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## An Ecological Study of the Vertebrates of a Streambank Community in Ellis County, Kansas

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AN ECOLOGICAL STUDY OF THE VERTEBRATES  
OF A STREAMBANK COMMUNITY IN  
ELLIS COUNTY KANSAS

being

A Thesis Presented to the Graduate Faculty of  
Fort Hays Kansas State College in  
partial fulfillment of the requirements for  
the Degree of Master of Science

By

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Date

1/5/61

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## THESIS ABSTRACT

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This investigation was conducted on Big Creek near Hays, Kansas. The study area, in the mixed-prairie association, is in the post-climax stage of succession. The principal plants of the area were: American elm, green ash, catalpa, Virginia wild rye, giant ragweed and western wheatgrass. The principal purpose was to make a complete list of the vertebrates, and to describe, as far as the data permitted, their ecological roles in the study area.

Several methods were employed to sample the various populations. Amphibians were collected by hand, reptiles by means of barrier traps, and small mammals by snap traps. In the case of birds and large mammals observations and other indications of their presence was the only means of identification.

A total of 165 amphibian specimens representing six species, five genera, four families and two orders was collected. The reptiles were composed of 75 specimens representing 16 species, 14 genera, and five families. Ninety species of birds representing 70 genera, 69 families and 12 orders were observed. In the case of the small mammals, 218 specimens were captured in a total of 2160 trap nights representing seven species.

Large mammals present in the area either permanently or sporadically were composed of 14 species, 13 genera, nine families and five orders.

Considerable information pertaining to food habits, habitat preference, and seasonal migrations was recorded.

## ACKNOWLEDGEMENTS

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## INTRODUCTION

Zoological research near Hays, Kansas has been primarily concerned with ecological relationships of small mammals in the mixed prairie association. Since much of the land in the immediate area is utilized for grazing purposes, such a concentration of study is desirable, but in doing this other fields of zoological research have been neglected. Very little information, therefore, is available on the streambank community and a broad gap has resulted in our knowledge of the fauna of this type of habitat. It was the author's objectives to attempt to partially bridge this gap and to establish the initial framework on which more intensive studies could be based.

Works presently available (Brennan, 1938; Dice, 1923; Fall, 1933; Frydendall, 1960; Hibbard, 1937) give the streambank community some consideration but have done so only in a fragmentary fashion and have not furnished a sufficient amount of pertinent data.

The purpose of this investigation was to make a complete list of vertebrates, and to describe, as far as the data permitted, their ecological role in the study area. During this investigation an effort was made to sample the various vertebrate populations either by visual observations or by means of traps and to relate the distribution of the species to the vegetation.

Observations or collections of all vertebrates were made during the investigation; the species, sex, weight and measurement of each individual were recorded whenever possible. The food habits of the species were determined by making an analysis of the scat and stomach content with supplementary material furnished by the literature.

A review of the literature pertaining to the habits and activities of many vertebrates disclosed that little work on this subject has been conducted. Publications that were useful in obtaining information concerning the distribution and food and habitat preferences of the vertebrates included Black (1934), Cockrum (1948, 1952), Grant (1927), Hibbard (1944), Hall (1955), and Howell (1906).

Study specimens of the reptiles and amphibians named in this paper and skins and skulls of several small mammals have been placed in the study collection at Fort Hays Kansas State College, Hays, Kansas.

## METHODS

Five principal methods were employed to study the vertebrates of a streambank community in Ellis County, Kansas.

### Visual Observations of Bird Populations

The bird populations were surveyed from the first week in March throughout the summer and fall. These observations were made approximately once each week in March and three times each week in April and May. Through the summer (June, July and August) surveys were conducted only once a week. In the fall (September and October) observations were again made three times weekly to secure data pertaining to fall migrations. Observations were made at various times during the day; however, they were generally made in the early morning or evening in order to observe the highest number of species and individuals. Many hours were spent walking through the study area observing habits and mating behavior of birds. All nests were identified and eggs counted to secure data helpful in determining reproduction rates.

### Snap Trapping

Selective snap trapping was employed to collect specimens of small mammals found in this area (Fig. 1). Trapping stations were located every 200 yards along the area and at various locations on the flood plains. These stations were placed in every available habitat and in different plant communities in order to collect all species in the area. The traps, baited with a rolled oats-peanut butter paste, were set in groups of six at each of the 15 stations. A total of 90 traps was set three consecutive days each month except during August when the traps were set six days in



Fig. 1. Type of snap trap used to sample the small mammal populations.

two different three-day periods. This change in trapping procedure was felt to be desirable because of a flood which occurred in the latter part of August and completely inundated a greater portion of the area. The second three-day period of trapping was carried out shortly after the flood to study the recovery of the small mammal populations.

The traps were checked early each morning, the specimens removed, weighed, and measured. The stomachs were removed from several specimens and analyzed to determine food habits.

### Barrier Trapping

Barrier traps were utilized in capturing snakes (Fig. 2). Four barriers with two traps per barrier were set in all of the major plant communities and were continuously maintained. These were first put into operation in the first week of May and were closed the last week of October. During this period specimens were removed three times weekly, usually in the early morning to prevent excessive mortality. Six natural barrier traps were placed in every available habitat and were maintained in the same location for periods of two weeks and then moved to different trapping sites in order to capture species not found where the permanent traps were located (Fig. 3).

Several individuals of each species captured were dissected and the stomach contents analyzed to gain knowledge of food habits and food preferences.

### Observations of Large Mammals

The large mammal populations were surveyed by several methods (In this paper a large mammal is any mammal larger than a Norway rat). Actual obser-



Fig. 2. Complete barrier trap in the Elymus community on the flood plain.



Fig. 3. Natural barrier snake trap of the type utilized to sample snake populations in areas other than flood plains.

vations of the mammal, identification of tracks, identification of scats, and observation of drawings proved to be the most fruitful methods of collecting data.

Scats and Pellet Analysis

Scats, pellets, and fecal pellets were collected in the field and analyzed in the laboratory to determine food habits and predators of several mammals. The remains of small mammals found in scats and pellets were identified from Cockrum (1952), Hall (1955), Blair, et al. (1957), Oyer (1946) and Glass (1951). In several cases, identification of rodents was made by fecal pellets (Webb, 1940).

No specific method was employed in collecting reptiles other than snakes. The specimens collected for this study were captured merely by lifting stones, rolling logs, and moving trash piles and then capturing them by hand. Several nocturnal trips were made for collecting specimens of this type.

Nomenclature for the broad-leaved herbaceous vegetation follows Rydbery (1932) while grassy vegetation follows Hitchcock and Chase (1950). Nomenclature of the trees follows Dickens, et al. (1928), mammals Hall (1955), reptiles and amphibians Smith (1956) and birds Peterson (1958).



## CLIMATOLOGICAL DATA

The study area is located in the 20 to 25 inch rainfall belt.

During the investigation period, March through October, a total of 16.57 inches of precipitation was received, a deviation of minus 3.54 inches from the long time average for this period of time.

Sixteen inches of snow was received during March. The maximum depth on the ground reached 21 inches on March second partly from the accumulation of pre-March snows. No additional snow fell during the study period (Table I).

The average maximum and minimum temperatures for each month are given in Table II. The maximum temperature recorded was 107° Fahrenheit on August third. The minimum temperature was 15° below zero Fahrenheit on March third.

Since this study began March seventh and ended October 21, climatological data given in this section will include the whole month instead of just the portions when the study was in progress. Data used in compiling this section were obtained from the Hays section of the Kansas Climatological Data (1960).

Table I. Amount of precipitation received during the study period including monthly averages and departures from long time mean. Amounts are given in inches.

Month	Total	Dep. from mean	Greatest day	Date	Total snow
March	.94	- .20	.22	16	16.0
April	2.34	.21	.84	30	0
May	2.87	- .54	.98	25	0
June	3.20	-1.07	.79	8	0
July	.09	-2.46	.06	27	0
August	3.76	.84	2.09	24	0
September	1.40	- .78	1.40	23	0
October	1.97	.49	.86	19	0
Total	16.57 inches				

Table II. Monthly minimum and maximum temperatures for the months during the investigation.  
 Figures given in degrees Fahrenheit.

Month	Av. max.	Av. min.	Ave.	Dep. from mean	High	Date	Low	Date	No. of days			
									Max.		Min.	
									90 or above	32 or below	32 or below	0 or below
March	38.8	19.3	28.8	-12.7	82	29	-15	3	0	11	27	4
April	69.2	42.3	55.8	2.2	87	22	26	3	0	0	3	0
May	73.3	48.1	60.7	- 1.8	91	25	31	12	1	0	1	0
June	81.6	59.7	70.7	- 3.5	106	30	50	14	6	0	0	0
July	90.6	62.5	76.6	- 4.0	105	2	57	31	14	0	0	0
August	91.8	63.4	77.6	- 1.3	107	3	51	19	21	0	0	0
September	84.3	55.7	70.0	- .9	97	4	42	10	0	0	0	0
October	70.8	43.8	57.3	- .8	88	11	27	31	0	0	3	0

## DESCRIPTION OF AREA

The study area is located on Big Creek approximately 1.5 miles southeast of Hays, Kansas near the center of Ellis County. The land is owned by the Fort Hays Branch of the Kansas State University Agricultural Station. The legal description is: the North One-fourth ( $N\frac{1}{4}$ ) of the North One-half ( $N\frac{1}{2}$ ) of Section nine (9), Township Fourteen (14) South, Range Eighteen (18) West of the Sixth (6) Principal Meridian (Fig. 4).

The study area is composed of approximately three-quarters of a mile of streambank and flood plain varying in width from 150 yards at the widest section to ten yards at the narrowest point. The stream bed serves as a boundary on the east while on the west part of the boundary is an alfalfa field and the remainder a cultivated field. The western boundary appears to be an ecotonal area between the two distinctly different communities (Fig. 5).

The stream is one of the larger creeks in Ellis County carrying runoff from approximately 659 square miles from the head waters to the study area. It originates in Gove County west of Hays and assumes a meandering course across Ellis and Russell Counties entering the Smoky Hill River near Ellsworth, Kansas. In the Hays area, it is normally a slow-flowing stream with an average drop of five to ten feet per mile. The creek bed, in most sections, is rather shallow, with flood plains not over five feet above the stream bed (Fig. 6). In a few places, however, the banks range from 20 to 30 feet in height above the water level.

During the dry periods of the year the flow of the stream is almost completely arrested with only a trickle flowing from one stagnant pool to another. However, during wet periods, when heavy rains occur, and during periods of rapid thaw in early spring, flooding is not uncommon. When



Fig. 4. A general view of the entire study area (in background). Taken from an adjacent sorghum field looking east.



Fig. 5. View showing the ecotonal boundary between the creekbank community and the alfalfa field.



Fig. 6. General view showing the nature of the creek bed.

flooding occurs the lower flood plains are completely inundated, causing some destruction to the vegetation. Many small trash piles and log jams are left behind on the flood plains and in the stream channel when the water recedes (Fig. 7).

The vegetation, according to Weaver and Clement's (1938) classification, has attained a post climax stage of succession. Some portions of the area exhibit a characteristic stratification of vegetation with three layers being evident while in other areas only two layers can be observed. This layering is not prevalent throughout the whole research area as some portions exhibit a homogeneity of vegetation with an absence of large trees (Fig. 8).

