
<u>Tantilla gracilis</u>	1	1	0	0	0	0
<u>Coluber constrictor</u>	2	6	3	5	1	1
<u>Elaphe guttata</u>	0	0	4	4	5	12
<u>Elaphe obsoleta</u>	0	0	0	0	2	2
<u>Lampropeltis getulus</u>	0	0	1	1	1	1
<u>Lampropeltis triangulum</u>	1	1	5	5	3	5
<u>Tropidoclonion lineatum</u>	0	0	1	1	0	0
<u>Eumeces obsoletus total</u>	7	9	19	46	20	52
<u>Lizard total</u>	8	10	25	69	26	86
<u>Snake total</u>	6	11	23	28	22	31
<u>Herpetile total</u>	15	22	49	98	50	119

total numbers of observations were used in analysis of differences among the three outcrops. Herpetiles (Table 3) were not randomly distributed among the three sites ( $\chi^2 = 20.89$  d.f. = 2,  $p < 0.01$ ; expected observations should be distributed equally among the sites since the areas sampled were equal in size). As with all herpetiles, lizards and snakes revealed the same difference among the three outcrop sites, (lizards:  $\chi^2 = 10.41$ , d.f. = 2,  $p < 0.01$ ; snakes:  $\chi^2 = 10.71$ , d.f. = 2,  $p < 0.01$ ). The Great Plains skink, common enough to be examined separately, was the major determinant of the lizard pattern ( $\chi^2 = 6.83$ , d.f. = 2,  $p < 0.05$ ). Analysis of total herpetiles demonstrated no significant difference between the shrub and forest outcrops ( $\chi^2 = 0.02$ , d.f. = 1,  $p > 0.05$ ). Thus, the grass outcrop had significantly fewer herpetiles than the shrub and forest outcrops (G vs S + F:  $\chi^2 = 20.88$ , d.f. = 1,  $p < 0.01$ ). Again snakes and Great Plains skinks were major determinants of the differences between outcrops with and without woody vegetation (snakes:  $\chi^2 = 10.68$ , d.f. = 1,  $p < 0.01$ ; Great Plains skinks:  $\chi^2 = 6.79$ , d.f. = 1,  $p < 0.01$ ).

To accurately explain differences in numbers between the outcrop sites, one needs to carefully examine the ecological and evolutionary aspects of the systems - this was not done in the present study. One can, however, gain a feel for possible reasons why numbers are different through an understanding of life histories and ecological aspects of the systems.

Amphibians and reptiles are poikilothermic, thus thermoregulation is an important aspect to their survival. In general reptiles can withstand higher temperatures while amphibians require relatively lower optimal temperatures (Fitch 1956c) and amphibians are more prone to desiccation than reptiles and require habitats affording higher humidity regimes. It is

reasonable to assume that amphibians and reptiles have evolved physiological compatibilities with the climatic conditions of habitats containing ample resources for their existence.

Part of the difference in herpetile numbers from grass to wooded outcrops is probably due to the lack of ample resources coupled with the limitations of the physical environment and climatic conditions. Therefore physiological adaptations to dry grassland habitats have not sufficiently evolved in amphibians and some moisture dependent reptiles, hence the grassland outcrop habitat is probably too dry for most amphibian species and abundant numbers of moisture dependent reptiles.

Great Plains skinks are physiologically adapted to relatively dry habitats and even though climatic conditions probably play a part in controlling numbers of this species other factors need to be considered. For example, these lizards are sight oriented predators and even though insect resources may be abundant in grassland habitats, seeing these insects becomes a problem, therefore as habitats become more structurally complex with woody vegetation, foraging areas relating to sight distances should increase on the ground. This example is only one of the ecological factors that may partially explain the significant difference in Great Plains skink numbers between the grass and wooded outcrops.

For terrestrial amphibians and reptiles, the difference in species richness among outcrops was likely related to changes in physical environment and habitat structure brought about by the kinds and amounts of woody vegetation along an outcrop. The presence of woody vegetation should reduce temperatures leading to milder microclimates, increase the range of types of microclimate patches, and produce more complex habitat structure

which should increase foraging potential. The increased complexity of habitat structure on wooded outcrops should provide a greater range of microhabitat patches, containing a greater variety of food resources, than on non-wooded outcrops. Ultimately, this greater range of microhabitat conditions should support a greater array of terrestrial herpetiles if the range of conditions are within the general physical requirements of these species and if all other ecological factors are favorable for their existence. As a result, species diversity should increase with an increase in vegetation complexity from grass to shrubs to trees. Differences in species richness of herpetiles on the outcrops agree with this expectation (Grass outcrop = 7, shrub outcrop = 9, forest outcrop = 11).

#### AQUATIC HABITATS

All amphibian species were observed most commonly in ponds, streams or temporary rain pools on KPRNA. During spring evenings of 1984 Woodhouse's toads (Bufo woodhousei) were frequently heard calling from aquatic habitats and on 10 June, 1984 5 anuran species were heard calling from a temporary grassland pool beside the main graveled trail between a brome field and the tallgrass prairie proper on KPRNA. These 5 species included: 2 plains spadefoot toads (Scaphiopus bombifrons); 2 Woodhouse's toads; approximately 7 chorus frogs (Pseudacris triseriata); 2 gray treefrogs (Hyla chrysoscelis); and approximately 20 Great Plains narrowmouth toads (Gastrophryne olivacea). On this same evening bullfrogs (Rana catesbeiana) and cricket frogs (Acris crepitans) were heard calling from a cattail infested KPRNA pond. On 15 August 1983 many newly metamorphosed Woodhouse's toads, cricket frogs, and a few leopard frogs (Rana blairi) were observed near one KPNRA pond. On this same day several

hundred newly metamorphosed bullfrogs and many cricket frogs were observed in a KPRNA pond laden with floating algae mats.

The only aquatic snake found on KPRNA, the northern water snake (Nerodia sipedon), was observed only in streams, while the red-sided garter snake (Thamnophis sirtalis) was observed near marshy areas along the spring fed streams.

#### ANNOTATED SPECIES ACCOUNTS

The following are accounts of species found on KPRNA. Common and scientific names are according to Collins et al. (1982). North American ranges are from Behler and King (1979) and Kansas ranges are taken from Collins (1982). General life history characteristics are from Ballinger et al. (1979), Behler and King (1979), Bragg (1940a, 1940b), Burt (1927), Caldwell and Collins (1981), Clarke (1958), Collins (1982 and references there in.), Fitch (1956b, 1956c, 1958b, 1960, 1982), Hall and Fitch (1972), Hudson (1942), Jones et al. (1981), Legler (1960), Smith (1956) and Willis et al. (1956).

