AN ABSTRACT OF THE THESIS OF

Timothy D. Stephens for the Master of Science Degree

in Biology presented on 18 May 1985

Title: Avian and Mammalian Faunas of Swartz Canyon, Kansas

Abstract approved: Dwight L. Spencer

From May, 1984, through December, 1984, collections and observations of birds and mammals were made in and around Swartz Canyon in southeast Comanche County, Kansas.

A total of 39 mammal and 94 bird species were documented as inhabiting the area. Bird and mammal data recorded in this study were qualitatively and quanitatively compared to related data of other studies. Data were found to agree with reference literature. Minor changes in the mammalian fauna were found to have occurred since Cockrum's (1952) investigation of Red Hills mammals.

There were no discrepancies between the birds and mammals recorded in this study and those mentioned in other studies of Red Hills birds and mammals. Bird and mammal habitat preferences were analyzed and species grouped on the basis of habitat preference; these groups were further compared and discussed. Bird distributional limits described by Johnston (1965) were investigated and assigned to appropriate species recorded in this study. Probable affinities between bird distributional limits and habitat preference were compared and discussed.

AVIAN AND MAMMALIAN FAUNAS OF SWARTZ CANYON, KANSAS

A Thesis
Submitted to
the Division of Biological Sciences
Emporia State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Timothy D. Stephens
May, 1985

Dwight L. Spencer
Approved for Major Department

Harold E. Durst
Approved for Graduate Council

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I am indebted to Mr. and Mrs. Larry Scherich for allowing me to conduct this investigation in Swartz Canyon. Thanks to the Scherichs and Stan Roth, instructor at Lawrence High School, for providing valuable information on their observation made in the Swartz Canyon area.

To Crispin Dippel, graduate student at Emporia State University, I would like to express appreciation in assisting in field collecting and observations. To my wife, Lisa Stephens, special thanks for companionship in the field, and the editing and typing of this paper. A special thanks to Floy Schwilling for typing and editing of the final draft of this thesis.

INTRODUCTION

Swartz Canyon is located in southeast Comanche County, Kansas. Comanche County, together with Clark County on the west and Barber County on the east, comprise the majority of the physiographic area known as the Red Hills (Fig. 1). This area in southwest and south central Kansas is characterized by rugged relief and areas of red soil. It is bordered on the south by Oklahoma, on the west and north by the High Plains, and on the east by the Wellington Area. A region of unique physiography, the Red Hills consists of buttes, bluffs, plateaus, and stream valleys. The uniqueness in topography, geology, and geography has resulted in an interest in the area's fauna. The Red Hills have not been extensively studied. Little comprehensive research dealing with the area's birds and mammals has been done.

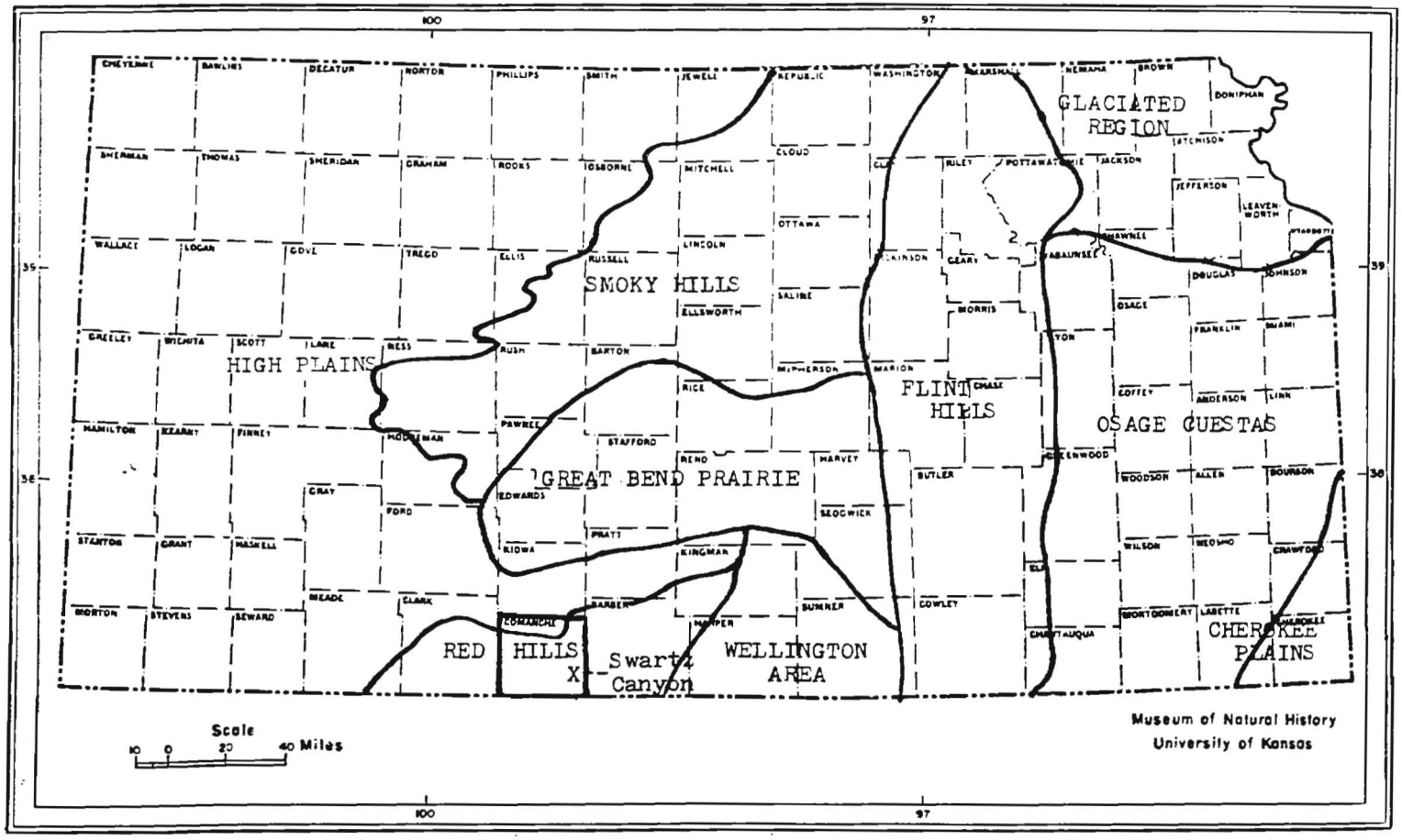
In view of the need for further research within the Red Hills, this investigation was undertaken with the following objectives:

1. To prepare a comprehensive list of birds and mammals inhabiting the Swartz Canyon area. This list was to be based on personal observations and field collections plus supplementary data from others who have collected or observed in the area.
2. To compare bird and mammal distributional data collected during this study with previously collected data.
3. To compile as complete a check-list as possible of avian and mammalian faunas occurring in Swartz Canyon and those inhabiting the Red Hills.

Literature Review

Despite the lack of comprehensive research within the Red Hills, some collecting, documentation, and studies have been done. The majority of

Figure 1. Physiographic map of Kansas.


100
97
GLACIATED REGION
SMOKY HILLS
HIGH PLAINS
FLINT HILLS
OSAGE CUESTAS
GREAT BEND PRAIRIE
RED HILLS
Swartz Canyon
WELLINGTON AREA
CHEROKEE PLAINS
Scale
10 0 20 40 Miles
Museum of Natural History
University of Kansas

past research has dealt with bats which inhabit the gypsum caverns. No previous studies dealing with bird and mammal censusing or populations confined to the Red Hills area have been located by a literature search.

Probably one of the first biologist interested in the fauna of the area and to visit Swartz Canyon was Nathaniel Goss. Goss (1886) reported observing nesting of black-capped vireos, Vireo atricapillo, and rock wrens, Salpinctes obsoletus, as well as other birds within Swartz Canyon and the surrounding areas. Hibbard (1934) investigated the bats inhabiting Red Hills caves. He visited Swartz Canyon and 12 caverns in the vicinity. Hibbard either observed or collected Myotis velifer, Myotis lucifugus, Eptesicus fuscus, and Plecotus townsendii within the caverns of Swartz Canyon. Twente (1955) investigated habitat selection and general behavior of cavern dwelling bats and conducted extensive research on the bats of Swartz Canyon. Dunnigan (1967) studied seasonal movements and population flucuations of the cave bat, Myotis velifer, many of which inhabited the caverns in Swartz Canyon. Jones (1967) mapped the distribution of Kansas bats and investigated the bats inhabiting Swartz Canyon caverns. Kuntz (1973) was the most recent researcher working in Swartz Canyon to have his works published. He investigated reproduction, growth, and development of Myotis velifer.

Although a review of the literature yielded few published studies dealing with the fauna of Swartz Canyon or the Red Hills, literature concerning the fauna of Kansas provided ample, general information on the birds and mammals expected to inhabit the area. Snow (1872) produced one of the first catalogues of Kansas birds. His publication was basically a check-list of Kansas birds and noted where and when the bird might be seen. Lantz (1898) published a review of Kansas ornithology, and he too

provided information on distribution and migration of Kansas birds. Snow (1902) revised his 1872 catalogue and included more recent information on the status of Kansas birds. Long (1940) also published a check-list of Kansas birds and Tordoff (1956) published another check-list updating the status of birds to be found in Kansas.

Literature dealing with Kansas mammals has been published, too. Allen (1940) provided a booklet on Kansas mammals which dealt with descriptions and distributions of mammals known to inhabit the State. Cockrum (1952) published a major work on Kansas mammals that was more extensive than Allen's and included species descriptions and distributions and often subspecies accounts as well. Cockrum also separated the state into seven distributional areas. Various Kansas mammals were assigned to one or more of these seven areas. Assignments were based on the presence or absence of a species within a given area. The Red Hills Subcenter is the distributional area of concern in this study. Bee et al (1981) published the latest book dealing with Kansas mammals. The book provided descriptions and distributions, but did not assign mammals to distributional areas.