The streambank and areas closely adjacent to the stream channel are thickly covered with trees of the following species: green ash (Fraxinus lanceolata), American elm (Ulmus americana), cottonwood (Populus sargentii), sand bar willow (Salix interior), catalpa (Catalpa speciosa), mulberry (Morus rubra), black walnut (Juglans nigra), box elder (Acer negundo), hackberry (Celtis occidentalis), and burr oak (Quercus macrocarpa).

The green ash was the most abundant tree in the study area followed, in order, by American elm, box elder, cottonwood, and hackberry. Griswold (1942), in a more extensive study of Big Creek, found the green ash to be the most common species but the hackberry second in abundance. His study was made on three streams in different sections of the county.

In areas where layering was evident, the previously mentioned species were the major components of the canopy which limited light penetration to such a degree that a condition of partial shade was almost continuously maintained (Fig. 9). Under this canopy, in areas where sufficient sunlight





Fig. 7. General view of the creek bank and small log jam left after flooding.



Fig. 8. View showing the layering of the vegetation. Note the herbaceous layer on the ground level, the smaller trees and shrubs forming the second layer and the larger trees forming the canopy.



Fig. 9. General view showing the density of the canopy. This photo exhibits the large areas shaded during most of the day.

was permitted to penetrate, and on peripheral areas, such species as flowering currant (Ribes odoratum), chokecherry (Prunus virginiana), false indigo (Amorpha fruticosa) and wild plum (Prunus americana) as well as small plants of the canopy species formed the second layer (Fig. 10). The third layer was composed of the more shade-tolerant herbaceous species such as marsh muhly (Muhlenbergia racemosa), Mexican muhly (Muhlenbergia mexicana), Virginia wild rye (Elymus virginicus), bed straw (Galium aperine), and plains blue grass (Poa arida).

Layering was much more distinct in some areas than in others. Much of the area exhibited two rather than three layers. On the flood plains the second layer was absent with only the canopy-forming trees and the herbaceous shade-tolerant plants growing beneath. In other areas, however, the canopy-forming layer was present with the second layer directly below and with the herbaceous layer absent. An example of this was a small area of approximately one acre which was heavily covered with catalpa trees, an escaped species, which formed an extremely dense canopy (Fig. 11). Under this canopy, the second layer was formed by Queen Ann's Lace (Conium maculatum), another escaped species. This plant ranged from eight to 15 feet in height with very little, if any, vegetation existing on the ground level (Fig. 12).

The canopy on one flood plain was not dense enough to produce an appreciable degree of shade. As a result this area was covered by an almost homogeneous stand of giant ragweed (Ambrosia trifida) which ranged from eight to 18 feet in height depending upon the mesic condition of the habitat (Fig. 13). This vegetation was so dense that very little, if any, direct sunlight penetrated to the soil level; thus, even during the driest



Fig. 10. Chokecherry bushes, a fruit-producing species which was utilized by several species of birds and mammals as a food source.



Fig. 11. A view showing the catalpa community.  
An almost completely shaded condition  
was maintained under this canopy.



Fig. 12. Queen Ann's lace growing under the canopy of the catalpa community.



Fig. 13. Giant ragweed community growing on the flood plain. Note the density of the vegetation.



periods of the summer, the surface of the soil was very damp. Due to this continual abundance of excessive soil moisture, a layer of algae, probably of the genus Chlorococcus, was found growing on the soil surface in conjunction with numerous fungal organisms thriving on decaying organic matter.

Only two small communities of western wheatgrass (Agropyron smithii), and one community of marsh muhly were observed. These were located in a small open area on the highest side of a flood plain which was void of trees. The largest grass communities were composed of Virginia wild rye which grew quite thickly on the flood plains in the partial shade conditions produced by the canopy-forming trees. Virginia wild rye was the most abundant grass in the area and was a common component of the herbaceous layer under the canopy-forming trees (Fig. 14).



Fig. 14. Homogeneity is shown by the Elymus community growing on the flood plain. A barrier snake trap is located in the middle of the picture.

## RESULTS AND DISCUSSION

### Amphibians

A total of 165 amphibian specimens representing six species, five genera, and four families were examined, weighed, and measured (Table III).

The common leopard frog (Rana pipiens) Schreber was the most common representative of the class Amphibia. It was captured 94 times followed, in order, by the garden toad (Bufo woodhousii) Girard, 28 times; the plains toad (Bufo cognatus) Say, 19 times; the striped chorus frog (Pseudacris nigrita)(Le Conte), 17 times; the cricket frog (Acris crepitans) Baird, 13 times; and the tiger salamander (Ambystoma tigrinum)(Green), four times.

The leopard frog (Rana pipiens) was by far the most numerous anuran found in the area. It occurred in all of the habitat types where sufficient moisture was present but was found most frequently in low vegetation closely adjacent to the water's edge. However, this was not always the case, as three adult specimens were taken in a wooded area with a very dense understory of vegetation approximately one hundred yards from the water. Specimens of this species were taken readily at all times of the day from the second week in March until the third week in October but nocturnal collecting trips proved to be the most fruitful.

Stomach analysis of 35 specimens disclosed that the diet was composed almost entirely of small terrestrial arthropods. Of the 35 stomachs analyzed two contained remains of the class Chilopoda, four contained arachnid remains and the remainder contained insect remnants primarily of the orders Diptera, Coleoptera, Hemiptera, and Hymenoptera.

According to Smith (1956) hibernating frogs retire in mud and water at depths below the frost line during winter months. The following spring

Table III. Species, number captured and habitat of amphibians captured between March 1960 and October 1960.

Species	Number captured	Habitat
<u>Bufo woodhousii</u>	28	Wildrye community
<u>Bufo cognatus</u>	9	Wildrye community
<u>Pseudacris nigrita</u>	17	Vegetation near water
<u>Rana pipiens</u>	94	Vegetation near water
<u>Acris crepitans</u>	13	Vegetation near water
<u>Ambystoma tigrinum</u>	4	Stream
	<u>165</u>	

breeding starts shortly after emergence and may continue through the second week in May.

Eggs are deposited on sticks and vegetation in the water in large gelatinous masses. These masses, containing approximately 3000 to 7000 eggs, were not an uncommon sight in the water of Big Creek during the latter part of May and the first week in June. The eggs hatch in 18 to 21 days.

Temperature appeared to be one of the principal factors in the habitat choice of the garden toad (Bufo woodhousii). From the latter part of March through the first week in May the garden toad was most frequently found inhabiting areas where sunlight was allowed to penetrate to ground level. The ecotonal area (alfalfa field and creek vegetation) and the western wheatgrass communities were heavily inhabited by this species during this period. As the weather became warmer during the summer, this toad was found in more dense vegetation where the temperature was lower. During August few individuals were observed during the warmer periods of the day but early in the mornings and evenings this species was found in the cool, moist habitats.

Ten individuals were taken into the laboratory, dissected, and their stomach contents analyzed. It was found that their diet was quite similar to the leopard frog but contained a higher percentage of arachnid remains. Of the ten stomachs analyzed, six contained arachnid remnants while the others contained insectan remains of the orders Diptera, Coleoptera, Hymenoptera, and Hemiptera. One stomach contained seven Hemiptera of the family Miridae.

Breeding usually occurs in a variety of places but muddy water exceeding the depth of three feet is usually chosen (Smith, 1956). Reproduction appears to be dependent upon the occurrence of rains; thus, breeding does not occur at any given period of the summer and not all individuals breed at the same time (Bragg, 1940<sup>a</sup>). Breeding, however, has been observed as early as March 25 and as late as August 17.

Youngstrom and Smith (1936) state that metamorphosis occurs when the toad is about 30 mm. long, after a larval period of approximately 39 to 40 days depending upon temperature and food supply. After metamorphosis, according to Smith (1950), growth is very rapid occurring at the rate of about three per cent of total adult weight per day with some becoming half grown during the first summer.

The plains toad (Bufo cognatus) was found in the same type habitat as B. woodhousii being found in areas of high light intensity in the early spring and retiring to areas of more dense vegetation during hot weather. This species was, however, never observed in heavily wooded areas where little herbaceous vegetation occurred. This toad was collected at all periods of the day, but was much more active at night than at any other time.

Seven specimens were dissected and their stomach contents analyzed. It was found that their diet was almost identical with that of B. woodhousii. Insects of the orders Coleoptera, Hymenoptera, Diptera and Hemiptera were found to make up approximately 94 per cent of the total stomach content. A representative number of ants (Formicidae) were found in three stomachs while none were found in B. woodhousii. No remains of arachnids were found in this species.

The breeding habits of this species appear to be quite similar to the garden toad. According to Bragg (1940<sup>b</sup>) they breed after spring rains whenever the water exceeds 12 degrees Centigrade. Breeding usually occurs in small ponds and stagnant pools which are relatively free of sediments. Many eggs are produced (20,000) and a high percentage hatch, thus producing a very high concentration of larval forms in pools. Smith (1956) found that tadpoles may exceed 750 per cubic foot of water.

Smith (1934) states that metamorphosis starts at one and one-half months after eggs are laid. About four months after transformation from larval to adult stage they may be half grown depending upon the availability of food.

The striped chorus frog (Pseudacris nigrita) was not abundantly found in this study. The specimens collected were taken in early spring and were not found during the summer months. Those collected were found during the day in short vegetation very close to the water.

Ten specimens were dissected and their stomach contents analyzed. The stomach contents were composed principally of arachnids (45%) and insects of the orders Coleoptera (15%), Hymenoptera and Diptera (10%).

Nothing pertaining to their breeding season and reproductive habits was discovered. Smith (1950) indicates that the breeding season begins in March and extends through April. The eggs are laid in May and hatch in four or five days depending upon the temperature. Approximately two months are required for complete development from the egg to the time of transformation.

The cricket frog (Acris crepitans) was found both during night and daylight hours within close proximity of the stream and would retreat to

the water readily if disturbed. They were usually found most abundantly in very shallow water with an abundance of vegetation.

Stomach analysis of ten specimens disclosed a variety of food. Insects of the families Miridae, Gerridae, Hydrophilidae, and Gyrinidae made up approximately 45 per cent of the total with 35 per cent being composed of the orders Hymenoptera, Diptera, and Coleoptera. Twenty per cent was composed of Lepidoptera larvae, crayfish larvae, and arachnids.

This frog is one of the earlier anurans to emerge from hibernation. One was observed in this study March 7. However, Smith (1934) states that emergence is sometimes earlier. This species usually breeds in early April and continues throughout May. Eggs ranging from 150 to 250 in number are laid singly and hatch several days after deposition.

The tiger salamander (Ambystoma tigrinum) is the most common member of the order Caudata in this section of the state. It was found, in this study, inhabiting shallow water usually hidden under debris near deeper pools to which they retreat when disturbed.

Three adult specimens were dissected to determine stomach content. It was found that 55 per cent of the total content was composed of unidentifiable animal material, five per cent tadpoles, ten per cent crayfish larvae, 20 per cent insects of the orders Diptera, Coleoptera and Hemiptera, five per cent plant material, and five per cent Lepidoptera larvae.

According to Bishop (1943) mating occurs in water with males depositing spermatophores which the females pick up with their cloacae after a period of courtship of body rubbing, tail lashing and close swimming. The eggs are laid in masses attached to twigs and sticks below the surface of the water. The incubation period ranges from 24 to 30 days. Larvae at



hatching average about 14 mm. in length, and reach 90 to 123 mm. after a development period of 75 to 118 days (Bishop, 1943).

Sometimes the larvae fail to transform but become sexually mature, breeding much like adults and remain aquatic.