#### AMPHIBIA

##### Caudata - Salamanders

Ambystoma tigrinum (Tiger Salamander). The tiger salamander is the most widely occurring salamander in North America. It occurs from southern Canada, south to Mexico and Florida, but is absent in New England, the Appalachians and the far west. Two subspecies occur in Kansas A. t. mavortium (barred tiger salamander) and A. t. tigrinum (eastern tiger salamander) with the latter found on KPRNA. Larval tiger salamanders were not recorded during 1983 but were found in a KPRNA pond during 1974 and

1975 (H.E. Klaaseen, per. com.). The pond in which the observations were made was dry during the sampling period of this study. The terrestrial form of this salamander spends much of its time underground in caves or animal burrows where suitable moisture and temperatures exist. During summer rains, this species forages above ground at night.

Tiger salamanders breed successfully in shallow waters free of predatory fish from December to March. The length of the breeding season in Kansas is not known, but probably lasts from one to three months (Collins 1982). Up to 1000 eggs can be laid per female and eggs are deposited singly or in twos or threes on submerged weeds or sticks. Hatching occurs in a few weeks and some larvae metamorphose into adults and become terrestrial in their first or second summer, while others are neotenic in permanent pools carrying out their reproductive cycle in the larval stage. Larval or adult tiger salamanders will consume almost any animal small enough to be swallowed.

#### Salientia - Frogs and toads

Scaphiopus bombifrons (Plains Spadefoot). This toad ranges throughout the Great Plains from southern Alberta and Saskatchewan, southeast through Montana to Missouri and central Oklahoma, south through western Texas and eastern Arizona into Mexico. An isolated population also exists on the southern tip of Texas. The plains spadefoot is found throughout western Kansas, east into the Flint Hills, and into northeastern Kansas along the Kansas river. It prefers sandy and loose soils of prairies and cultivated fields. This nocturnal toad is active from April to September, spending the daylight hours underground. The spadefoot burrows by backing into the



ground using the single rigid spade on the inside of each hind foot to loosen soil. They also reside in small mammal burrows in northeastern Kansas. On 10 June, 1984 at 2230 hours, after large rains, two males were observed calling from a road side prairie ditch on KPRNA. The air temperature at this time was 19 C.

The plains spadefoot congregates in temporary breeding pools of open prairie or floodplains after warm, heavy spring rains. Breeding continues throughout the summer given the proper conditions. Females may lay up to 2000 eggs in clumps of 10-250 eggs which they attach to submerged vegetation. The time required for hatching and metamorphosis varies with water temperature, oxygen content and competition for available food between tadpoles. Apparently under crowded conditions tadpoles become cannibalistic (Collins 1982). A variety of insects are eaten by this species.

Bufo woodhousei (Woodhouse's Toad). This large toad occurs throughout most of the United States; B. w. woodhousei is common throughout Kansas and does well in a variety of habitats, including disturbed residential areas. It was observed near streams, ponds, in grassland, shrubby and forested habitats on KPRNA. The first sighting of this species was on 14 June and the last on 21 August. On 15 August, 1983 several young, newly metamorphosed Woodhouse's toads were seen near a KPRNA pond. Males were heard calling at night from late April through June 1984. Clarke (1958) found this toad to be active from 9 March to 8 October in Osage County, Kansas, with an observed activity temperature range of 14.4-29.4 C.

The Woodhouse's toad is an opportunistic breeder throughout its active season, taking advantage of suitable rainfall. It breeds in permanent and temporary waters especially in river flood plain areas. Up to 25,000 eggs are laid per female and the strings of eggs are attached to vegetation in shallow waters. This toad generally spends the day in hiding and forages at night on a variety of insects and spiders. It is capable of consuming two-thirds of its body weight in one day (Smith 1934).

Acris crepitans (Northern Cricket Frog). This cricket frog ranges from southern New York to the Florida panhandle, west to Texas and south eastern New Mexico, northward to Wisconsin and Michigan. A. c. blanchardi (Blanchard's Cricket Frog) occurs throughout Kansas and is common near streams and ponds on KPRNA. Fitch (1958b) observed this species invading woodlands and open areas when moist conditions with favorable humidities existed. Cricket frogs were observed on KPRNA from 29 April to 15 October in a temperature range of 13.4-40.7 C. Clarke (1958) observed an activity period from 14 February to 15 November with a temperature range of 5.6-37.8 C in Osage County, Kansas. This species has been observed at temperatures as low as 4.5 C in northeastern Kansas (Fitch 1956c). After a rain large breeding choruses were heard in KPRNA ponds on the night of 10 June 1984 at an air temperature of 19 C.

Blanchards cricket frogs breed from April to July in Kansas, warm weather permitting. During the breeding season, males can be heard calling near a variety of aquatic habitats from lakes and ponds to streams and roadside ditches. Eggs are laid singly or in small clumps of 2-7 and up to 400 eggs may be laid per female. Eggs hatch after 3-4 days and

metamorphosis occurs within 5-10 weeks. Approximately 50 newly metamorphosed individuals were seen on the KPRNA near a mostly dried pond on 15 August, 1983. This relatively small frog eats a variety of insects and small spiders. Jameson (1947) found that bottom dwelling aquatic insects were also among the prey of this species. Because of this, he postulated that adult frogs fed underwater as well as on the surface or out of water.

Pseudacris triseriata (Striped Chorus Frog). The large range of this species extends from Alberta, Canada to northern New York (excluding New England, the northern Appalachians and the southern coast), south to Georgia and west to Arizona. The subspecies P. t. triseriata (Western Chorus Frog) is found throughout the eastern two-thirds of Kansas, west into the northern high-plains. It has not been reported from southwestern Kansas. This species is found in a variety of habitats from grasslands to forested areas where moist conditions exist. In marginal habitats or in times of harsh weather extremes these frogs seek refuge underground. On KPRNA the western chorus frog is easily observed in early spring while chorusing in ponds and slow moving waters of spring fed streams throughout the tallgrass prairie habitats on KPRNA. During the hot, dry summer months, however, it is rarely encountered. The western chorus frog was the first species heard calling on KPRNA and was first observed on 1 March and lastly on 25 May, 1983 across a temperature range from 4.2-21.2 C. On 10 June, 1984 at 2230 hours several males were observed calling from a grassy roadside ditch on KPRNA at an air temperature of 19 C.