A majority of the reference material used in this study was unpublished data from university museum collections, and observations either from personnel of the Kansas Fish and Game Commission or private citizens. Mammal collections at the University of Kansas Museum of Natural History and Fort Hays State Museum of the High Plains were examined. Both bird and mammal collection records at Emporia State University were researched. The Kansas Fish and Game Commission provided Kansas Ornithological Society (KOS) check-lists for Comanche and Barber counties. Collections and observations by Stan Roth and his Lawrence High School students were also

referred to in this study. Swartz Canyon area residents, Mr. and Mrs. Larry Scherich, commented on fauna they had observed in and around Swartz Canyon. Their observations were also noted in this study.

DESCRIPTION OF STUDY AREA

Red Hills

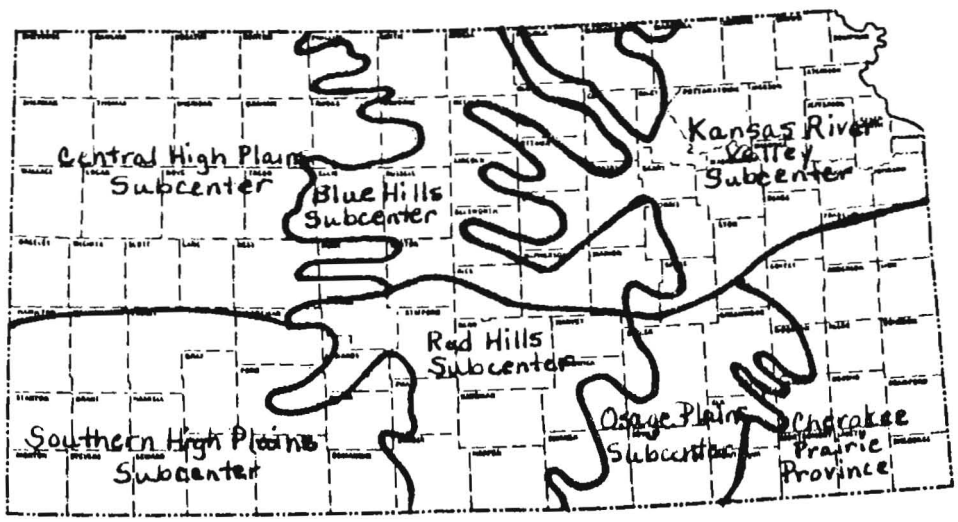
Cockrum (1952) developed a system for separating the state of Kansas into distributional areas on the basis of the presence or absence of certain mammal species. The Red Hills Subcenter belongs to the Great Plains Distributional Area. It is bordered on the south by Oklahoma, on the north by the Blue Hills Subcenter, and on the east by the Osage Plains Subcenter (Fig. 2). The Kansas Geological Survey defined a physiographic Red Hills whose boundaries differ somewhat from that of Cockrum's (Fig. 3). A Red Hills physiographic map was prepared in yet a different way by Frye (1953) (Fig. 4).

In Miller (1975), the Red Hills were divided into Escarpment and Ashland Basin sub-regions. The Escarpment crosses the mid section of the area from east to west as a deeply eroded belt 10 to 20 miles wide and marks the border of the High Plains. This belt which covers a large majority of the area is called the "Red Hills" because of the exposed soil and rocks. The underlying Permian redbeds are composed primarily of red shales, siltstones, and sandstones capped with gypsum, and sands and gravels of Pleistocene age (Schoewe, 1949; Frye, 1953).

Soils in the canyon areas of the redbeds, as in Swartz Canyon, developed from layers of sediment that are veneered with the debris of gypsum rock derived from steep valley side walls. The layers of sediment range from a trace to more than 20 feet thick. Little or no soil has formed on the thinner layers of sediment, but Vernon and Kingfisher soils commonly formed on the thicker layers. Kingfisher soils have a high water capacity and are well suited for both dryland crops and native grasses. The Vernon Series is a poorer soil with a low capacity for water and not well suited for dryland crops, but rather for native

Figure 2. Mammalian distributional areas in Kansas (after Cockrum, 1952).

Figure 3. Physiographic map of Kansas prepared by the Kansas Geological Survey.