### Reptiles

A total of 75 reptilian specimens representing 16 species, 14 genera, and five families were examined, weighed, and measured.

The blue racer (Coluber constrictor) (Linnaeus) was the most common representative of the class Reptilia. It was captured 12 times followed, in order, by the common garter snake (Thamnophis ordinatus) (Linnaeus), ten times; the plains garter snake (Thamnophis radix) (Baird and Girard), eight times; the bull snake (Pituophis melanoleucus) (Blainville), eight times; the ornate box turtle (Terrapene ornata) (Agassiz), seven times; the common water snake (Natrix sipedon) (Linnaeus), five times; the painted turtle (Chrysemys picta) (Schneider), four times; the common snapping turtle (Chelydra serpentina) (Linnaeus), three times; the six-lined race runner (Cnemidophorus sexlineatus) (Linnaeus), three times; the rat snake (Elaphe guttata) (Baird and Girard), three times; the ring neck snake (Diadophis punctatus) (Linnaeus), three times; the coachwhip snake (Masticophis flagellum) (Shaw), two times; the hognose snake (Heterodon platyrhynchos) Latreille, two times; the speckled king snake (Lampropeltis getulus) (Linnaeus), two times; the red king snake (Lampropeltis triangulum) (Linnaeus), two times; and the earless lizard (Holbrookia maculata) Girard, one time.

The blue racer (Coluber constrictor) was collected or observed in almost all habitats of the study area but was collected in largest numbers on

the flood plains in the wild rye communities and along the ecotonal areas where moisture was not too evident. All specimens observed were collected during daylight hours, thus indicating a diurnal nature.

Eight of these snakes were taken into the laboratory, dissected, and their stomach contents analyzed. It was found that their diet was composed of an enormous variety of animal matter. Among the dietary components were insects (Coleoptera), three immature mice probably Peromyscus spp., one cricket frog, and an abundance of unidentifiable animal remains.

Mating is preceded by a short period of courtship where bodily movements and caudocephalid movements are exhibited by the male in the presence of the female (Oliver, 1955). After mating has been accomplished eight to 25 eggs are laid in June and July, the eggs average 35 X 22 mm. in size and are laid in the ground, in rotten logs, debris, and places of similar nature (Conant, 1938).

The common garter snake (Thamnophis ordinatus) was quite abundant from the first week in March throughout July after which none were taken. A majority of the specimens taken were captured at night under logs, trash piles, and similar places. Areas of high moisture seemed to be one of the most highly preferred habitats for this species. It was found along the stream in low vegetation where moisture was continually evident.

Stomach analyses of five specimens were undertaken. It was found that frogs made up the bulk of the diet (75%) with the remaining 25 per cent being composed of worms and unidentifiable organic material.

Very little is known about the reproductive habits of this species. According to Smith (1956) mating occurs in May in Maryland and 14 to 78

young, measuring six to eight inches in total length, are produced in August and September.

The habitat of the plains garter snake (Thamnophis radix) is very similar to T. ordinatus. In this study the plains garter snake was found in wet areas closely adjacent to the water's edge in an Ambrosia trifida community. It was, however, found greater distances from water than was T. ordinatus.

Four specimens were dissected to determine food habits. These analyses revealed that the food of the plains garter snake was quite varied. Of the four snakes dissected, the stomach contents were composed of the following articles: insects (15%) of the orders Coleoptera, Hemiptera, with the families Miridae, and Coccinellidae being present in appreciable numbers; tadpoles five per cent; frogs five per cent; mice 20 per cent; earthworms 15 per cent; insect larvae ten per cent; and unidentifiable animal material 40 per cent.

Schmidt and Davis (1941) indicate that hibernation occurs on land in holes or ant hills several inches to several feet below the soil surface. Mating occurs shortly after emergence from hibernation in April and May and 13 to 40 young are born from July through September (Smith, 1950).

The bull snake (Pituophis melanoleucus) was found largely in wild rye communities and along the ecotonal line in relatively open areas. None were captured in the Ambrosia trifida community or in areas where sunlight was limited.

Three specimens were dissected but only one had any identifiable remains in its stomach. The contents consisted largely of small mammalian remnants of the genus Peromyscus. According to Oliver (1955), rodents and

rabbits make up 67 per cent of the diet while the remainder is composed of quail eggs (28%) and lizards (5%). Smith (1956) states that food animals are usually killed by constriction. Animals too small to be crushed are swallowed alive. The snake usually searches out its prey in burrows or similar places and kills it by compressing the animal against the wall of the burrow. When killing or capturing prey, tactile stimulation, rather than sight, is utilized to a great extent. Any touch upon the snake's body causes it to attempt to compress or constrict whatever is there (Smith, 1950). The bull snake is oviparous with ten to sixteen eggs being laid in July. According to Smith (1950), these eggs measure 42 to 52 mm. in length and 28 to 38 mm. in width and hatch in July and August. The young snakes measure approximately 15 inches in total length and shed their skins about ten days later. They apparently do not eat for several weeks and may overwinter without eating; others have eaten nine weeks after hatching (Smith, 1956).

This snake, because of the high percentage of small mammals eaten, is sometimes referred to as the farmer's best friend. They are very efficient mousers and will control mouse populations in farm buildings much better than cats. According to Smith (1950), many farmers encourage bull snakes to remain near their buildings for that reason.

The ornate box turtle (Terrapene ornata) was found from the last week in May until the last week in August after which none were observed (Fig. 15). It was restricted quite narrowly in choice of habitat with all specimens being found in the most open places of the study area. The ecotonal area from which the vegetation had been removed by mowing was most heavily

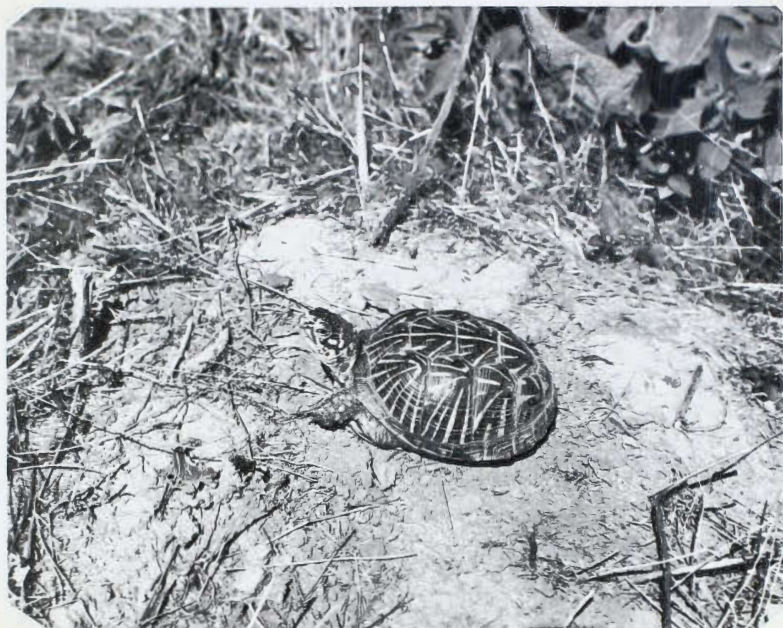


Fig. 15. An ornate box turtle; the most common turtle in the area.

populated. Five were sighted lying partially covered in small holes along a strip approximately one-half mile long on June 21. Brennan (1938) reported that at this period of the year, this species reaches sufficient numbers to damage melon crops. He reported seeing 30 individuals in less than half an hour near a melon patch in Ellis County, Kansas. This species is primarily diurnal but is more active during the morning and evening hours than during the hot period of the day.

Copulation usually occurs from May 11 to 20 and eggs are laid in the first two weeks of August (Pope, 1946). Smith (1956) states that the eggs average 36 X 22.5 mm. in size and hatch during the last week in August and first week in September.

This species is utilized as food in some sections but otherwise has no economic importance except for its ability to kill large numbers of harmful insects.

The common water snake (Natrix sipedon) is found quite abundantly along streams and rivers. It was found infrequently in this study. Throughout the study period only five specimens were observed. According to Hudson (1942), this species is quite ubiquitous in habitat choice but in this investigation it was found to be quite narrowly restricted to a semi-aquatic environment. It was observed most frequently lying on logs extending into the water from which they would retreat rapidly when disturbed. It is believed that, although this species does venture into terrestrial habitats, it is primarily aquatic.

Although stomach analyses were carried out on this species, nothing pertaining to its food habits was disclosed. The principal food items of

the water snake are tadpoles, crayfish, and other aquatic and semiaquatic animals (Smith, 1956).

Mating occurs in April and May and perhaps in September. Ten to 76 young are born from August to October. There is some evidence that the size of the brood is dependent upon the size of the female. The average number of young produced in Nebraska is 27 (Hudson, 1942).

The painted turtle (Chrysemys picta) was a common inhabitant of the semiaquatic habitat. It was observed most often along the water's edge on logs, rocks, and other projections over the water. It was also found in short vegetation adjacent to the stream channel.

According to Oliver (1955), water plants composed 61 per cent of the food consumed while the remainder was made up of insects (19%), mollusks (5%), crustacea (5%), vegetable debris (4%), carrion (2%), fish (2%), frog remains (1%), and worms (1%).

Smith (1956) states that a period of courtship occurs before mating. The male swims backward in front of the female facing her as she swims forward. With his forelimbs he rubs the snout of the female. This activity may continue for a quarter of an hour or longer.

Pope (1946) relates that mating occurs in both spring and autumn but it was found that the autumn copulation was ineffectual for fertilization because no spermatozoa could be found in the females taken a few weeks before the close of the autumn season.

The eggs (five to 15) are laid in shallow holes in June and July and hatch in approximately 72 days. If hatching occurs in late fall, the young may not emerge from the nest until the following spring (Smith, 1950).

The common snapping turtle (Chelydra serpentina) occurred in the same type habitat and was often found with the painted turtle. No adults of this species were taken. Three immature specimens were taken in the last week of August shortly after flooding had occurred. Therefore, since none were observed before flooding, it would seem feasible to assume that they were carried down by the flood waters. Two specimens were dissected but nothing of any significance was found in their stomachs so no analysis was undertaken. However, Oliver (1955) states that the following items are eaten readily and make up a high percentage of the food consumed: game fish, 34 per cent; hydrophytes, 36 per cent; carrion, 20 per cent; invertebrates, eight per cent; and miscellaneous vertebrates, two per cent.

Ditmars (1933) states that mating occurs at any time of the year except when the animals are in hibernation. The sperm remain viable in the female for long periods of time. According to Hudson (1942), eggs are laid in June and hatch in August. Nests are scooped out in the ground at varying distances from the water by the female. Twenty to 30 eggs, approximately one inch in diameter, are deposited.

This species has considerable importance as a food animal, and because of this and the fact that a large portion of its diet is composed of game fish, it is much hunted and is rapidly approaching extinction.

The six-lined race runner (Cnemidophorus sexlineatus) was rarely captured in this study. It was found in the wild rye communities on the flood plains. According to Clark, et al. (1958), they generally inhabit open rocky places with sandy soil.

Seven of these lizards, four of which were captured outside of the study area, were dissected and their stomach contents analyzed. Insects of



the orders Diptera, Hemiptera, and Hymenoptera comprised the largest percentage of the food consumed (55%). Arachnids were found to make up 20 per cent, members of the class Chilopoda ten per cent, earthworms five per cent, and insect larvae ten per cent.