Breeding of this species occurs mainly in March and April, but occasional breeding takes place during periods of heavy summer rains. A female may lay 100-1500 eggs on submerged plant stems. Eggs are deposited in clumps of 20-300 and generally hatch within 2 weeks. Tadpoles metamorphose within 2 months. On the morning of 14 March, 1983 a male and female western chorus frog were collected from a temporary KPRNA spring fed, grassland stream and placed along with water, and dead grass into a glass jar. Upon returning to the lab that afternoon, the frogs were in amplexus and the female was in the process of laying eggs. Four egg masses resulted - containing 294 eggs. The dead grass substrate along with eggs were placed in a 38 l (10 gal) aquarium containing approximately 9 cm of water. The water was aerated and ranged in temperature from 17-25 C with a mean of 21 C. Tadpoles were first noticed on 19 March and no more hatched after 22 March. Twenty tadpoles hatched and the remaining eggs appeared infertile and soon began to deteriorate. On 14 April fifteen were yet alive and 3 of those were preserved on 20 April. On 29 April small appendages were apparent on tadpoles. By 25 May, four had completely metamorphosed and others were in the last stages of metamorphosis. All were preserved on 26 May. The western chorus frog feeds mainly on small insects.

Hyla chrysoscelis (Cope's Gray Treefrog) - Hyla versicolor (Gray Treefrog) complex (Collins 1982). These two species have overlapping ranges and are indistinguishable in appearance. They occur from southern Ontario and Main to northern Florida west to central Texas, north through Oklahoma to Manitoba. In Kansas the gray treefrog is found in the eastern third of the state with KPRNA on the extreme western margin of its range. This

arboreal frog prefers woodland and woodland edge habitats where it calls from trees and shrubs on moist warm nights. Male gray treefrogs are territorial and encounter calls and fighting occur when ones territory has been invaded. After heavy rains two males were observed calling from a roadside prairie ditch on KPRNA on 10 June, 1984. This observation was at 2230 hours with an air temperature of 19 C and the collected male was green in color. The gray treefrog is the only amphibian in Kansas that can change its color completely from gray to brown to green to better blend with its surroundings (Collins 1982). This frog can withstand high temperatures with no ill effects. Fitch (1956c) recorded activity at temperatures up to 30 C in northeastern Kansas while Clarke (1958) found this species active in a temperature range of 15-31 C from 12 May through 28 July in Osage County, Kansas.

The gray treefrog breeds in temporary or permanent waters from April to July in Kansas, providing temperatures are above 15 C. Preferred breeding sites are waters surrounded by trees and weedy vegetation, but evidence from this study shows that breeding in open grassland pools is possible. Females lay up to 3800 eggs in small floating masses. After 4-5 days, eggs hatch and tadpoles metamorphase into frogs within two months. The gray treefrog eats a variety of insects.

Rana blairi (Plains leopard Frog). This species ranges from central Nebraska to Illinois and the western edge of Indiana, south to Kansas and into Texas and north to eastern Colorado. The Plains leopard frog occurs throughout Kansas and can be found in virtually all permanent or temporary aquatic habitats. It has also been observed long distances from aquatic

situations. Lynch (1978) suggested this frog occurs predominantly in silt laden rather than clear streams of Nebraska. This species was common on KPRNA and was observed near ponds and streams. On 16 March, 1983 at an air temperature of 4.2 C, several dead leopard frogs and one immobile live individual were found in a grass bordered stream on KPRNA. Fitch (1956c) also observed this species during the winter months.

The Plains leopard frog breeds throughout its active season as long as adequate rainfall permits. Up to 6500 eggs are produced per female which hatch within three weeks. Metamorphosis may take place in the first summer or tadpoles overwinter and metamorphose their second summer. Non-aquatic insects make up the majority of this frogs diet.

Rana catesbeiana (Bullfrog). The bullfrog occurs in the central and eastern United States up into New Brunswick and parts of Nova Scotia. It did not originally occur, but has been extensively introduced into the western United States. It occurs throughout Kansas in permanent deep waters of streams, rivers, lakes, ponds and swamps. This large frog is common on KPRNA especially in ponds. Only a few were observed in streams probably because of its requirements for deep permanent aquatic habitats. The bullfrog was first observed on 16 April and lastly on 30 August, 1983 at a temperature range of 13.4-40.7 C on KPRNA. On 15 August, 1983 several hundred medium sized bullfrogs were observed in a KPRNA pond laden with large floating algae mats.

This species is less cold tolerant than other frog species, thus it is a much later breeder. Breeding takes place from late April into July and males are territorial in defense of breeding sites. Forty thousand eggs may

be laid by a single female. Eggs hatch in 4 or 5 days and tadpoles remain in the larval state from 3 to 14 months before metamorphosis. The bullfrog's diet varies widely. It consumes an array of terrestrial and aquatic vertebrates and invertebrates.

Gastrophryne olivacea (Great Plains Narrowmouth Toad). This toad occurs in a band from southeastern Nebraska and western Missouri through Kansas, Oklahoma and Texas into Mexico, west through northern Mexico into south central Arizona. It occupies the eastern two-thirds of Kansas and Fitch (1956a) described the optimal habitat for this species in northeastern Kansas to be that of rocky slopes in open woods. This species has also been observed in flood plains and cultivated fields. Because of its secretive habits, spending most of its time underground, it is rarely seen. In 1983 two specimens were found under rocks on KPRNA, one on 2 June, in gallery forest edge habitat and the other on 5 June, in the gallery forest. Air temperature of these observations were 14.3 C and 17.7 C respectively. On 10 June, 1984 at 2230 hours around 25 males were heard calling from a temporary roadside puddle surrounded by grassland habitat on KPRNA.

This small toad is an opportunistic breeder cueing on warm temperatures and adequate rainfall. A female can lay up to 600 eggs which hatch in two days and metamorphosis takes 20-30 days. The Great Plains narrowmouth toad forages beneath the soil surface and feeds almost exclusively on ants.