Central High Plains Subcenter
Blue Hills Subcenter
Kansas River Valley Subcenter
Red Hills Subcenter
Southern High Plains Subcenter
Osage Plains Subcenter
Cherokee Prairie Province

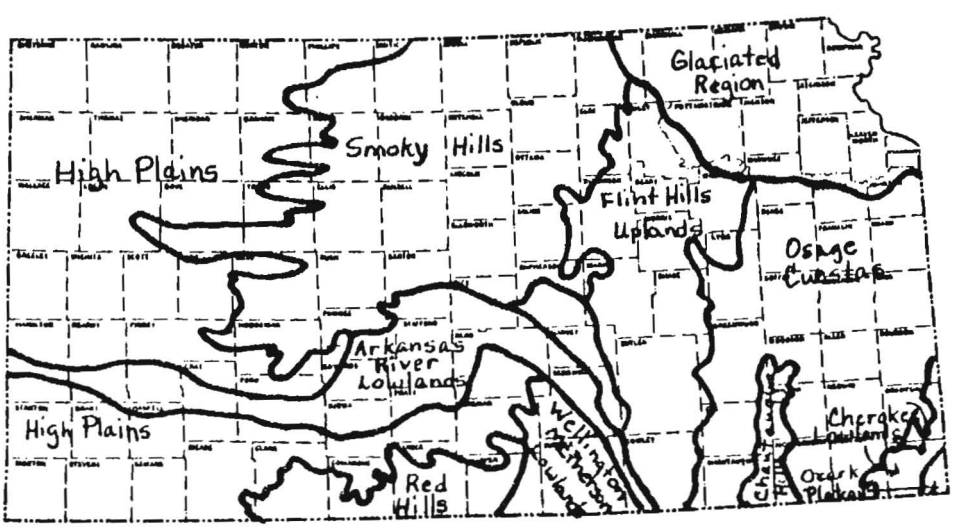
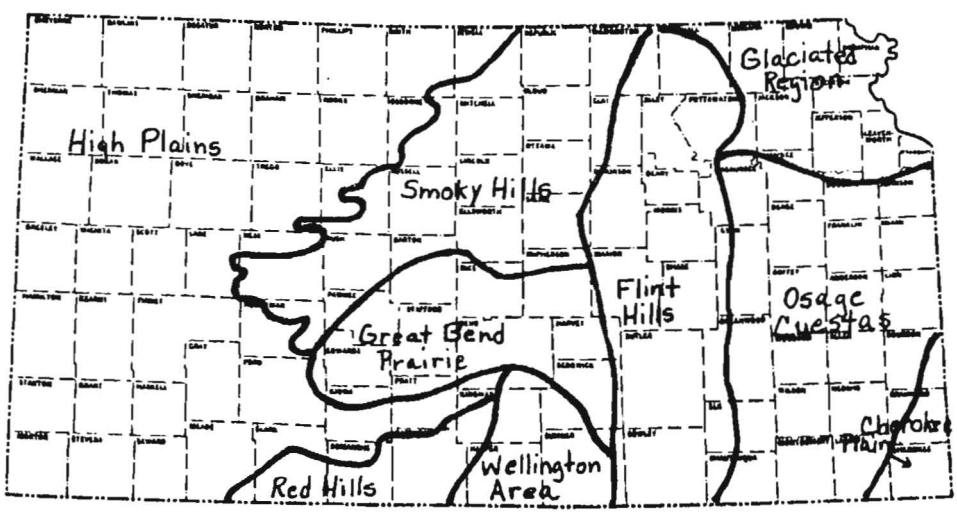

Glaciated Region
Smoky Hills
High Plains
Flint Hills Uplands
Osage Cuestas
Arkansas River Lowlands
High Plains
Red Hills
Cherokee Plains
Ozark Plateau

Figure 4. Physiographic Red Hills (after Frye, 1953).


Glaciated Region
High Plains
Smoky Hills
Flint Hills
Osage Cuestas
Great Bend Prairie
Cherokee Plains
Wellington Area
Red Hills

grasses (S.S. B.C., 1977).

The subhumid climate of the Red Hills is characterized by hot summers, cool to cold winters, large daily and annual temperature variations, considerable sunshine, and moderate to low humidity. Most of the rain falls late in spring and early in summer resulting in annual average precipitation of about 25 inches. Deficient precipitation is the principal limiting factor. The Red Hills are known for their inconsistancy and variability in rainfall from year to year as well as month to month (S.S. B.C., 1977).

Swartz Canyon being both characteristic of the Red Hills and a relatively undisturbed area, was chosen as the primary study site. The canyon is located 14 miles south and 16 miles east of Coldwater, in Comanche County (Fig. 5). The canyon is relatively secluded and surrounded by rangeland except for cultivated fields three miles to the south. The area has been moderately grazed for at least the past 40 years. There are no prominent signs of human disturbance within the canyon area.

Swartz Canyon runs north and south, widening as it extends north. The south end in some places is as narrow as 100 feet from wall to wall, while the north end, or mouth, is nearly one-quarter of a mile wide. The Salt Fork of the Arkansas River makes a southerly dip to within about 0.25 mile of the canyon mouth.

The canyon rim is composed of gypsum outcroppings as much as 20 feet thick, and is perforated with pockets, sinks, and caverns. Two of the larger caverns at the south end of the canyon have been the site of extensive bat research by scientists mentioned previously.