Nothing was established pertaining to their reproductive habits but Smith (1946<sup>b</sup>) states that mating occurs in spring during the last of April or first week in May. The eggs, four to six in number, are laid from early June to the middle of July. The eggs measure 17 X 9.5 mm. and are deposited four to 12 inches below the surface of the soil usually under rocks, logs, or similar objects (Smith, 1950). Hibernation occurs when temperatures reach a low average usually in October or November. Activity begins early in the morning during the summer but falls off in the afternoon and during the entire day on cool or rainy days.

The rat snake (Elaphe guttata) was found inhabiting places where there was a sparsity of herbaceous vegetation in wooded areas and in the wild rye and western wheatgrass communities. These findings do not correlate with Smith (1950) who states that it seldom inhabits wooded areas and is principally a prairie species. This snake was never seen during daylight hours and was only observed once at night. The other specimens were captured in the snake traps.

Ring neck snakes (Diadophis punctatus) were noted under rocks, logs, and drift piles some distance from water in relatively open areas.

According to Smith (1950), each female produces one to three eggs from June to August. These eggs, measuring 27 X 6.5 mm. are laid in rotten logs or in the ground and hatch in 50 to 70 days. Growth is very rapid the

first year with an increase in length of 67 per cent, and for the successive years increases of 36, 31, and nine per cent (Smith, 1956).

The coachwhip snake (Masticophis flagellium) was taken twice in the ecotonal area. It is doubtful if this species is a regular inhabitant of the streambank community as none were taken away from the ecotone. Therefore, it would seem feasible to assume that the two specimens taken were immigrants from the alfalfa field adjacent to the ecotonal area.

Two specimens of the common hognose snake (Heterodon platyrhinos) were collected along the ecotone but none were taken in the wooded areas of the streambank. According to Smith (1950), this species is dependent upon a dry environment. This could possibly account for its absence in the shade, wooded habitat of the research area.

The speckled king snake (Lampropeltis getulus) was collected in areas where excessive moisture was evident. One specimen was collected in the Ambrosia trifida community and the other was taken in the Catalpa speciosa community. Both were found under logs.

Stomach analyses of six individuals, of which five were captured outside the study area, were undertaken. It was discovered that the food consumed consisted primarily of small mammals (40%), lizards (20%), unidentified animal material (10%), insects (10%), earthworms (10%), and bird eggs (10%). One specimen contained three western meadowlark eggs not yet broken.

Very little is known about the reproductive habits of this species. According to Smith (1950), mating normally occurs in May and an average of nine eggs are laid in June which hatch in August.

The red king snake (Lampropeltis triangulum) was very rarely taken. Only two were captured throughout the study period. This species seems to be somewhat fossorial being able to burrow readily. Both specimens were taken from holes under rotten logs.

Nothing was established pertaining to food habits. According to Hudson (1942), food similar to that taken by L. getulus is utilized.

No data is recorded on the breeding habits of the subspecies found in Kansas. In the eastern race, 11 to 16 eggs measuring 30 X 16 mm. are laid in the ground in piles of drift during June and July and hatch in September (Smith, 1950).

One earless lizard (Holbrookia maculata) was taken in the wild rye community on the flood plain. This is a very different habitat from that normally inhabited by this species. Most researchers indicate that areas of sandy soil with very limited vegetation are preferred. Since only one specimen was taken, it would indicate that they are not regular inhabitants of a streambank community.

### Birds

The avifauna of the study area was represented by 90 species, 69 families, and 12 orders.

Many of the species observed were migratory, thus were present in the study area for very short durations. It was impossible to attempt to discuss their natural history and ecological relationships because of their absence during most of the study period. An attempt was made to discuss, in more detail, the nonmigratory species which were present throughout the study. Only the dates of observation and relative numbers were recorded for migratory species.

Table IV. Species, number captured and habitat of reptiles captured between March 1960 and October 1960.

Species	Number captured	Habitat
<u>Holbrookia maculata</u>	1	Sandy area
<u>Cnemidophorus sexlineatus</u>	3	Wildrye community
<u>Chelydra serpentina</u>	3	Water's edge
<u>Chrysemys picta</u>	4	Water's edge
<u>Terrapene ornata</u>	7	Ecotonal area
<u>Lampropeltis triangulum</u>	2	Under logs
<u>Heterodon platyrhinos</u>	2	Sandy area
<u>Lampropeltis getulus</u>	2	Ecotonal area
<u>Elaphe guttata</u>	3	Under logs
<u>Coluber constrictor</u>	12	Wildrye community
<u>Thamnophis radix</u>	8	Along streambank
<u>Masticophis flagellum</u>	2	Grassy area
<u>Natrix sipedon</u>	5	In water of creek
<u>Thamnophis ordinatus</u>	10	Under logs
<u>Diadophis punctatus</u>	3	Open areas
<u>Pituophis melanoleucus</u>	8	Grassy areas
Total	75	

The order Ciconiiformes was represented by the great blue heron (Ardea herodias) Linnaeus. This species was observed three times (April 12, 20, and September 20).

The Anseriformes was represented by the mallard (Anas platyrhynchos) Linnaeus; the green wing teal (Anas carolinensis) (Gmelin); the blue wing teal (Anas discors) Linnaeus; the pintail (Anas acuta) Linnaeus; and the shoveller (Spatula clypeata) (Linnaeus). One mallard was observed on October fourth. The green winged teal was observed three times (March 30, April 9, and October 15). The blue winged teal was sighted two times (March 30 and October 11). The pintail was observed three days in succession on April 20, 22, 24. The shoveller was only sighted once on October 12.

The Falconiformes was represented by two families: the Accipitridae, of which the Swainson hawk (Buteo swainsoni) Bonaparte and the marsh hawk (Circus cyaneus) are members; and the Falconidae to which the sparrow hawk (Falco sparverius) Linnaeus belongs. The hawks previously mentioned were sighted several times soaring over the area but were rarely seen in the area.

Due to the heavy cover of trees and shrubby vegetation, these birds were not successful at attempting to utilize the study area for capturing prey. It would be feasible to assume that when these species were sighted they were probably searching for prey animals in the surrounding areas and had little, if any, relation with the research area.

The order Galliformes was represented by the bobwhite (Colinus virginianus) (Linnaeus) and the ring-necked pheasant (Phasianus colchicus) Linnaeus. Both species were frequently observed. The bobwhite was quite

numerous in the areas where cover was very dense. They appeared to show preference for the Ambrosia trifida communities and to areas with an abundance of woody vegetation. One larve covey of approximately 35 birds resided in the area during the whole study period. On May second, two nests were found in the Ambrosia trifida community in small depressions in the ground. These nests were composed largely of leaves and grasses. One nest contained nine eggs while the other contained twelve. These were observed almost daily and it was discovered that the incubation period was between 19 and 21 days. Mating and incubation occurs almost all summer. According to Goodrich (1946), nests may be found from April to October but most incubation is probably accomplished from May to August.

The ring-necked pheasant was a common sight in the research area. It was observed most frequently in the wild rye communities and along the ecotone. This species was not found in areas where the canopy was too dense to allow flight or in areas where continual dampness prevailed. In the last week in March and the first two weeks in April, cock pheasants were observed quite frequently along the ecotone in the early mornings crowing and exhibiting other types of courtship behavior. This is presumably an indication of the establishment of crowing grounds. As the study progressed, fewer and fewer males were observed in this area. Mating is polygamous and occurs, according to Wing (1951), from early April to July. The remains of three nests were found along the edge of the alfalfa field after the vegetation had been removed by mowing. Although the eggs were broken it was estimated that the average clutch was nine. According to Wing (1951), the incubation period for this species varies from 20 to 23 days.

The American coot (Fulica americana) Gmelin was the only member of the Gruiformes observed in this study. This species was only a rare visitant to the area. It was sighted on October first and October 12.

The Charadriiformes was represented by one species, the killdeer (Charadrius vociferus) Linnaeus. This species was present in the area all summer. The first observation was on March ninth; it was present, but in small numbers, until the termination of the study. This bird was most frequently observed feeding along the water's edge. Nesting was not evident in the area; however, this species is a common summer resident.

The greater yellowlegs (Totanus melanoleucus) (Gmelin) and the spotted sandpiper (Actitis macularia) (Linnaeus) were represented in this study. The greater yellowlegs was sighted once on April third; the spotted sandpiper was observed on March 21 and September 14.

The mourning dove (Zenaidura macroura) (Linnaeus) was the only member of the family Columbidae (order Columbiformes) found in this study. This species was first observed March 10 and was numerous in the area until the termination of the study. They were present in the area throughout the day but were much more common in the early morning and evening. The wooded area probably served as a roosting area and a watering place. They left the creekbank area in the mornings and returned each evening after ranging into the surrounding areas during the day. Four nests of this species were found in crotches of tree limbs. These nests were very poorly constructed being composed of only a few twigs with no lining. The average number of eggs was two per nest.

The Cuculiformes was represented by the yellow billed cuckoo (Coccyzus americanus) (Linnaeus). This species was first sighted on April 31 and last

observed September 30. It was very common in the area during July and August. This species tended to prefer areas which were heavily wooded and was observed most often in the Catalpa speciosa community where sunlight was decreased markedly. According to Sullivan (1910), they are considered among the most beneficial of the woods-dwelling birds. Their abundance and entomophagus habits make this species highly beneficial in natural control of insects.

The horned owl (Bubo virginianus) (Gmelin) and the screech owl (Otus asio) (Linnaeus) were the only members of the family Stringidae (order Stringiformes) observed. The horned owl was present in the area throughout the study period; two (probably a pair) were sighted almost daily. No nests were located but according to Goodrich (1946), they nest upon ledges, in hollow trees, and in abandoned hawk nests forming a nest with little or no lining. Pellets of this species were collected and analyzed. It was found that the food eaten was primarily composed of small rodents. Remains of Peromyscus spp., Microtus ochrogaster, Citellus tridecemlineatus, and Reithrodontomys spp. were found along with some remnants of Syvilagus spp. and birds. These birds appeared to utilize the research area as a roosting place during the day and were commonly sighted together in the same tree day after day. It is assumed that they searched for prey in the surrounding areas during the mornings, evenings, and nights.

No visual observations of the screech owl were made but its call was one of the more common sounds in the study area during hours of darkness. From the number of calls it was estimated that at least a pair was inhabiting the area throughout the study period. According to Goodrich (1946), screech owls are known to include numerous birds in their diet. For this



reason, they are considered by some to nullify, if not exceed, the good they do through the destruction of mice, insects, and other harmful species.

The belted kingfisher (Megaceryle alcyon) (Linnaeus) of the family Alcedinidae was the only representative of the order Coraciiformes. This was, however, a common bird in the area from the second of April until the termination of the study. It was most often observed perched on a tree limb extending over the water. At times, this bird would actually dive into the water to capture a food animal, usually a small fish. This species was usually sighted singly or in pairs, never more than three in a flock. Nesting was not noted in this study, but according to Goodrich (1946), nesting usually occurs in holes in banks or under bridges.

Five woodpeckers (family Picidae) of the order Piciformes were represented in this study. The following species were observed: the yellow shafted flicker (Colaptes auratus) Bangs, the red shafted flicker (Colaptes cafer) Vigors, the red headed woodpecker (Melanerpes erythrocephalus) (Linnaeus), the hairy woodpecker (Dendrocopos villosus) (Linnaeus), and the downy woodpecker (Dendrocopos pubescens) (Linnaeus).