## REPTILIA

## Testudines - Turtles

Chelydra serpentina (Snapping Turtle). The snapping turtle is found from southern Alberta to Nova Scotia, south to the Gulf of Mexico. The subspecies C. s. serpentina (Common Snapping Turtle) is found throughout Kansas with least abundance in the western one-third of the state. It thrives in most aquatic habitats, with a preference for waters with soft mud bottoms, laden with logs and branches and abundant edge vegetation. It spends a lot of time half buried in mud bottoms of aquatic habitats, but will travel some distances to other bodies of water. Six observations were recorded in streams and ponds on KPRNA at an air temperature range of 24.5-40.0 C. The first observation was on 22 May and the last on 15 August. Clarke (1958) recorded first and last observation dates as 1 May and 9 August respectively, in Osage County, Kansas.

In Kansas these turtles generally mate between April and November, warm weather permitting. Courtship and breeding takes place underwater and two clutches may be produced each year. Twenty-five to thirty eggs are laid in land nests, dug by the female, near or some distance from water. The common snapping turtle eats aquatic plants, insects, crayfish and other invertebrates as well as almost any vertebrate, dead or alive, that happens to be available.

Terrapene ornata (Western Box Turtle). This turtle ranges from southern South Dakota, Iowa and eastern Illinois, south to Louisiana and Texas and west to southwestern Arizona, with a separate population



occurring in northwestern Indiana and adjacent Illinois. The subspecies T. o. ornata (Ornate Box Turtle) is abundant throughout Kansas, with its greatest abundance in the western open prairie. It also does well in open woodlands, natural breaks and the grasslands of eastern Kansas. This turtle is generally considered terrestrial but Clarke (1950) observed several individuals in aquatic habitats. On KPRNA, this diurnal animal was observed 20 times, most often in open grassland habitat and along trails. The first sighting was 28 May and none were recorded after 14 August. The temperature range observed for this species was 19.6-29.5 C. Clarke (1958) observed this species from 1 April to 24 October through a temperature range from 12.8-38.9 C in Osage County, Kansas.

Ornate box turtles generally breed in the spring and fall, but summer breeding also occurs. Females dig a nest and lay 2-8 eggs from May to July with June being the most common month for nesting (Legler 1960). Ornate box turtles have well traveled homeranges in which several preferred feeding sites occur. Food consists of an array of insects, dead vertebrates, berries and other fruits.

Chrysemys picta (Painted Turtle). The painted turtle is found from British Columbia to Nova Scotia, south to Georgia, west to Louisiana, north to Oklahoma, and northwest to Oregon. A few isolated populations also exist in the southwestern United States. Distributed throughout Kansas is the subspecies C. p. belli (Western Painted Turtle). This aquatic turtle thrives in slow moving or stationary bodies of water. Basking is an important biological aspect to the survival of these diurnal animals therefore, sufficient habitats with partially submerged logs and branches

are preferred. Two specimens were seined from a KPRNA pond on 15 August. This species probably exists in other ponds on KPRNA and possibly in deep slow moving pools along Kings Creek. Clarke (1958) observed this turtle from 8 April through 11 November in Osage County, Kansas.

Courtship and copulation generally occur from March to June and infrequently into the summer. Clutch size ranges from 4-20 eggs and the female nests from May to July. The eggs may hatch after approximately two months of incubation or not until cold weather arrives in late fall (Collins 1982). Young western painted turtles are mainly carnivorous while adults live on dead or living plant and animal material.

#### Squamata (Sauria)-Lizards

Crotaphytus collaris (Collared Lizard). This species exists from eastern Utah and Colorado to southwestern Illinois, south through central Texas, into Mexico and west into central Arizona. The subspecies occurring in Kansas C. c. collaris (Eastern Collared Lizard) is restricted to the central and southeastern part of the state. It is found in rocky areas of open and wooded habitats. This diurnal lizard is common on KPRNA and was mostly recorded in gallery forest edge habitat along limestone outcrops, but was also observed along limestone outcrops contained in shrubby and grassland habitats. Compared to other Kansas reptiles, the collared lizard requires high temperatures at an optimal range of 22.8-33.9 C for its activity. At a temperature of 10 C it is completely helpless (Fitch 1956b). Adults are generally active from April through September while young are capable of activity into October. This lizard species was observed 68 times

on KPRNA at a temperature range from 14.3-27.2 C. Adults were observed from 23 May - 17 August, while juveniles were observed up to 15 October.

This fast moving lizard breeds during May and June and sexual dimorphism affords sexual display by the male of this species. The duller looking female develops orange spots or bars on her side while pregnant. The eastern collared lizard is an aggressive, territorial species and aggressiveness in males and females peaks in June at the time of oviposition in Pottawatomie County, Kansas (Yedlin and Ferguson 1973). Within three weeks of mating, 2-21 eggs are deposited under the soil surface and two to three months later the eggs hatch. Two clutches per season may be produced. The eastern collared lizard detects prey by sight and feeds mainly on insects. Smaller lizards are occasionally consumed and an instance of preying on a young Sigmodon hispidus (cotton rat) was reported in Arkansas by McAllister and Trauth (1982).

Phrynosoma cornutum (Texas Horned Lizard). The Texas horned lizard is found from Kansas to Texas and west to southeastern Arizona. An isolated population occurs in Louisiana and introduction has taken place in northern Florida. This lizard occurs across the Southern part of Kansas northwestwardly into the northcentral part of the state. This diurnal species inhabits dry areas with rocky, sandy or loamy soils supporting sparse vegetation. Three specimens were observed on KPRNA between 16 May and 6 July. Two on the main graveled trail of KPRNA and one in upland tallgrass prairie habitat.

It is thought that mating does not occur before May or June in Kansas and courtship has not been studied in this species. Collins (1982) reported

an average clutch size in Kansas of 22 eggs. Ballinger (1974) found that reproductive activities began in April and stopped in mid-July in Texas. Clutch size averaged 29 in his study. The Texas horned lizard consumes mainly ants, but also feeds on small insects and spiders.