The canyon proper can be separated into five habitat areas (Fig. 6); open prairie (Fig. 7), eroded drainages (Fig. 8), canyon walls and gypsum

Figure 5. Location of Swartz Canyon in Comanche County.

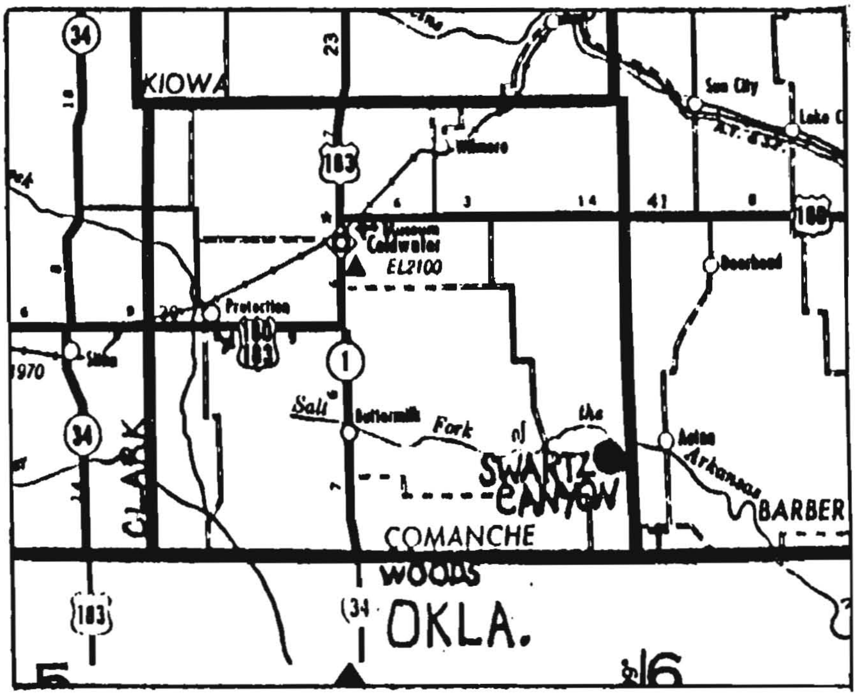

KIOWA
Wilmore
Coldwater
EL2100
Protection
CLARK
Salt
Buttermilk
Fork
of
the
SWARTZ
CANYON
Arkansas
BARBER
COMANCHE
WOODS
OKLA.
Sun City
Deerhead
Aetna

Figure 6. Location of habitat areas in a segment of the study site. (1. Canyon walls & gypsum outcropping; 2. River bottom and floodplain; 3. eroded drainages; 4. open prairie [caverns not in photo]).

Figure 7. Open prairie at the northwest end of Swartz Canyon.

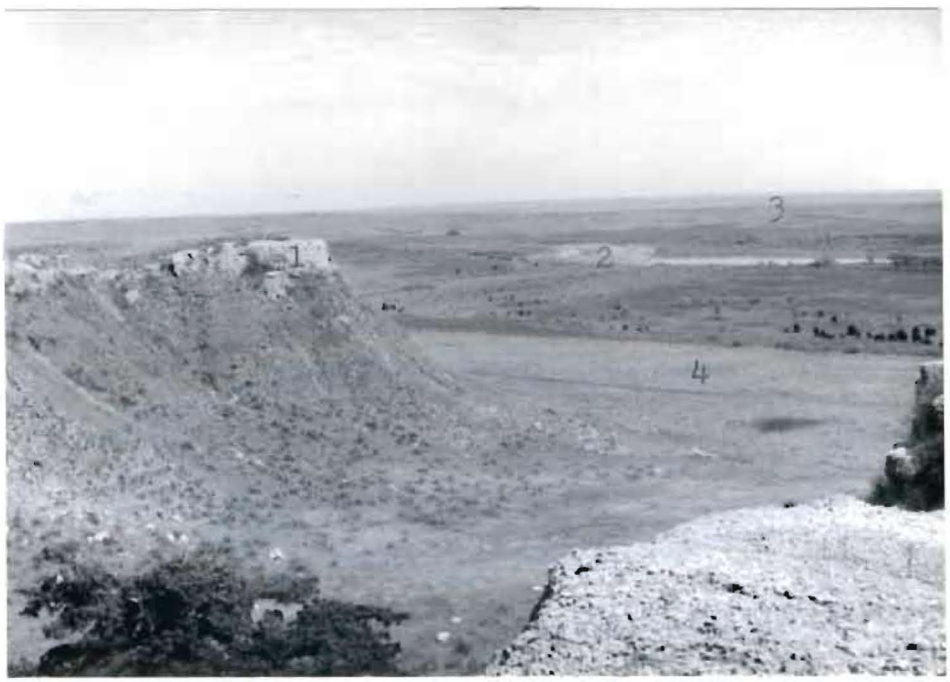

1
2
3
4

Figure 8. Eroded drainages located west of the canyon.

outcroppings (Fig. 9), river bottom and floodplain (Fig. 10), and caverns (Fig. 11).