The yellow shafted flicker was the most common species of this family. It was common in the area throughout the study period; the highest numbers were recorded in July and August. This species, according to Tordoff (1956) is, more or less, limited to the eastern portion of the state with the red shafted flicker replacing it in the western counties. Hybridization sometimes occurs when the two species inhabit the same areas. Hybrid offspring showed marked resemblances to the yellow shafted species except that the underwing and tail coloration is an orange color instead of yellow. Both

species were very common in this study and undoubtedly interbreeding resulted. However, the yellow shafted species tended to be the most numerous.

The red headed woodpecker was also a very common resident of the area. It was first sighted March 30 and was present until October 13. A majority of the individuals were observed in American elm trees or flying from one tree to another. This species seemed to prefer somewhat open areas with scattered trees rather than the Catalpa speciosa community where the canopy was very dense.

The hairy and downy woodpeckers were also observed in close relationship with each other inhabiting the same habitats. The habitats preferred by these birds were areas where trees were quite dense but with an incompletely closed canopy. These species were observed most often on trunks of American elm and green ash trees where they fed upon insects and larvae under the bark scales.

The Passeriformes was represented by the largest number of families in this study. This order contained the Tyrannidae of which the eastern kingbird (Tyrannus tyrannus) (Linnaeus), the western kingbird (Tyrannus verticalis) Say, the scissor tailed flycatcher (Muscivora forficata) (Gmelin), the eastern phoebe (Sayornis phoebe) (Latham), and the crested flycatcher (Myiarchus crinitus) Bangs are members.

The eastern and western kingbirds were occasionally observed between May first and September second. These birds were found primarily along the periphery of the study area where they ranged out over the open fields to feed. They were sighted in wooded areas infrequently.

The scissor tailed flycatcher was observed once in this study (a pair was observed August 21).

The eastern phoebe was a rare visitant to the area (April 12, May 21, July 14).

The crested flycatcher was also observed in small numbers (May 3, July 12, July 30, and August 12).

The only member of the Aludidae, the horned lark (Eremophila alpestris) (Linnaeus) was observed very infrequently. This bird tended to be a prairie species but was observed twice along the ecotonal area (March 7 and April 4).

The tree swallow (Iridoprocne bicolor) (Vieillot), bank swallow (Riparia riparia) (Linnaeus), barn swallow (Hirundo rustica) Linnaeus and purple martin (Progne subis) (Linnaeus) were the only members of the family Hirundinidae observed in this study.

The bank swallow was an infrequent transient. Individuals were observed on April 21 and 24.

The barn swallow was much more common in the area, being abundant from April 19 until September eighth. These birds were commonly observed sitting on power lines close to the study area and on tree limbs along the ecotonal area. They were most active early in the mornings and evenings when they fed heavily upon flying insects.

Nesting occurred under a bridge approximately two hundred yards away from the study area. The nests, constructed on bridge beams, were mud structures with interwoven reinforcements of grass, horse hair, and string. Feathers were utilized as a lining for the mud structure. Clutches of four to five eggs were laid in June and hatched in July.

Individual bank swallows were observed on April 12, June 9, and August 12.

The purple martin was also rarely observed (June 21 and July 15).

The blue jay (Cyanocitta cristata) (Linnaeus), and the crow (Corvus brachyrhynchos) Brehm were the only members of the family Corvidae observed. These species were two of the most common birds observed in this study especially during their migrations.

The blue jay was first observed on April 27. After this date, the population rapidly increased until it was the most numerous species. They remained in great numbers until late July when they began decreasing in numbers. From July 21 to September 12 the population appeared to become somewhat stabilized until the fall migration which occurred between September 22 and October sixth. These birds seemed to have no particular habitat preference and were observed inhabiting every available area. However, they were less numerous in the heavily wooded areas than in other places. Mating and nesting occurred in June and July. Eight nests were discovered in dense shrubs and low trees. These nests were rather crudely constructed of sticks, bark, weeds, and almost any other similar material. The average clutch was five; hatching was in June and July. This species utilized mulberries, hackberries, chokecherries, and currants extensively as food. When these fruits were ripening large numbers could be counted feeding on them.

The crow was abundant in early spring and fall; few individuals were observed during July and August. The first observation was made on March seventh and the last on October 21. Largest numbers were observed during early mornings and evenings. During the fall migrations, crows moved into the area in large numbers about sunset and left early the next morning.

The black capped chickadee (Parus atricapillus) Linnaeus of the family Paridae was a fairly common resident throughout the study period. They were

very common from the beginning of the study until late May. Their numbers then decreased slightly until September when they again increased slightly.

The family Sittidae was represented by the white breasted nuthatch (Sitta carolinensis) Latham and the red breasted nuthatch (Sitta canadensis) Linnaeus. Single red breasted nuthatches were sighted on April 23 and May fourth. The white breasted nuthatch was observed only once (June 12).

The house wren (Troglodytes aedon) Vieillot and the Carolina wren (Thryothornus ludovicianus) (Latham) of the family Troglodytidae were observed on the area. The house wren was present in small numbers all summer. Two nests were observed in American elm trees along the ecotone. These nests were located in holes in the lower limbs and were closely guarded by the female. The clutch size varied from six to eight eggs and clutches were complete in June.

The Carolina wren did not breed in the area and was sighted only four times (June 14, July 16, 21, and August 14).

The mockingbird (Mimus polyglottos) (Linnaeus), the catbird (Dumetella carolinensis) (Linnaeus) and the brown thrasher (Toxosoma rufum) (Linnaeus) were the only members of the family Mimidae observed. The mockingbird was observed infrequently from April fourth until September 24. It may have bred but no evidence of nesting was discovered.

The catbird was only rarely observed (June 21 and July 3).

The brown thrasher was numerous from April 12 until August first. It was rarely observed between August first and September second. It was most frequently observed in heavy, shrubby vegetation; chokecherry bushes were inhabited frequently, especially during the period when the fruit was ripening.

The family Turdidae was represented by the robin (Turdus migratorius) Linnaeus, the wood thrush (Hylocichla mustelina) (Gmelin), the hermit thrush (Hylocichla guttata) (Pallas), the olive backed thrush (Hylocichla ustulata) (Nuttall) and the eastern bluebird (Sialia sialis) (Linnaeus).

The robin was one of the more common species observed. It was prevalent in the area from March seventh until October 21. This species is present in the Hays area all year but there is a variation in population numbers in April and again in September and October.

It is likely that the summer resident population migrates farther south in fall and that these are replaced by a more northern population in winter. In April these winter residents return north and the breeding population returns from the south.

The wood thrush was observed May 2, 14; the hermit thrush on April 29 and May fourth; the olive backed thrush, May 14; the eastern bluebird, May 21.

The golden crowned kinglet (Regulus satrapa) Lichtenstien and the ruby crowned kinglet (Regulus calendula) (Linnaeus) were the only members of the family Regulidae observed. The golden crowned kinglets were observed on March 21 and September 12 and the ruby crowned kinglets only on September 14.

The cedar waxwing (Bombycilla cedrorum) Vieillot was the only member of the family Bombycillidae observed in this study. They were uncommon transients in the area on March 7, 12, 19, and again on October 14, 18.

The family Ianiidae was represented by the loggershead shrike (Ianius ludovicianus) Linnaeus. It was not commonly observed in the study area. Observations made on March 19 and June 12 were of single individuals sitting

on limbs along the ecotonal area and on telephone wires along the road near the study area.

The starling (*Sturnus vulgaris*) Linnaeus of the family Sturnidae was very numerous in the research area during the entire study period; most numerous in April and May and again in September and October. The population became stabilized during the summer months, and showed little variation.

This old world species was introduced into the United States in 1890, and first appeared in Kansas in 1929 and 1930. The first arrivals were pushed back by the cold weather but gradually they adapted to meet this environmental resistance. It is now a hardy species and has become established over most of its American range (Cooke, 1925).

Starlings build nests of twigs, grasses, leaves, and similar material almost anywhere sufficient protection can be found. About six blue-white eggs are laid. They are essentially ground feeding, insectivorous birds and when present in large numbers account for an untold quantity of destructive insects (Kalmbach and Gabrielson, 1925).

The red eyed vireo (*Vireo olivaceus*) and the warbling vireo (*Vireo gilvus*) (Vieillot) were the only members of the family Vireonidae observed in this study. There were rare visitants to the area during their migratory flights. The red eyed vireo was observed on May 24 and June 12; the warbling vireo on May 14, 21, and June 12.

The following represented the family Parulidae in this study: black and white warbler (*Mniotilta varia*) (Linnaeus); Tennessee warbler (*Vermivora peregrina*) (Wilson); Nashville warbler (*Vermivora ruficapilla*) (Wilson); yellow warbler (*Dendroica petechia*) (Linnaeus); orange crowned war-

bler (Vermivora celata) (Say); myrtle warbler (Dendroica coronata) (Linnaeus); Audobon warbler (Dendroica audoboni) (Townsend).

The warbler migration took place from April 13 to June first. As the season progressed their numbers increased very rapidly with the peak of the migration occurring about April 22. The myrtle warbler was the most numerous, being present in great numbers, followed, in order, by the black and white warbler, the yellow warbler, the Nashville warbler, the Tennessee warbler, the orange crowned warbler and the Audobon warbler.

Few warblers were observed from June first to August 31 but from this date until September 14, an increase in numbers was noted.

The English sparrow (Passer domesticus) (Linnaeus) was the only representative of the family Ploceidae. This species was present in significant numbers during the entire study. It was most frequently observed in the crowns of the highest trees. It nested on the area and in buildings within close proximity to the research area. Nests were composed of large, crudely arranged, masses of grasses, feathers, string, and similar materials. It was found that an average of six eggs was laid.

Goodrich (1946) states that this species was first released in Brooklyn, New York in 1850 and was later released in other parts of the United States and Canada. Apparently, it was first introduced to control caterpillars defoliating the shade trees of the east. It served this purpose, but had the capacity to adapt to fit almost all natural habitats in the United States, thus becoming a pest (Goodrich, 1946).

The family Icteridae was represented by the following: western meadowlark (Sturnella neglecta) Audobon; yellow headed blackbird (Xanthocephalus xanthocephalus) (Bonaparte); redwing (Agelaius phoeniceus) (Linnaeus);



orchard oriole (Icterus spurius) (Linnaeus); Baltimore oriole (Icterus galbula) (Linnaeus); cowbird (Molothrus ater) (Boddaert); common grackle (Quiscalus quiscalus) (Linnaeus).

The western meadowlark was observed only in the ecotonal area adjacent to the alfalfa field, as would be expected of the primarily prairie species.

The yellowheaded blackbird was observed only once, on August 21.

The redwing was observed only during April and September when several aggregations of approximately forty individuals were observed in the Ambrosia trifida community.

The common grackle was one of the more common species observed in this study and was abundant throughout the entire study period. The population peaks were reached during March and September; numbers became stabilized during the summer months. This is a nesting species in this area but no evidence of nesting was found. According to Beal (1900), this species is omnivorous. During migrating periods, large amounts of grain are eaten.