Eumeces obsoletus (Great Plains Skink). This skink ranges from southeastern Wyoming, southern Nebraska and southwestern Iowa through the Great Plains to central Arizona, Mexico and westcentral Texas. Across this range, the Great Plains skink occurs in an array of habitats from mixed woodland and prairies to deserts. This skink, the largest of the genus Eumeces, is found throughout Kansas mainly inhabiting open rocky hillsides with low vegetation. This lizard was observed 123 times making it the most frequently encountered herpetile in the areas searched on KPRNA. Among the outcrop sites, the Great Plains Skink was observed most frequently along the limestone outcrop associated with gallery forest (see Table 3 in Results and Discussion). This lizard was first observed on 9 May and none were seen after 31 August. Observations were in a temperature range of 14.0-31.0 C. In northeastern Kansas Fitch (1955) noticed this diurnal species to be most active at temperatures in the thirties (C). Some individuals of this species have relatively small home ranges while others wander fairly long distances. Fitch (1955) recorded a maximum movement of 152.4 m over 14.5 months for an individual skink. One individual moved 150 m in one night, along the forest outcrop on KPRNA.

In Kansas, Great Plains skinks breed in May although not all mature females breed each year. Around 11 eggs are laid in burrows beneath large rocks and the female guards the eggs during the one to two month incubation

period. On 6 July, 1984 a female with a clutch of 19 eggs was discovered under a rock in forest edge habitat on KPRNA. After hatching the young are reproductively immature for several years. Various invertebrates make up the natural diet of these animals, but in captivity these skinks will consume vertebrates such as small rodents and lizards (Hall 1972).

Ophisaurus attenuatus (Slender Glass Lizard). This legless lizard ranges along the east coast from Virginia to Florida, west into Texas, Oklahoma, Kansas and Nebraska, north to southern Wisconsin, and Illinois. The range of O. a. attenuatus (Western Slender Glass Lizard) in Kansas is poorly defined. It is known to occur in the eastern one-third of the state and patchy observations have been made in central Kansas.

This secretive lizard is mainly diurnal but has been known to be active at night (Collins 1982). Preferred habitats include open grassland prairie, and woodland edge near streams or ponds. When confronted, this lizard quickly escapes in tall grasses or into small mammal burrows. Four individuals were found on KPRNA. Two of these observations, one based on an autotomized tail, were found in gallery forest edge habitat along the forest outcrop. One was collected after perishing in a grassland prairie fire and the other was a road kill found on the main trail of KPRNA by a brome grass field. The first observation was 30 April and the last on 2 October. The live individual observed, was active at a temperature of 25.9 C. These lizards mate in May and a clutch from 6-17 eggs is laid in June or July. Sexual maturity in this species is reached at three to four years (Collins 1982). The western slender glass lizard feeds on a variety of insects, spiders, snails and also eats reptile eggs.

Squamata (Serpentes)-Snakes.

Carphophis amoenus (Worm Snake). This small snake is found from southern New England to central Georgia, west to southeastern Nebraska, eastern Kansas, eastern Oklahoma and northeastern Texas. In Kansas, C. a. vermis (Western Worm Snake) is found only in the eastern one-third of the state. It has not been found beyond the western edge of the Flint Hills region in Kansas. This fossorial snake is found under limestone rocks and in the damp soil of forested or partly forested hillside habitats as well as forest edge habitats. Four individuals were found under limestone rocks in forested areas of KPRNA at an air temperature range of 13.1-18.2 C from 8 May to 6 June. As the summer becomes dryer and hotter these snakes are harder to find. This may partially explain the low numbers encountered on KPRNA. Clark (1970) studied the ecology of this snake in northeastern Kansas and reported an activity period from 1 April to 20 October with concentrated activity in April, May and June.

The western worm snake mates in the spring and fall and an average clutch of 2-3 eggs is deposited in underground burrows in June or July. The eggs generally hatch sometime in August. Food for this species consists only of earthworms in northeastern Kansas.

Diadophis punctatus (Ringneck Snake). The range of this snake extends from Nova Scotia to the Florida Keys, west to the Pacific coast and south into central Mexico. D. p. arnyi (Prairie Ringneck Snake) is found throughout Kansas with its greatest abundance in the forested eastern third of the state. It is readily found under rocks in forested areas and

occasionally large aggregates can be found under a single rock. This aggregative behavior seems to be related to olfactory cues laid down by snakes in route to the site of aggregation (Dundee and Miller 1968). This snake is dependent on moisture and requires water frequently. Prairie ringneck snakes were found from 29 April through 15 October in forested, shrubby and grassland habitats on KPRNA. All but two of the 33 observed were found under rocks. These snakes were encountered at temperatures of 13.1-27.8 C. During the hot dry days of summer, this snake was rarely found. In northeastern Kansas Fitch (1975) estimated this species to number 719-1849 snakes per hectare.

These small snakes breed in spring after emerging from hibernation. An average clutch of four eggs is laid, sometimes in a communal nest, in June or July and hatching occurs in August or September. Prairie ringneck snakes partially constrict their prey and mainly feed on earthworms but have also been reported to consume insect larvae, small frogs, and hatchling snakes. Fitch (1975) found a hatchling lizard in the stomach of one of these snakes.

Tantilla gracilis (Flathead Snake). This small opisthoglyph snake is found in southwestern Illinois to eastern Kansas south through Oklahoma and Arkansas to eastern Texas and slightly into Mexico. This species exists in the eastern third of Kansas with Riley and Geary counties lining the western edge of its occurrence. It has been found in open prairie and forested areas in Kansas from April to October. Little is known of its daily habits other than it may be nocturnal (Smith 1956). Only one specimen was collected on KPRNA. It was found on 24 June under a limestone rock on a

south facing grass slope. Air temperature at the time of capture was 29.6 C.

The flathead snake mates in May and a clutch of 1-4 eggs is laid in June or July. The eggs hatch sometime in September. Food consists of earth dwelling insect larvae, such as cut worms, wireworms and crane fly larvae (Force 1934). The flathead snake also feeds on centipedes, slugs and sow bugs.

Coluber constrictor (Racer). This widely occurring snake is found in every state of the contiguous United States except for Alaska. The subspecies C. c. flaviventris (Eastern Yellowbelly Racer) is found throughout Kansas and has been extensively studied in northeastern Kansas by Fitch (1963b). He found it occupying open grasslands in areas constituting native species and areas of introduced species. He also observed this species in brushy areas in ravines, at woodland edges and in riparian thickets; weedy fields; and open type woodlands. This snake is rarely seen in forested areas except before or after hibernation in fall or spring. On KPRNA this agile snake was observed 29 times and 12 of those observations were of individuals who succumbed to a controlled prairie fire on the afternoon of 26 April. This was the first sighting of this species with none after 12 August. Fitch (1963b) and Clarke (1958) reported activity periods from April to November and 26 March to 23 October, respectively, in eastern Kansas. The observed temperature range on KPRNA spanned from 19.2 to 28.3 C.