Open Prairie

As a result of its geographic location, Swartz Canyon exhibits characteristics of both shortgrass prairie to the west, and tallgrass prairie to the east. The major open prairie region within the study area included those level areas above the canyon rim and below the rim, but beyond the canyon mouth. Predominant grasses present in these areas were: western wheatgrass, Agropyron smithii; silver bluestem, Andropogon sacchoroides; little bluestem, Andropogon scoparius; blue gamma, Bouteloua gracilis; side-oats grama, Bouteloua curtipendula; and buffalo grass, Buchloe dactyloides. Typical forbs were: snow-on-the-mountain, Euphorbia marginata; lead plant, Amorpha canescens; yellowspine thistle, Cirsium ochrocentrum; rosering gaillardia, Gaillardia pulchella; and green milkweed, Asclepias veridiflora.

Eroded Drainages

Small ledges and bluffs occurred where the prairie begins sloping toward the canyon. These drainages, because of their eroded physiography, offered cover and nest sites not found in the open prairie. The vegetation was predominantly that of the surrounding open prairie, but a few species of trees were found along these watersheds. They were: red cedar, Juniperus virginiana; American elm, Ulmus americana; and hackberry, Celtis laevigata.

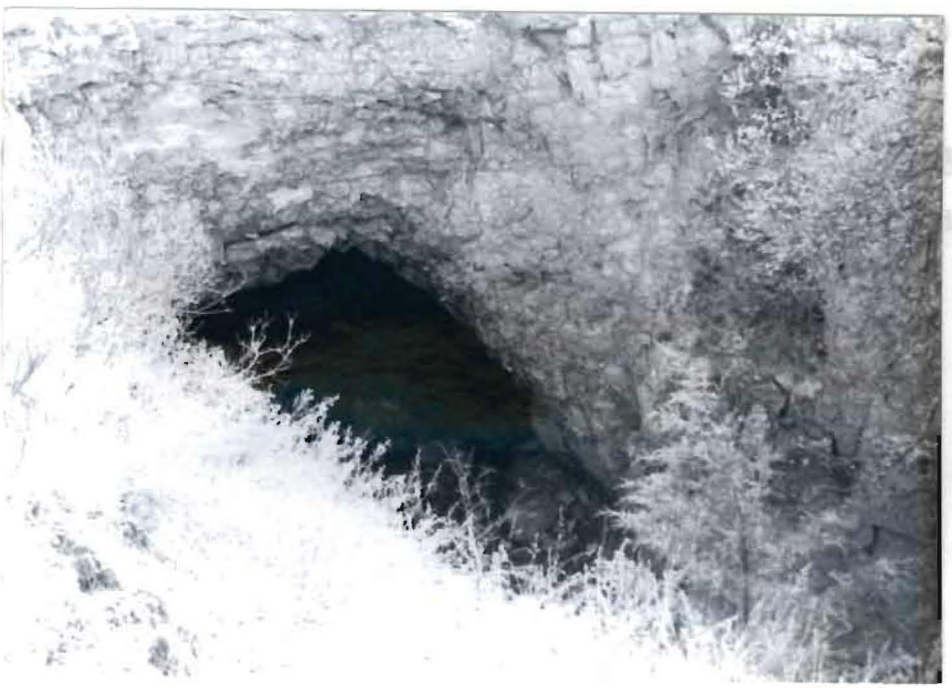
Canyon Walls and Gypsum Outcroppings

The majority of the canyon contained dense, woody vegetation, particularly in the sheltered areas along the gypsum outcroppings and in deep narrow canyons. Both the dense vegetation and porous gypsum rock offered

Figure 9. Canyon walls and gypsum outcroppings at the northwest end of the canyon.

Figure 10. River bottom and floodplain located 0.25 mi. north of canyon mouth.

Figure 11. Caverns located at the southern tip of the canyon.



cover and habitat for a variety of animals. The common woody plants were: eastern cottonwood, Populus deltoides; American elm, Ulmus americana; red cedar, Juniperus virginiana; poison ivy, Toxicodendron radicans; sumacs, Rhus glabra and R. aromatica.

River Bottom and Floodplain

The floodplain consisted entirely of sand soil. Large dense stands of salt cedar, Tamarix ramosissima with thickets of sandhill plum, Prunus angustifolia predominated on floodplain areas farthest from the river. Eastern cottonwood and black willow, Salix niger, were the most prevelant trees found in woodlands bordering the river.

Vast areas of sagebrush, Artemesia filofolia and soapweed, Yucca glauca were also present in the sand soil bordering the floodplain.

METHODS AND MATERIALS

During the six month period 23 May through 24 November 1984, Swartz Canyon was visited periodically to make observations and collections. Presence of a given species was verified by a variety of methods. Direct observation of animals, nests, tracks, scat, or other signs were recorded. Trapping and luring methods were also employed.