The family Fringillidae was represented by more species than any other family in this study. The following species were observed: cardinal (Richmondina cardinalis) (Linnaeus); blue grosbeak (Guiraca caerulea) Linnaeus; indigo bunting (Passerina cyanea) (Linnaeus); dickcissel (Spiza americana) (Gmelin); eastern goldfinch (Spinus tristis) (Linnaeus); savannah sparrow (Passerculus sandwichensis) (Gmelin); grasshopper sparrow (Ammodramus sava-narum) (Gmelin); vesper sparrow (Pooectes gramineus) (Gmelin); lark sparrow (Chondestes grammacus) (Say); Oregon junco (Junco oreganus) (Townsend); slate colored junco (Junco hyemalis) (Linnaeus); tree sparrow (Spizella arborea) (Wilson); field sparrow (Spizella pusilla) (Wilson); Harris sparrow (Zonotricha querula) (Nuttall); song sparrow (Melospiza melodia) (Wilson).

The cardinal was observed frequently from March seventh to May third. After this date few were observed until October third when the population began to increase.

The blue grosbeak was observed only on June 23; the indigo bunting on June 24.

The dickcissel (a prairie species) was observed occasionally along the ecotone. Birds were observed May 23, June 24, and June 26 in trees along the ecotone and on fences enclosing a pasture close to the study area.

The eastern goldfinch was observed on April 12, May 21, June 11, June 16, and September 21 but was never present in large numbers.

The pine siskin was observed abundantly from April first to April 20; after this date none were observed. It was one of the earlier migratory species arriving in large numbers and then quickly moving on.

The towhee was observed on three occasions (April 21, 28, and May 4). It preferred low bushes and shrubby vegetation and was never observed in the crowns of the tallest trees.

Several transient sparrows were rarely observed in this study. The Savannah sparrow was observed only on June 12; the grasshopper sparrow only on July 14; the vesper sparrow on June 16 and July 14 and the lark sparrow on May 14, June 12, and June 16.

The Oregon junco and the slate colored junco were observed early in the study (March 7 until April 10). Both species were observed most frequently feeding on the ground in the Elymus community. The Oregon junco was less common and was observed only three times (March 7, 12, 21). The slate colored junco was very common in March and the first week in April.

The tree sparrow was a common winter resident of the area during March. From March 31 to September 29 none were sighted. After this date until the termination of the study, they began to increase again. During March many of these birds were observed feeding on the seeds produced in the Ambrosia trifida community.

The field sparrow was observed along the ecotonal area between the alfalfa field and the streambank on June 12, July 21, July 28, and August 14. The Harris sparrow was observed on March seventh, March 12, March 14, and October 12. This species was most frequently observed in the Ambrosia trifida community where it fed on seeds of this plant.

The song sparrow was observed in brushy, tangled areas along the edge of the study area on March 22, March 24, April 2, and October 14. On one occasion, three were observed feeding on seeds of Setaria lutescens along the ecotonal area.

### Mammals

The opossum (Didelphis marsupialis) Linnaeus was one of the more common mammals observed in this study. It was most often observed at night in the wild rye communities and along the ecotone. Four opossums were observed between March seventh and October 21. Tracks and scats of this species were quite common in the area indicating their presence in moderate numbers.

The opossum is omnivorous. An analysis of the stomach contents of three specimens taken in June and August was undertaken by Adrian (1958). It was discovered that the contents consisted of 81 per cent animal material which included earthworms, frogs, crayfish, insects, unidentified bird feathers and unidentified mammalian hair. Miscellaneous plant fragments made up 19 per cent of the diet. Fitch (1954) states that during the winter, the opos-

sum lives chiefly as a scavenger, utilizing miscellaneous food sources such as garbage and storm-killed vertebrates. Scat analyses undertaken in this study indicate that large amounts of plant material was eaten. During the periods when such fruit bearing plants as mulberry, chokecherry, and wild grape were bearing fruit, the diet of this species was composed primarily of these fruits.

Hall (1955) and Cockrum (1952) state that three to 17 young are born after a gestation period of approximately 11 days. After parturition the young animal crawls into the pouch on the lower abdomen and attaches itself to a teat. Here they remain attached for a period of 70 days; at the end of this period the condition of the young roughly corresponds to the condition of other mammals at birth (Hall, 1955).

The eastern mole (Scalopus aquaticus) (Linnaeus) was known to be present in the study area because of its ridged feeding burrows. It was found only along the ecotonal line where the soil had been cultivated. Therefore, it seems feasible to assume that they are restricted largely to cultivated fields and seldom inhabit streambank areas.

This species constructs two types of burrows; the feeding burrow just under the soil surface and the permanent burrows six to ten inches below the surface (Cockrum, 1952). Hall (1955) reported that these animals spend more than 99 per cent of their time below ground, emerging only at night from the burrows. At such time they are preyed upon by owls. Adrian (1958) stated that the skulls of moles were found in approximately 0.4 per cent of pellets of B. virginianus in Ford County, Kansas.

Scheffer (1923) relates that moles have a comparatively low reproductive rate. Since protection against predation is afforded, to a great ex-

tent, by the underground habitat, a great reproductive rate is not necessary to maintain the normal population numbers. Hall (1955) states that only one litter of three to five young is produced annually in March and April.

The eastern cottontail (Sylvilagus floridanus) (J. A. Allen) was the most common lagomorph found in the study. It occurred in almost all of the terrestrial habitats but was more common in bushy areas where the undergrowth was quite dense. One area containing smooth sumac (Rhus glabra) was very heavily utilized by this species especially in early March when green vegetation was not yet evident.

A great variety of herbaceous food is eaten by this species. During the inclement periods of winter, bark and woody stems of saplings were eaten. There was much indication of this type of feeding in the area in early March. Almost every small woody plant had been gnawed above the snow level.

Breeding occurs from mid-January into August and each female may produce several litters.

Owl pellet analyses and scat analyses indicated that these animals fall prey to a number of predators. Although remains were found infrequently in pellets of B. virginianus, Smith (1958) found that cottontail rabbits composed approximately 1.4 per cent of the owl's diet. Rabbit remains were also found in scats of the coyote and raccoon.

The black-tailed jackrabbit (Lepus californicus) Gray was not a regular inhabitant of the area. It was observed only three times along the ecotonal line and apparently it was an immigrant from surrounding communities.

The fox squirrel (Sciurus niger) Linnaeus was present in small numbers in the area; none were observed in the spring and early summer. Two nests

were found in August. In September and October several observations of the adult animals were made.

Bugbee and Riegel (1945) studied the seasonal food preferences of this species at Hays, Kansas. They found that in late summer and fall such foods as hackberry nipple galls (Pachysylla mamma), red cedar berries (Juniperus virginiana), honey locust pods (Gleditsia triacanthos) and bark of Russian olive trees (Eleagnus angustifolia) were eaten. Adrian (1958) found that seeds of American elm made up 70 per cent of the stomach contents of a specimen killed May 6, 1958.

Fox squirrel nests are of two types; the loosely constructed summer nests of leaves in the upper branches of trees and the more substantial winter nests composed of leaves and twigs. The latter are sometimes found in hollow trees.

In Kansas, according to Hall (1955), mating occurs in January and the two to four young are born in late February or early March.

The beaver (Castor canadensis) Kuhl occurred in the area in very small numbers. No visual observations were made but several freshly gnawed trees were found (Fig. 16).

Beavers are primarily herbivorous. The main food items are the inner bark and twigs of several species of deciduous trees. Members of the genus Populus are preferred (Stains and Baker, 1958).

Very little is known about the reproduction of the beaver. Asdell (1946) believes that mating usually occurs in January and February. After a gestation period of approximately 128 days, a litter of three or four is born.

One specimen of the grasshopper mouse (Onychomys leucogaster) (Wied) was trapped in this study in the western wheatgrass community. This single



Fig. 16. The only indication of beaver activity in the study area was the gnawed trees.

record suggests that this species is not a common inhabitant of the creek-bank community. Adrian (1958) stated that in Ford County this mouse showed a distinct preference for open areas but apparently no preference for any given vegetation type.

Its diet consists primarily of 85 to 90 per cent insects from early spring to early fall. During the winter a variety of plant seeds are eaten. An analysis of 13 stomachs of specimens taken in June showed that grasshoppers and camel crickets comprised 93 per cent of the total diet (Adrian, 1958).

Asdell (1946) indicates that breeding occurs from April to September, with a gestation period of 33 days. The average number of embryos per female is 4.2.

The western harvest mouse (Reithrodontomys megalotis) (Baird) was most abundant in very heavily vegetated areas with an abundance of seed-producing plants. During the period when the seeds of foxtail (Setaria spp.) and wild rye (Elymus virginicus) were ripening the numbers captured in these communities increased. According to Hall (1955), the food of this species is primarily made up of grass seeds; chiefly those of switch grass (Panicum virgatum), indian grass (Sorghastrum nutans), foxtail, and side oats grama (Bouteloua curtipendula).

Adrian (1958) found an average of 4.7 embryos in gravid females examined. Hall (1955) stated that the normal litter size ranges between two and five.

The deer mouse (Peromyscus maniculatus) (Wagner) was captured 13 times during the study period. Most of these were captured in the western wheat-grass community in association with P. leucopus. P. maniculatus was restricted to this relatively open area and was not found in the heavily wooded creek-bank community with P. leucopus.



Stomach analyses of ten specimens taken in June and July showed that insects made up a large percentage of the total diet. The remainder of the food eaten was composed of plant seeds too well masticated for identification.

Adrian (1958) found that of the 18 stomachs analyzed, insects, primarily grasshoppers, made up 67 per cent of the food taken by adults and 94 per cent of food taken by sub-adults. Brown (1946) reported P. maniculatus utilized a total of 24 species of plants, of which seven were grasses and 17 were forbs.

According to Asdell (1946) and Brown (1946), the deer mouse tends to breed throughout the year. Gravid females were taken in March, April, and August in this study. These were dissected and it was found that the litter size varied from one to nine. Adrian (1958) stated that, of the 85 gravid females examined, an average of 3.3 embryos was found.

The woods mouse (Peromyscus leucopus) (Rafinesque) was the most common small mammal captured, being taken 113 times in this study. It was first found in Ellis County by Frydendall (1960). This mouse showed a definite preference for shaded areas with much open space on the ground level. It was captured most abundantly around trash piles and around bases of large trees where herbaceous vegetation was very sparse (Fig. 17). However, it was found occasionally in all other areas. The western wheatgrass communities were the least productive. This species tends to replace P. maniculatus in the moist, shady habitats and is not found in the more xeric prairie habitats on the uplands. Hibbard (1944) seems to believe this restriction is due to the more humid environment in these habitats. However, Dice (1922) found the deer mouse and the woods mouse in open fields of the same area but



Fig. 17. The type of habitat where Peromyscus leucopus was most abundantly captured. The trash piles similar to the one in the picture were very productive. Note the large amount of open space on the ground level.

failed to find sufficient differences in their ecological requirements to be the basis of the distinctly different habitat preference. Chew (1951) found experimentally that P. leucopus could survive the severe prairie habitat but he pointed out that survival of the individual does not imply survival of the race.

One hundred and ten specimens of P. leucopus were brought into the laboratory, dissected and their stomach contents analyzed. It was discovered that a majority of the food eaten was composed of seeds. The seeds of Setaria spp., Amaranthus spp., Ambrosia spp., and Helianthus spp. were the most common food components. Insects, green portions of plants, and tree bark were present but only in small quantities.

Asdell (1946) stated that the woods mouse, like the deer mouse, breeds throughout the year. However, reproduction tends to decline in July and August. Hall (1955) stated the gestation period was from 21 to 27 days. Of the seventeen gravid females examined an average of 5.5 embryos per female was found.

Nests of this species were found in log piles, holes in trees, and burrows.