The eastern yellowbelly racer mates in spring after emerging from hibernation and eggs are laid from mid to late summer. Two to three months



of incubation are required before hatching. Clutches range in size from 7-31 eggs (Fitch 1963b) and occasionally females deposit eggs in communal nests. This diurnal snake moves with its head above the substrate in search of prey. It feeds on a wide variety of insects, small snakes, lizards, frogs, birds and small mammals (Fitch 1963b).

Elaphe guttata (Corn Snake). This species is found in southern New Jersey, south through Florida and southern Tennessee to Texas, Mexico, and eastern New Mexico, southwestern Colorado, southeastern Nebraska to southwestern Illinois. An isolated population occurs in eastern Utah and western Colorado. E. g. emoryi (Great Plains Rat Snake) occurs throughout Kansas with least abundance in the arid western portion of the state as well as some of the southcentral to southeastern counties in Kansas. It is found in forest edge and open forest habitats as well as around barnyards and abandoned farm houses. On KPRNA most observations occurred in forest edge habitat, but sightings were also recorded in shrubby and grassland habitats. One young individual was observed eight consecutive days under the same rock along the gallery forest outcrop. Apparently the snake was undergoing the process of ecdysis because clouded eyes were observed several days after first discovering the snake. In the same fire that killed the racers (see preceding account), eleven adult Great Plains rat snakes also perished. Throughout this study 34 observations were recorded from 26 April to 26 September at temperatures from 11.7-29.4 C.

This snake mates from March to May and clutches of 3-21 eggs are laid from late May to July. Hatching occurs from July to September. The Great Plains rat snake is a constrictor and feeds on small vertebrates such as

mice, rats, birds and bats. The author has observed this species eating frogs in captivity.

Elaphe obsoleta (Rat Snake). This snake is found in the eastern half of the United States up into eastern Ontario, Canada. E. o. obsoleta (Black Rat Snake) occurs in eastern Kansas and generally inhabits deciduous forest habitats, although in northeastern Kansas it has been found to occupy mesic and xeric woodlands, woodland edges, and brushy fields (Fitch 1963a). This species was sighted 11 times from 10 May to 11 August in the gallery forest, forest edge and in and around buildings near headquarters on KPRNA. Observations were made at temperatures from 17.2 to 29.8 C.

The Black rat snake generally breeds from April to June, but occasionally at any other time throughout its active season. Females generally produce their first clutches late in their fourth year of life (Fitch 1963a). Eggs are deposited in or under logs or under rocks during June and July. Clutch size ranges from 6-30 and hatching occurs within one to two months. This constrictor with its arboreal habits feeds on birds, small mammals, lizards and frogs. A large male (snout to tail length (STL) = 1.73 m) taken from the manager's chicken house on KPRNA defecated a mass of broken egg shells. Plumber (1977) reported the black rat snake preying upon swallows in colonies along steep river banks of the Kansas River near Lawrence, Kansas.

Pituophis melanoleucus (Gopher Snake). This large snake is found in southern New Jersey, western Virginia, southern Kentucky, Wisconsin, southwestern Saskatchewan, southern Alberta and southcentral British

Columbia south to southern Florida, eastcentral and westcentral Mexico and the tip of Baja, California. The subspecies P. m. sayi (Bullsnake) is common throughout Kansas in open grasslands, open woodlands, woodland edge and especially grazed pasture and cultivated fields. Three road kills of this species were found beside cultivated fields near the west entrance of KPRNA from 24 May - 9 June. This snake is normally active from April to November above an air temperature of 15.6 C but winter activity in Kansas has also been reported (Collins 1974, McDowell 1951, Parks 1969). This species is generally diurnal in its activities, but may be active at night during extremely hot weather.

Breeding takes place in the spring and females lay an average of 12 eggs beneath large rocks or logs or in underground burrows from June to August. Hatching generally occurs after two to three months of incubation. The bullsnake has been held in high regard, economically, as a most beneficial animal because of its consumption of grain eating rodents. Killing its prey by constriction, it feeds on pocket gophers and exhibits distinct excavative behaviors upon encountering a gopher mound (Carpenter 1982). Food also consists of rats, mice, ground squirrels, rabbits and periodically birds and bird eggs. Maxon (1981) observed a bullsnake preying on a robin nestling and egg in a bur oak tree on the Cedar Creek Natural History Area in Anoka County, Minnesota.

Lampropeltis getulus (Common Kingsnake). This snake is found in the southern half of the United States into northern Mexico. Kansas is an area of integration between L. g. holbrooki (Speckled King Snake) and L. g. splendida (Desert King Snake) (Blaney 1977). Habitats described by Collins

(1982) include most areas of open woodland, woodland edge or lowlands and he goes on to say they have been found in open prairie. On KPRNA, only two of the nine individuals found were not in open grassland habitat. One was found in forest edge habitat and the other in shrubby habitat. The others were observed or caught in Sherman live traps in small mammal trapping areas on the open prairie of KPRNA, suggesting that the preferred habitat of this species is open grassland at least on KPRNA. During this study, it was observed from 24 May - 24 July at a temperature range of 27.1-30.4 C. Clarke (1958) reported this snake active from 16 April - 8 October in Osage County, Kansas.

Like most other snakes in Kansas, the common kingsnake mates in spring and eggs are laid in the summer months. A gravid female collected by the autor in Butler County laid 6 eggs on 21 July, 1981. All eggs hatched on 25 September, 1981. This constricting species, preys upon small mammals, birds, lizards, other snakes (including venomous species), and bird and reptile eggs. It was observed preying upon the eggs of Coluber constrictor flaviventris (Eastern Yellowbelly Racer) on KPRNA during the course of this study.