Bird documentation was based entirely on songs, calls and direct observation. A list of all birds heard or observed and habitat or strange behavior data were recorded on a daily basis. Special effort was made to observe birds at opportune times and at opportune locations, such as morning hours, migration periods, watering or feeding sites, and booming grounds. Binoculars and a field guide (Robbins et al, 1966) were used for bird observations and identification.

Presence of small mammals such as mice and rats was documented by using three different size snap traps. The smallest were common household mouse traps; intermediate in size were museum specials, and the largest were rat snap traps. All three types were fixed to the ground, when set, by a six-penny nail inserted through a drilled hole opposite the bait tray. Bait used for mice and rats was rolled oats and peanut butter. Gophers were collected with Macabee gopher traps. Mounds were dug out and the traps were placed seven to 10 inches within the exposed tunnels and wired to a nearby stake or bush. Bats were observed in caves and at roost sites during the day. All other mammals recorded were either documented by means of visual observation or by tracks, scat, nests, or other signs.

Traps were set two or three hours before sunset and checked the following morning. They were marked with plastic marking tape to facilitate

locating later. Comprehensive fieldnotes were taken and included number of traps set and location and identification of specimens collected. Fieldnotes of observed mammals and/or mammal signs were recorded as well as notes pertaining to habits, habitat, and unusual behavior.

Supplementary data from collections, literature, and personal observations were obtained from a variety of sources. The mammal collections at the University of Kansas Museum of Natural History (M.N.H.), Fort Hays State University Museum of High Plains (M.H.P.), and Emporia State University Schmidt Museum of Natural History (S.M.N.H.), were examined. Kansas Ornithological Society check-lists for Barber and Comanche counties served as sources of bird data. Stan Roth, Lawrence High School, and the Scherichs of southeast Comanche County provided information from personal observations. Various literature sources referred to in the INTRODUCTION were used as well.

RESULTS

Species Account for Mammals

The following species list of the mammalian fauna within the Swartz Canyon area was based primarily on my observations and collections. Species not observed or collected by me, but documented by other sources, are also noted in this account along with the source of documentation. Museum specimens noted in this list were collected in at least one of the three counties: Clark, Comanche, and/or Barber. These specimens are housed at either the University of Kansas Museum of Natural History (M.N.H.), Fort Hays State University Museum of High Plains (M.H.P.), or Emporia State University Schmidt Museum of Natural History (S.M.N.H.). Relative abundance of species observed or collected in this study is indicated by one of the following defined terms (after Clarke et al, 1958):

abundant - Individuals can be expected to be found in large numbers in appropriate habitat.

common - Individuals can be expected to be found regularly and in small numbers in appropriate habitat.

occasional - Individuals can be expected to be found irregularly; on most visits to appropriate habitat, specimens will not be found.

scarce - Only a few individuals have been recorded.

Family Didelphidae

Didelphis virginiana, Virginia opossum. Common. Tracks were commonly found in the sand and mud of the river bottom area. Specimens at M.N.H.

Family Soricidae

Cryptotis parva, least shrew. Occasional. A single animal was collected in open prairie approximately 200 feet from the closest woody vegetation. Specimens at M.N.H.

Family Talpidae

Scalopus aquaticus, eastern mole. Common. Surface tunnels were common in sandy soil of the floodplain. Specimens at M.N.H. and M.H.P.

Family Vespertilionidae

Myotis lucifugus, little brown myotis. Not recorded in this study. Specimens at M.N.H.

Myotis velifer, cave myotis. Abundant. Numbers were observed in a large cavern at the south end of the canyon. Specimens at M.N.H., M.H.P., and S.M.N.H.

Pipistrellus subflavus, eastern pipistrelle. Not recorded in this study. Stan Roth of Lawrence High School has observed and collected this bat within Swartz Canyon. Specimens at M.N.H. and M.H.P.

Eptesicus fuscus, big brown bat. Not recorded in this study. Numbers have been collected in Swartz Canyon caverns by Stan Roth. Specimens at M.N.H., M.H.P., and S.M.N.H.

Plecotus townsendi, Townsend's big-eared bat. Not recorded in this study. It has been collected in Swartz Canyon by Stan Roth. Specimens at M.N.H., M.H.P., and S.M.N.H.

Family Molassidae

Tadarida brasiliensis, Brazilian free-tail bat. Not recorded in this study. Specimens at M.N.H., M.H.P., and S.M.N.H.

Family Leporidae

Sylvilagus floridanus, eastern cottontail. Common. Is most frequently sighted near woody vegetation of the floodplain and gypsum wall areas. Specimens at M.N.H. and M.H.P.

Lepus californicus, black-tail jack rabbit. Occasional. A single animal was observed in open prairie. Specimens at M.N.H. and M.H.P.

Family Sciuridae

Spermophilus tridecemlineatus, thirteen-lined ground squirrel. Occasional. It was observed in open prairie, usually near paths or pasture roads. Specimens at M.N.H.