The muskrat (Ondatra zibethicus) (Linnaeus) was not common in the area. The only sighting during the study period was in the daytime. However, since muskrats are primarily nocturnal, they were probably more common than casual observations indicated. No indication of colonies or houses was discovered leading to the assumption that it was not a breeding species in the area. Since aquatic vegetation is its main food, it seems feasible to assume that this might possibly be a factor for its limited numbers in the area. The

muskrat is essentially herbivorous, eating rhizomes of cattails (Typha spp.) and other aquatic plants (Stains and Baker, 1958).

Errington (1937<sup>b</sup>) stated that the breeding season in central Iowa occurred during May, June, and July. The gestation period was 29 to 30 days. The number of young per female averaged 6.3 in 26 litters studied by Errington (1939). The young are born blind and helpless, open their eyes between the 12th and 20th day of life, and become independent after the first month (Hall, 1955).

The prairie vole (Microtus ochrogaster) (Wagner) was an uncommon representative of the microtine rodents captured in this study. This species was only captured twice during the study period. One specimen was captured in the western wheatgrass community and the other in the wild rye community. This is primarily a prairie species inhabiting most of the habitats of the mixed prairie association near Hays, Kansas. This species tends to exhibit a marked population fluctuation with the cotton rat (Sigmodon hispidus). Martin (1956) suggested an ecological relationship between the abundance of cotton rats and the depressed population of the vole.

The prairie vole feeds primarily on growing grass in spring and summer. Martin (1956) indicated that voles cut successive sections from the bases of grasses until the meristematic tissues are within reach and then only these are eaten. This habit is one factor which causes much concern in range management due to the large amounts of vegetation destroyed. Martin (1956) stated that seeds of plants, insects, rhizomes, and tubers are also eaten.

A number of studies have been made on the breeding habits of the prairie vole (Bailey, 1924; Jameson, 1956; Martin, 1956; and Fitch, 1957). Martin (1956) found the rate of reproduction to be correlated with rainfall. It is

thought that the amount of rainfall exerts an influence indirectly by affecting the vegetation. The gestation period of this species is approximately 21 days. Adrian (1958) examined seven gravid females and found an average of 3.3 embryos per female. The size of the litter, however, is affected by the age of the female and by the season of the year (Jameson, 1956).

Examinations of owl pellets collected on the study area disclosed that approximately ten per cent of the food eaten by horned owls was composed of the prairie vole. Since this species was not captured in this study in significant numbers, it is assumed that the owls captured prey on areas other than the study area.

The Norway rat (Rattus norvegicus) (Berkenhout) was captured in a trash dump on the study area and was not found in any other habitat (Fig. 18). They were uncommon, being captured four times during the study period. A variety of food is eaten by this species; stomach content analysis of the four specimens revealed large amounts of wheat, milo, and other grains. Several bushels of such grains had been dumped there because of spoilage.

Cockrum (1952) states that if food is abundant and shelter is adequate, breeding in this species occurs throughout the year. The litter size varies in different parts of the world and an average for Kansas has not been determined (Cockrum, 1952). One gravid female was examined in this study and eight embryos were found.

The house mouse (Mus musculus) Linnaeus is an exotic species common in the fields during the summer and around farm buildings in the winter months. Sixty-seven specimens were captured during the study period. They were captured with greatest frequency during June, July, and August; in September and October their abundance decreased markedly. It is assumed that this



Fig. 18. The only habitat of Rattus norvegicus found on the study area.

species abandoned the fields at the onset of cold weather. They were captured in all available habitats but were found in largest numbers in the wild rye communities and in trash piles.

Stomach analyses revealed that insects (especially Orthoptera) made up a large percentage of the diet of the house mouse during June and July. Seeds and grain were found to compose the largest percentage during August, September, and October.

Asdell (1946) stated that the house mouse breeds throughout the year. The gestation period is approximately 19 days. Of 16 gravid females examined, the average number of embryos was seven.

The coyote (Canis latrans) Say was known to be present in the area because of numerous scats and tracks (Fig. 19). This carnivore was not a permanent resident and was present only as it passed through the area. Most of the tracks and scats were observed along the ecotonal area and not deep in the streambank community.

Hall (1955) stated that the coyote population fluctuates; after reaching a peak in abundance the population declines for two to four years to a low point then an increase in numbers is noted. Gier (1955) analyzed the stomachs of 1656 coyotes and found that rabbits constituted 53 per cent, carrion 27 per cent, rodents 7.7 per cent, other mammals 0.8 per cent, chicken 7.3 per cent, wild birds 0.7 per cent, and miscellaneous 3.5 per cent. The coyote, like other predators, consumes the largest percentage of the most accessible food item in the habitat. Scats analyzed in this study contained largely rabbits (Sylvilagus spp.), rodents (Peromyscus spp., Microtus spp., Reithrodontomys spp.) and birds (probably chicken or pheasant).



Fig. 19. Coyote tracks found in the study area along the ecotone.



According to Gier (1955), the coyote breeds from early February to late March. After a gestation period of approximately 60 days, from three to 12 young are born.

The raccoon (Procyon lotor) (Linnaeus), judging from the number of tracks and scats found, was the most abundant larger mammal present in the area (Fig. 20). During the study, four raccoons were observed. Tracks, as could be expected, were most numerous along the streambank closely adjacent to the water's edge, while scats were found in greatest abundance along the ecotonal area.

The raccoon, according to Hall (1955), is an omnivorous animal. Fifty-five per cent of the raccoon's diet is plant material. Food eaten depends upon what is most abundant in the habitat. Scat analysis revealed that in July large amounts of mulberries were eaten; in August, chokecherries were eaten in large numbers; and in September and October hackberries and sorghum were the principal foods. Very few mammalian remains were discovered with the genus Peromyscus being the most common animal eaten. Adrian (1958) stated that many more mammalian remains were found in scats during the winter. The raccoon also fed heavily upon aquatic animals when possible. Fragments of crayfish (Procambarus sp.) were found along the stream where raccoons had consumed the fleshy portions.

According to Stains (1956), mating occurs from December to June in Kansas. After a gestation period of 63 days a litter from one to six is born. Usually only one litter per year is produced.

The mink (Mustela vison) Schreber was not visually observed and only once were the tracks positively identified, thus indicating very few animals in the immediate area.



Fig. 20. Raccoon tracks found in the study area.

Mink, according to Stains and Baker (1958), prefer streams that have abundant bank vegetation. Areas of brush and timber near swamps also provide a good habitat.

The mink, being largely carnivorous, eats a large variety of animal life. Korschgen (1958) found that mink ate frogs, muskrats and aquatic invertebrates; plant material is also eaten but in very small percentages.

The long tailed weasel (Mustela frenata) Lichtenstein was another very uncommon mammal of the study area. One was observed while fishing at approximately 6:00 p.m. July 13, 1960. The animal was sighted darting from an old fallen tree into a hole in the bank approximately ten feet from the water level.

Errington (1936) revealed that weasels ate a variety of animal life. Insects, mainly Carabidae, and small mammals made up the bulk of the food eaten. The thirteen lined ground squirrel was the most common species in the fecal samples.

A single litter of nine young are born in the spring, usually in April, after a gestation period up to 337 days (delayed implantation). After implantation, embryos develop in 27 days (Hall, 1955).

The badger (Taxidea taxus) (Schreber) was common in the area throughout the study period. Its presence was evident due to the large number of burrows located (Fig. 21). Thirteen burrows were observed along the ecotonal area, but none were observed in the heavily wooded areas. Three observations of this species were also made.

Stains and Baker (1958) stated that the food of the badger consists almost entirely of small mammals. Insects, the young of ground nesting birds, and reptiles are sometimes eaten (Snead and Hendrickson, 1942).



Fig. 21. A badger burrow along the ecotone.  
These burrows were quite common in  
this area.

Adrian (1958) stated that the badger mates in late summer, but implantation does not occur until about February 15. A litter of from one to five is produced between February and May.

The striped skunk (Mephitis mephitis) (Schreber) was found to be one of the more common mammals of the area. Visual observations of this species were made two times and one dead specimen was found. Numerous tracks and scats were also located (Fig. 22). Skunks are frequently found in heavily populated areas and are well adjusted to life close to, or even under, the dwellings of men, although the animals prefer wooded areas and adjoining grasslands often within close proximity to water (Stains and Baker, 1958).

Dens are often enlarged burrows of other animals and are seldom originally excavated. Often these animals utilize such shelters as hollow logs, rock piles, haystacks and buildings.

According to Stains and Baker (1958), the striped skunk is omnivorous and eats a wide variety of foods. Scats collected at various times during the summer were analyzed. It was discovered that insects, made up the largest percentage of the diet during the whole summer. Fruits such as mulberries and wild grapes were also eaten but not to any extent. A majority of scats collected also contained mammalian remains. Skull fragments of Peromyscus spp. and Mus spp. were identified.

According to Adrian (1958) the striped skunk breeds in late February. After a gestation period of 63 days, from two to 16 young may be born in one litter, but four is the usual number for the first brood of a female and six to eight for the second (Stains and Baker, 1958).

An animal, believed to be a spotted skunk (Spilogale putorius) (Linnaeus), was observed at night on July 10, 1960. Stains and Baker (1958) re-



Fig. 22. Striped skunk tracks along the ecotone.

ported this species to be more inclined to assume a negative attitude toward man and does not inhabit heavily populated areas to any great extent.

The spotted skunk, like the striped skunk, is an omnivorous animal. Crabb (1941) analyzed 834 scats and found that the largest percentage of the diet during the summer to be composed of insects and in winter and spring mice constituted the principal food.

Hall (1955) stated that this species has one litter per year of two to seven young. The young attain adult size in three and a half to four months.

## SUMMARY

A study of the vertebrates of a streambank community was made between March seventh and October 21, 1960.

The primary purposes of this study were to discover what vertebrates inhabited this type of community and what ecological role each species played. It was also hoped that data pertaining to seasonal migrations of birds could be obtained.

The study area was a strip of streambank approximately three-quarters of a mile long on Big Creek near Hays, Ellis County, Kansas. The streambank was heavily covered with vegetation. Deciduous trees composed a large percentage of the vegetation with a very dense understory of herbaceous and shrubby plants growing under the canopy.

Amphibian specimens were captured in this study by searching under rocks, logs, and areas of similar nature. One hundred and sixty-five amphibian specimens were collected in this study representing six species, five genera, four families and two orders. Amphibian specimens were collected, taken into the laboratory, dissected and their stomach contents analyzed.

Reptilian specimens were captured by hand or by means of barrier traps especially in the case of snakes. A total of 59 specimens of snakes representing three families, nine genera, and 11 species were captured. Reptiles collected, other than snakes, were composed of 14 specimens representing two orders, four families, five genera, and five species. Stomach analyses were carried out whenever possible on the reptiles to aid in determining food habits.



The bird populations were surveyed by observations beginning the seventh of March and continuing throughout the summer and fall. A total of 90 species, representing 70 genera, 69 families, and 12 orders were observed during the study period. Observations of mating behavior, feeding habits, and habitat preferences were made. When nests were found, the clutch size was determined, and materials used in the construction of the nests were noted.

Selective snap trapping was utilized in collecting specimens of small mammals found in the area. A total of 2160 trap nights produced a catch of 218 specimens representing seven species of small mammals.

The specimens captured were dissected and their stomach contents analyzed. In the case of the gravid females, the embryos were counted.

The large mammal populations were surveyed by actual observations of the mammal, identification of tracks, identification of scats, and other indications.