Lampropeltis triangulum (Milk Snake). This tri-colored snake occurs in southeastern Maine, southwestern Quebec, southeastern and southcentral Ontario, southern Wisconsin, and central and southeastern Minnesota south through most of the United States east of the Rocky Mountains and in Mexico south to Columbia and Venezuela. Two subspecies occur in Kansas, L. t. gentilis (Central Plains Milk Snake) in the western and central part of the state and L. t. sypila (Red Milk Snake) in the extreme eastern part of the

State. KPRNA lies in an area of integration between these two subspecies (Collins 1982). In northeastern Kansas Fitch and Fleet (1970) found this snake inhabiting areas of "open woodland or woodland edge, with grass or other vegetation kept short by grazing, and an abundant supply of flat rocks or similar shelter." Most of the 13 observations of this species on KPRNA were in forest edge or shrubby habitats although one was observed in open grassland habitat at an air temperature of 27.0 C. This snake rarely basks in the open, but thermoregulates in conjunction with the under-surface of sun heated flat rocks. All but the grassland observation were noted under rocks. This snake was first observed on 12 May and none were found after 2 July. These observations occurred at temperatures from 12.9-29.7 C. Clarke (1958) observed this species from 13 April to 7 July in Osage County, Kansas.

This secretive snake mates in spring and 5-6 eggs are laid during June or July in Kansas. Eggs hatch from August to September. Milk snakes constrict their prey and feed on small mammals, birds, lizards and snakes (including venomous species).

Thamnophis sirtalis (Common Garter Snake). This snake ranges across southern Canada and the United States from coast to coast but is absent in the desert regions of southwestern United States. In Kansas, the subspecies T. s. parietalis (Red-Sided Garter Snake) occurs mainly from westcentral to the eastern edge of the state and has been found in almost all habitats present, with a preference for areas with moist vegetation. It was observed in cultivated fields, open grasslands, shrubby habitats, and in marshy areas near spring-fed grassland streams on KPRNA. Nine observations of this

species were made at temperatures of 18.8-29.5 C from 15 March - 6 October on KPRNA.

The red-sided garter snake is ovoviviparous. It breeds from late March to early May and occasionally in the fall. Young are born in late summer to early fall. Fitch (1965) reported a brood size of 4-29 with a mean of 14.5 based on egg counts from palpating abdomens of 132 females. Sometime between 2 August - 7 August 1983 a captive female collected on KPRNA gave birth to 35 young, 8 of which were dead. Of the live individuals, 15 were female and 12 male. Boyer (1941) and Martof (1954) recorded litter sizes in T. s. sirtalis of 27 and 85 respectively. This snake feeds mainly on frogs and earthworms and sometimes eats toads, salamanders, small mice and small snakes. Young of the brood observed by the author, fed voraciously on minnows placed in their water bowl while their mother ate bullfrogs and green sunfish.

Tropidoclonion lineatum (Lined Snake). The lined snake is found from southeastern South Dakota, south to southcentral Texas; west through the Oklahoma panhandle to central Colorado and northeastern New Mexico. Isolated populations also occur in Illinois, Iowa, Missouri and New Mexico. Three subspecies described by Ramsey (1953) occur in Kansas: T. l. lineatum (Northern Lined Snake), T. l. annectans (Central Lined Snake) and T. l. texanum (Texas Lined Snake). Intergrades of these subspecies occur throughout Kansas (Collins 1982) on rocky grassland slopes, forest edge and under debris in residential areas. Three specimens were found on KPRNA: one under a rock, on the shrubby limestone outcrop at a temperature of 18.8 C on 16 May; one on the road between two brome grass fields on 7 June at a

temperature of 27.3 C; and the remains of one was found after a controlled prairie fire on 26 April. This species was observed from 18 April - 1 October in Osage County, Kansas (Clarke 1958).

This snake breeds before and after hibernation and two to twelve young are born in August. Sexual maturity is reached after two years. This species feeds mainly on earthworms.

Nerodia sipedon (Northern Water Snake). This snake occurs from Maine to the coast of North Carolina, northwestern South Carolina, and Georgia to southern Alabama and eastern Louisiana, west to eastern Colorado and northeast through Minnesota to southern Ontario and Quebec. The subspecies N. s. sipedon is found throughout Kansas in aquatic habitats such as streams, rivers, marshes, ponds, and lakes. It spends a great deal of time sunning on branches hanging over such aquatic habitats. Some individuals of this species leave their summer habitat and travel to woodland limestone outcrop sites to hibernate. Compared to other Kansas snakes, this species is capable of remaining active at lower temperatures. Collins (1982) stated that 25 C was the optimal temperature for this species. On KPRNA this snake was observed four times in fast flowing streams at an air temperature range of 28.3-34.8 C. Like other snakes the northern water snake is diurnal during the cool periods of its active season and becomes nocturnal during hot periods.

This snake breeds from April to June after emergence from hibernation and 8 to 46 young are born from August to October. The northern water snake feeds on fish, frogs, toads, salamanders and occasionally small mammals.

Agkistrodon contortrix (Copperhead). This venomous pit viper is found from southwestern Massachusetts west to extreme southeastern Nebraska south to the Florida panhandle and southcentral and western Texas. The subspecies A. c. phaeogaster (Osage Copperhead) is found in eastern Kansas with Riley and Geary Counties along the western edge of its range. This species is generally associated with deciduous forests and Fitch (1960) found copperheads most frequently along rock ledges of forested areas in northeastern Kansas. One specimen was found on 2 July by E. J. Finck on the graveled road near the western entrance of KPRNA between a wheat field and a wooded waterway. No others were found during the course of this study.

This snake generally breeds from April to May but mating occurs through August. Young numbering from 1-14 are born in August through October. Females are suspected to give birth every other year and aggregative behavior in pregnant females has been observed (Fitch 1960 and references there in). The osage copperhead has a varied diet of small rodents, frogs, toads, lizards, birds, other snakes and insects. The young of this species are equipped with a yellow-tipped tail sometimes used to lure prey.

#### NOTES OF SPECIES NOT FOUND

Some herpetiles are known to be absent from areas because of a lack of suitable habitats, while others are not found in areas with what seem to be favorable habitats. The latter phenomenon has yet to be fully understood and commonly lends itself to speculation. The following is a discussion



dealing with species recorded for Riley and Geary counties but not collected on the KPRNA.

Four turtle species, Graptemys pseudogeographica (False map Turtle), Pseudemys scripta (Slider), Trionyx muticus (Smooth Softshell) and Trionyx spiniferus (Spiny Softshell) were not found on the KPRNA. This absence is due to lack of habitat, since these turtles generally inhabit rivers and associated permanent waters which are non-existent on KPRNA.

Sceloporus undulatus (Eastern Fence Lizard) seems to be scarce in the Flint Hills region of Kansas (Collins 1982). Ferguson et al. (1980) stated that this species is virtually absent from eastern Kansas except for a few isolated populations, one of which they discovered on the Kansas River shore in Pottawatomie County. This lizard thrives mainly in low, sandy regions, and along limestone outcrops in western Kansas. These habitat types do not occur on KPRNA.

