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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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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

[1] 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).

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

[1]Species observed under an object, e.g. rock, log or other plant material.

[2]Species observed in the open.

*Species observed in water.

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

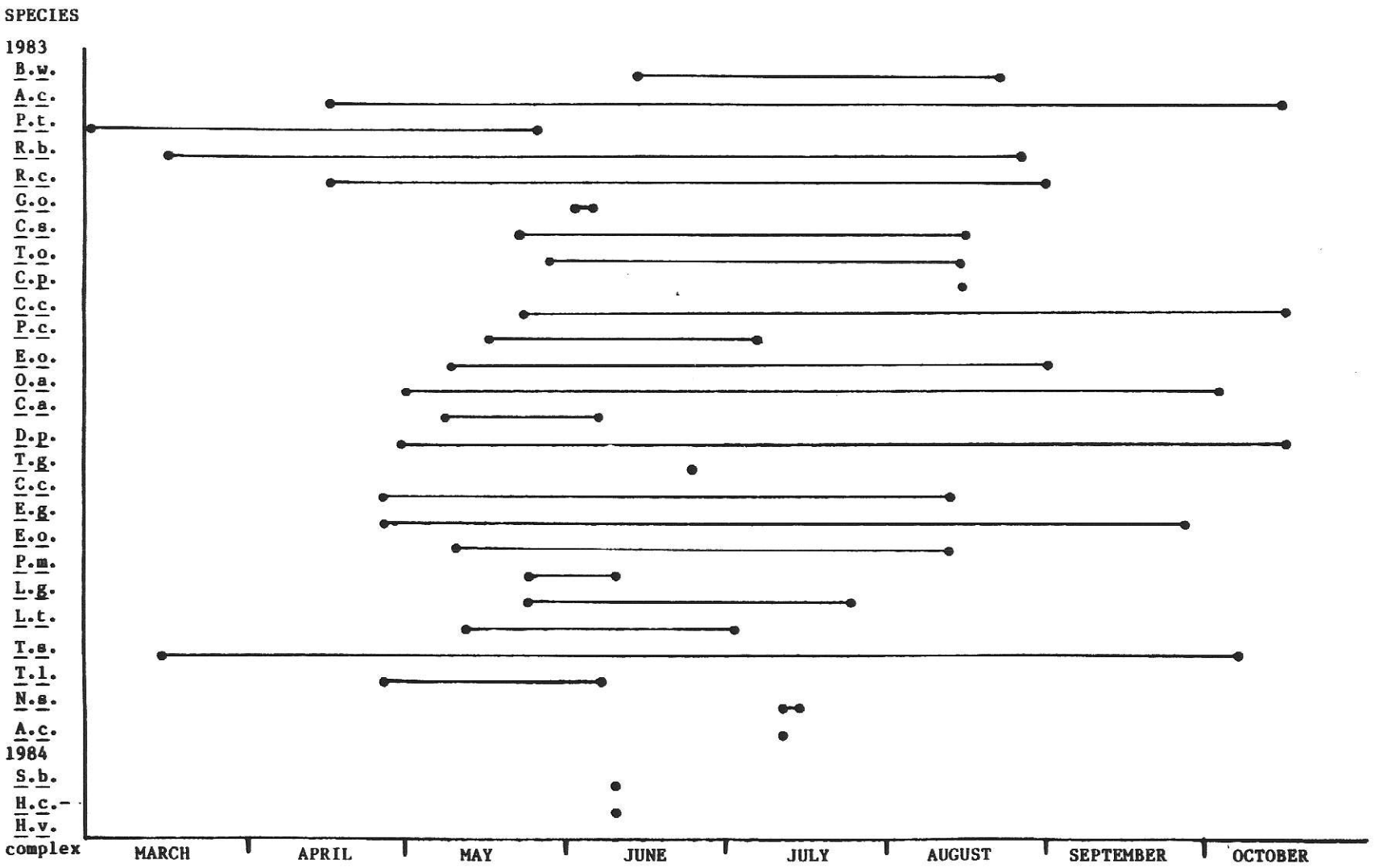

Table 3. Herpetiles observed at specific outcrop sites on the KPRNA.

Species	Grass outcrop minimum individuals	Grass outcrop total observations	Shrub outcrop minimum individuals	Shrub outcrop total observations	Forest outcrop minimum individuals	Forest outcrop total observations
Bufo woodhousei	0	0	1	1	0	0
Gastrophryne olivaceae	0	0	0	0	2	2
Terrapene ornata	1	1	0	0	0	0
Crotaphytus collaris	1	1	6	23	4	32
Eumeces obsoletus	7	9	19	46	20	52
Ophisaurus attenuatus	0	0	0	0	2	2
Carphophis amoenus	0	0	0	0	3	3
Diadophis punctatus	2	3	9	12	7	7
Tantilla gracilis	1	1	0	0	0	0
Coluber constrictor	2	6	3	5	1	1
Elaphe guttata	0	0	4	4	5	12
Elaphe obsoleta	0	0	0	0	2	2
Lampropeltis getulus	0	0	1	1	1	1
Lampropeltis triangulum	1	1	5	5	3	5
Tropidoclonion lineatum	0	0	1	1	0	0
Eumeces obsoletus total	7	9	19	46	20	52
Lizard total	8	10	25	69	26	86
Snake total	6	11	23	28	22	31
Herpetile total	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 (χ^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: χ^2 = 10.41, d.f. = 2, p < 0.01; snakes: χ^2 = 10.71, d.f. = 2, p < 0.01). The Great Plains skink, common enough to be examined seperately, was the major determinant of the lizard pattern (χ^2= 6.83, d.f. = 2, p < 0.05). Analysis of total herpetiles demonstrated no significant difference between the shrub and forest outcrops (χ^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: χ^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: χ^2= 10.68, d.f. = 1, p < 0.01; Great Plains skinks: χ^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 poikelothermic, 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 desication than reptiles and require habitats affording higher humidity regimes. It is

reasonable to assume that amphibians and reptiles have evolved physiological compatabilities 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 ovserved 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 generaly 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 territoral 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. Prefered 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 meduim sized bullfrogs were observed in a KPRNA pond laden with large floatng 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