A total of 14 species, representing 13 genera, nine families and five orders of large mammals were found to be present in the area either permanently or sporadically.

Scats, pellets, and fecal pellets were collected in the field, brought into the laboratory, and analyzed to determine predator-prey relationships, food habits, and food preferences.

No members of the order Chiroptera were found in the area but the author feels that if this study had been continued for a longer period of time that their presence might have been noted.

No members of the family Soricidae were captured. Cans, baited with bacon rind, were buried in several locations in attempting to capture the

shrews but the efforts were futile. This family would probably also be captured if the study could have been continued over a longer period of time.

APPENDIX

A. List of amphibians captured

<u>Bufo woodhousii</u>	Garden toad
<u>Bufo cognatus</u>	Plains toad
<u>Rana pipiens</u>	Leopard frog
<u>Acris crepitans</u>	Northern cricket frog
<u>Pseudacris nigrita</u>	Striped chorus frog
<u>Ambystoma tigrinum</u>	Tiger salamander

B. List of reptiles captured

<u>Holbrookia maculata</u>	Earless lizard
<u>Cnemidophorus sexlineatus</u>	Six-lined racerunner
<u>Chelydra serpentina</u>	Snapping turtle
<u>Chrysemys picta</u>	Painted turtle
<u>Terrapene ornata</u>	Ornate box turtle
<u>Lampropeltis triangulum</u>	Red king snake
<u>Heterodon platyrhinos</u>	Hognose snake
<u>Lampropeltis getulus</u>	Speckled king snake
<u>Elaphe guttata</u>	Rat snake
<u>Coluber constrictor</u>	Blue racer snake
<u>Masticophis flagellum</u>	Coachwhip snake
<u>Natrix sipedon</u>	Common water snake
<u>Thamnophis ordinatus</u>	Common garter snake
<u>Diadophis punctatus</u>	Ring-necked snake
<u>Pituophis melanoleucus</u>	Bull snake

## C. List of birds observed

<u>Ardea herodias</u>	Great blue heron
<u>Anas platyrhynchos</u>	Mallard
<u>Anas carolinensis</u>	Green winged teal
<u>Anas discors</u>	Blue winged teal
<u>Anas acuta</u>	Pintail
<u>Spatula clypeata</u>	Shoveller
<u>Buteo swainsoni</u>	Swainson hawk
<u>Circus cyaneus</u>	Marsh hawk
<u>Falco sparverius</u>	Sparrow hawk
<u>Colinus virginianus</u>	Bob white
<u>Phasianus colchicus</u>	Ring neck pheasant
<u>Fulica americana</u>	American coot
<u>Charadrius vociferus</u>	Killdeer
<u>Totanus melanoleucus</u>	Greater yellow-legs
<u>Actitis macularia</u>	Spotted sandpiper
<u>Zenaidura macroura</u>	Mourning dove
<u>Coccyzus americanus</u>	Yellow billed cuckoo
<u>Otus asio</u>	Screech owl
<u>Bubo virginicus</u>	Horned owl
<u>Megaceryle alcyon</u>	Belted kingfisher
<u>Colaptes auratus</u>	Yellow shafted flicker
<u>Colaptes cafer</u>	Red shafted flicker
<u>Melanerpes erythrocephalus</u>	Red headed woodpecker
<u>Dendrocopos villosus</u>	Hairy woodpecker
<u>Dendrocopos pubescens</u>	Downy woodpecker

<u>Tyrannus tyrannus</u>	Eastern kingbird
<u>Tyrannus verticalis</u>	Western kingbird
<u>Muscivora forficata</u>	Scissor tailed flycatcher
<u>Sayornis phoebe</u>	Eastern phoebe
<u>Myiarchus crinitus</u>	Crested flycatcher
<u>Eremophila alpestris</u>	Horned lark
<u>Iridoprocne bicolor</u>	Tree swallow
<u>Riparia riparia</u>	Bank swallow
<u>Hirundo rustica</u>	Barn swallow
<u>Progne subis</u>	Purple martin
<u>Cyanocitta cristata</u>	Blue jay
<u>Corvus brachyrhynchos</u>	Crow
<u>Parus atricapillus</u>	Black capped chickadee
<u>Sitta carolinensis</u>	White breasted nuthatch
<u>Sitta canadensis</u>	Red breasted nuthatch
<u>Certhia familiaris</u>	Brown creeper
<u>Troglodytes aedon</u>	House wren
<u>Thryothorus ludovicianus</u>	Carolina wren
<u>Mimus polyglottos</u>	Mocking bird
<u>Dumetella carolinensis</u>	Cat bird
<u>Toxostoma rufum</u>	Brown thrasher
<u>Turdus migratorius</u>	Robin
<u>Hylocichla mustelina</u>	Wood thrush
<u>Hylocichla guttata</u>	Hermit thrush
<u>Sialia sialis</u>	Eastern bluebird
<u>Regulus satrapa</u>	Golden crowned kinglet

<u>Regulus calendula</u>	Ruby crowned kinglet
<u>Bombycilla cedrorum</u>	Cedar waxwing
<u>Lanius ludovicianus</u>	Loggerhead shrike
<u>Sturnus vulgaris</u>	Starling
<u>Vireo olivaceus</u>	Red eyed vireo
<u>Vireo gilvus</u>	Warbling vireo
<u>Mniotilta varia</u>	Black and white warbler
<u>Vermivora peregrina</u>	Tennessee warbler
<u>Vermivora celata</u>	Orange crowned warbler
<u>Vermivora ruficapilla</u>	Nashville warbler
<u>Dendroica petechia</u>	Yellow warbler
<u>Dendroica coronata</u>	Myrtle warbler
<u>Dendroica auduboni</u>	Audobon warbler
<u>Passer domesticus</u>	English sparrow
<u>Sturnella neglecta</u>	Western meadowlark
<u>Xanthocephalus xanthocephalus</u>	Yellow-headed blackbird
<u>Agelaius phoeniceus</u>	Redwing
<u>Icterus spurius</u>	Orchard oriole
<u>Icterus galbula</u>	Baltimore oriole
<u>Molothrus ater</u>	Cowbird
<u>Quiscalus quiscalus</u>	Common grackle
<u>Richmondia cardinalis</u>	Cardinal
<u>Quiraca caerulea</u>	Blue grosbeak
<u>Passerina cyanea</u>	Indigo bunting
<u>Spiza americana</u>	Dickcissel
<u>Spinus tristis</u>	Eastern goldfinch

<u>Spinus pinus</u>	Pine siskin
<u>Pipilo erythrophthalmus</u>	Towhee
<u>Passerculus sandwichensis</u>	Savannah sparrow
<u>Ammodramus savannarum</u>	Grasshopper sparrow
<u>Pooecetes gramineus</u>	Vesper sparrow
<u>Chondestes grammacus</u>	Lark sparrow
<u>Junco oreganus</u>	Oregon junco
<u>Junco hyemalis</u>	Slate colored junco
<u>Spizella arborea</u>	Tree sparrow
<u>Spizella pusilla</u>	Field sparrow
<u>Zonotrichia querula</u>	Harris sparrow
<u>Melospiza melodia</u>	Song sparrow

D. List of mammals observed

<u>Didelphis marsupialis</u>	Opossum
<u>Scalopus aquaticus</u>	Eastern mole
<u>Sylvilagus floridanus</u>	Eastern cottontail
<u>Lepus californicus</u>	Black-tailed jackrabbit
<u>Sciurus niger</u>	Fox squirrel
<u>Castor canadensis</u>	Beaver
<u>Onychomys leucogaster</u>	Northern grasshopper mouse
<u>Reithrodontomys megalotis</u>	Western harvest mouse
<u>Peromyscus maniculatus</u>	Deer mouse
<u>Peromyscus leucopus</u>	Woods mouse
<u>Ondatra zibethicus</u>	Muskrat
<u>Microtus ochrogaster</u>	Prairie vole

<u>Rattus norvegicus</u>	Norway rat
<u>Mus musculus</u>	House mouse
<u>Canis latrans</u>	Coyote
<u>Procyon lotor</u>	Raccoon
<u>Mustela vison</u>	Mink
<u>Mustela frenata</u>	Long-tailed weasel
<u>Taxidea taxus</u>	Badger
<u>Mephitis mephitis</u>	Striped skunk
<u>Spilogale putorius</u>	Spotted skunk

E. List of herbaceous vegetation

<u>Convolvulus sepium</u>	Hedge bindweed
<u>Rhus toxicodendron</u>	Poison ivy
<u>Bromus japonicus</u>	Japanese brome
<u>Ambrosia trifida</u>	Giant ragweed
<u>Elymus canadensis</u>	Canada wildrye
<u>Allionia nyctaginea</u>	Broad leaved four o'clock
<u>Chenopodium gigantospermum</u>	Stinking goosefoot
<u>Kochia scoparia</u>	Fireweed
<u>Lactuca ludoviciana</u>	Wild lettuce
<u>Agropyron smithii</u>	Western wheatgrass
<u>Cirsium undulatum</u>	Wavy leaved thistle
<u>Solidago serotina</u>	Fall goldenrod
<u>Taraxicum officinale</u>	Dandelion
<u>Elymus virginicus</u>	Virginia wildrye
<u>Galium aparine</u>	Bedstraw



<u>Sophia pinnata</u>	Tansy mustard
<u>Sophia intermedia</u>	Tansy mustard
<u>Rumex altissimus</u>	Tall dock
<u>Helianthus annuus</u>	Annual sunflower
<u>Chenopodium album</u>	Lambsquarters
<u>Amaranthus retroflexus</u>	Red root pigweed
<u>Nyctelea nyctelia</u>	Nyctelea
<u>Silphium integrifolium</u>	Rosinweed
<u>Poa arida</u>	Plains bluegrass
<u>Poa pratensis</u>	Kentucky bluegrass
<u>Viola missouriensis</u>	Missouri violet
<u>Teucrium canadensis</u>	Wood germander
<u>Convolvulus arvensis</u>	Bindweed
<u>Pepo foetidissimus</u>	Wild gourd
<u>Xanthium commune</u>	Cocklebur
<u>Roripa sinuata</u>	Water cress
<u>Vernonia baldwini</u>	Iron weed
<u>Muhlenbergia racemosa</u>	Marsh muhly
<u>Muhlenbergia mexicana</u>	Mexican muhly
<u>Carex spp.</u>	Sedge
<u>Leptilon canadense</u>	Mules tail
<u>Sporobolus cryptandrus</u>	Side-oats grama
<u>Conium maculatum</u>	Queen Ann's lace
<u>Apocynum cannabinum</u>	Hemp dogbane
<u>Solanum rostratum</u>	Bull nettle

## F. List of woody vegetation

<u>Fraxinus lanceolata</u>	Green ash
<u>Vitus vulpina</u>	Wild grape
<u>Morus rubra</u>	Mulberry
<u>Acer negundo</u>	Box elder
<u>Prunus virginiana</u>	Chokecherry
<u>Ribes odorata</u>	Flowering currant
<u>Quercus macrocarpa</u>	Burr oak
<u>Prunus americana</u>	Wild plum
<u>Juglans nigra</u>	Black walnut
<u>Populus sargentii</u>	Cottonwood
<u>Salix amygdaloides</u>	Peach-leafed willow
<u>Catalpa speciosa</u>	Catalpa
<u>Rhus glabra</u>	Smooth sumac
<u>Celtis occidentalis</u>	Hackberry

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