The two species of hognose snakes Heterodon nasicus (Western Hognose Snake) and Heterodon platyrhinos (Eastern Hognose Snake) are found most commonly in relatively open disturbed habitats (Platt 1969) and their occurrences in some areas of Kansas are spotty. One western hognose snake and five eastern hognose snakes have been collected in Riley County while only reports, with no existing specimens, have occurred in Geary County. C. C. Smith has observed this genus on KPRNA and the species observed was most likely Heterodon platyrhinos. Because of habitat constraints, the eastern hognose snake is probably very rare on KPRNA, and most likely the western hognose snake does not exist.

Lack of habitat probably also excludes Nerodia rhombifera (Diamondback Water Snake). This large snake mainly inhabits permanent

lakes, marshes, swamps and the backwaters of rivers (Collins 1982). These aquatic habitats are non-existent on KPRNA.

Cnemidophorus sexlineatus (Six-lined Racerunner) may occur in isolated areas of KPRNA. Fitch (1958a) stated that, "The racerunner does not thrive in a typical prairie habitat, either of tallgrass type or of shortgrass. Where it occurs in prairies, it requires patches of open ground such as are produced by excessive grazing or trampling (especially about salt licks or watering places of livestock) or such as occur naturally, along eroded gully banks and stream edges or on slopes and hilltops where soil is shallow and rocky, and vegetation is sparse." This species may have widely occurred in the area, prior to the purchase of KPRNA, when grazing was more intense. Now, grazing is minimal and most areas of KPRNA are ungrazed. This may partly explain the failure to find this species.

Thamnophis proximus (Western Ribbon Snake) and Thamnophis radix (Plains Garter Snake) exist in prairie habitats particularly near the edges of swamps, lakes, marshes, rivers and streams. A few marshy areas exist on KPRNA, but large permanent waters do not. Many of the streams are temporary and dry in the summer months. It is possible that small numbers of these species exist in isolated areas of KPRNA, but the above mentioned factors along with the presence of the hardy red-sided garter snake probably excludes these species.

Bufo cognatus (Great Plains Toad) is found mainly in the western half of Kansas and prefers upland mixed-grass and shortgrass prairie habitats. The undisturbed tallgrass prairie of KPRNA probably inhibits the occurrence of this species. However, isolated areas may allow existence.

Lampropeltis calligaster (Prairie Kingsnake) is relatively uncommon in most of its range (Fitch 1978). Throughout a thirty year field study of snake populations in northeastern Kansas this secretive species was obtained in numbers too small to be a major objective (Fitch 1978). Beside the fact none were found during this study there is no evidence against the possible occurrence of this species on KPRNA.

Storeria dekayi (Brown Snake) may also occur on KPRNA. It requires moist areas of forest or forest edge habitat which exists on KPRNA. An individual of this species was found by the author approximately six miles south of KPRNA in Geary County.

Sistrurus catenatus (Massasauga) has not been reported in Riley County despite the relatively rigorous collecting by various investigators (e.g. Gloyd 1929, Smith 1931, 1934). The author has collected this species in the Flint Hills region of Lyon County approximately 70 miles southeast of KPRNA. Superficially, the habitats on KPRNA seem favorable for this species' existence, but some aspect may be missing. It is likely that this species does not occur on KPRNA, but perhaps specimens will be found in the future inhabiting isolated areas.

Crotalis horridus (Timber Rattlesnake) is found in the eastern United States and KPRNA is along the extreme edge of its distributional range. This timid snake prefers open woodland hillsides and succession resulting in the closing of forest canopy evidently destroys the habitat requirements of this species. Over a 30 year period Fitch (1982) observed this species dwindle from 53 in the first decade of field work to 39 in the second decade to 1 in the third decade in northeastern Kansas in conjunction with

forest succession. If this species exists in the limited open woodland habitats on KPRNA, it is expected to be very rare.

KPRNA is along the extreme edge of Kansas distributional ranges of four other species, therefore not finding them was not surprising. These species include: Sincella lateralis (Ground Skink), at western edge of range; Eumeces septentrionalis (Prairie Skink), at northern edge of range; Tantilla nigriceps (Plains Blackhead Snake), at eastern edge of range; and Nerodia erythrogaster (Plainbelly Water Snake), at northern edge of range.

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HERPETOFAUNA OF THE KONZA PRAIRIE RESEARCH NATURAL AREA IN THE FLINT HILLS  
REGION OF KANSAS WITH RESPECT TO HABITAT SELECTION

by

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## ABSTRACT

A survey of the amphibians and reptiles inhabiting the Konza Prairie Research Natural Area (KPRNA) in the Flint Hills region approximately ten kilometers south of Manhattan, Kansas was carried out from 1 March to 15 October 1983. Supplemental nighttime searches for anurans were also conducted in the spring of 1984. The objectives of this study were to compile a species list and gather information on habitat distribution and natural history of herpetiles on the KPRNA.

Three 600 m transects, each with five trapping stations 150 m apart, served as primary terrestrial collecting sites. The three sites included, an upland limestone outcrop dominated by native grasses with a few patchy areas of shrubs; a limestone outcrop dominated by shrubs with a few trees; and a limestone outcrop associated with the gallery forest along Kings Creek with approximately two-thirds of this outcrop in forest edge habitat and one-third in the forest proper. Additional searches were carried out on an irregular basis in other terrestrial areas across KPRNA. Ponds, streams, marshes and temporary pools were visited in search of aquatic herpetiles.

Twenty-nine species were found on KPRNA - one salamander, eight frogs and toads, three turtles, four lizards and thirteen snakes. A total of fifteen species were found on the limestone outcrop sites, two amphibians and thirteen reptiles. Individual numbers of total herpetiles, snakes and Great Plains skinks (Eumeces obsoletus) were significantly different between the grass outcrop and the outcrops with woody vegetation (shrub outcrop and forest outcrop). Species richness increased with an increase in structural complexity and microclimatic conditions determined by the amount

and types of vegetation in the outcrop habitats (grass outcrop = 7 species, shrub outcrop = 9 species, forest outcrop = 11 species).

This preliminary work will perhaps stimulate further ecological investigations of herpetiles on this natural tallgrass prairie preserve.