Cynomys ludovicianus, black-tailed prairie dog. Occasional. No prairie dog towns in the Swartz Canyon area. A road-kill was examined four miles west of the canyon. Specimens at M.N.H.

Sciurus niger, fox squirrel. Common. It was rarely seen in the canyon but was frequently sighted in an Osage orange (Maclura pomifera) shelter-belt two miles west of the canyon. Specimens at M.N.H.

Family Geomyidae

Geomys lutescens, plains pocket gopher. Abundant. Collected in both open prairie and floodplain areas, although mounds were more common in sandy soil of the floodplain. Specimens at M.N.H., M.H.P., and S.M.N.H.

Family Heteromyidae

Perognathus flavescens, plains pocket mouse. Not recorded in this study. Specimens at M.N.H., M.H.P., and S.M.N.H.

Perognathus flavus, silky pocket mouse. Not recorded in this study. Specimens at M.N.H.

Perognathus hispidus, hispid pocket mouse. Common. Frequently collected in open prairie near small vertical bluffs and eroded drainages. Specimens at M.N.H., M.H.P., and S.M.N.H.

Dipodomys ordii, Ord's kangaroo rat. Abundant. Numbers were collected in sandy areas bordering the river and floodplain areas. Specimens at M.N.H., M.H.P., and S.M.N.H.

Family Castoridae

Castor canadensis, beaver. Occasional. A single animal was inhabiting a stream-fed cavern at the south end of the canyon.

Family Cricetidae

Reithrodontomys montanus, plains harvest mouse. Occasional. They were collected in both open prairie and rocky outcroppings. Specimens at M.N.H. and M.H.P.

Peromyscus maniculatus, deer mouse. Abundant. Frequently collected near low bluffs and eroded areas in open prairie. Specimens at M.N.H., M.H.P., and S.M.N.H.

Peromyscus leucopus, white-footed mouse. Occasional. Few animals were collected from areas of woody vegetation bordering gypsum outcropping in narrow forks of the canyon. Specimens at M.N.H. and M.H.P.

Onychomys leucogaster, northern grasshopper mouse. Common. They were collected near eroded bluffs and drainages in open prairie. Specimens at M.N.H., M.H.P., and S.M.N.H.

Sigmodon hispidus, hispid cotton rat. Not recorded in this study. Specimens at M.N.H., M.H.P., and S.M.N.H.

Neotoma floridana, eastern woodrat. Not recorded in this study. Specimen at M.H.P.

Neotoma micropus, southern plains woodrat. Abundant. Collected

among the pockets and crevices of the gypsum outcroppings. Houses were also seen in brushy areas of the floodplain. Specimens at M.N.H., M.H.P., and S.M.N.H.

Microtus ochrogaster, prairie vole. Not recorded in this study. Specimens at M.N.H. and M.H.P.

Ondatra zibethicus, muskrat. Occasional. A single animal was sighted in the Salt Fork River. Specimens at M.N.H.

Family Erethizontidae

Erethizon dorsatum, porcupine. Occasional. It has been observed in cottonwood trees by both Stan Roth and the Scherichs of southeast Comanche County. Specimen at S.M.N.H. (from Woods Co., Oklahoma).

Family Canidae

Canis latrans, coyote. Common. Was seen and heard frequently. Specimens at M.N.H.

Family Procyonidae

Procyon lotor, raccoon. Common. Tracks and scat were frequently sighted near the river. Scat was also frequently found among the trees and gypsum outcroppings of the canyon walls. Specimens at M.N.H. and M.H.P.

Family Mustelidae

Mustela vison, mink. Occasional. Tracks along the river bank were observed once during this study. Specimens at M.N.H.

Taxidea taxus, badger. Common. Dens or holes were common in both open prairie and floodplain areas. Specimens at M.N.H. and M.H.P.

Mephitis mephitis, striped skunk. Common. Animal and tracks were observed more frequently near the river bottom and to a lesser extent near brush areas of the canyon. Specimens at M.N.H.

Family Felidae

Lynx rufus, bobcat. Common. Observed hunting among the brush areas surrounding the rock outcroppings. Tracks were sighted along the river bottom area as well. Specimens at M.N.H. and M.H.P.

Family Cervidae

Odocoileus hemionus, mule deer. Common. Were observed foraging and bedding within the canyon.

Odocoileus virginianus, white-tailed deer. Common. Frequently observed watering, feeding, and playing in the bushy areas of the floodplain.

Family Antilocarpa

Antilocarpa americana, pronghorn antelope. Occasional. A single animal was sighted in the floodplain area.

Tables 1 and 2 give the source of documentation and preferred habitat for mammals listed in the previous species account.

Table 1. Source of documentation for species account of Swartz Canyon area.

Species	The Writer	M.N.H.	M.H.P.	P.O.
Didelphis virginiana	X			
Cryptotis parva	X			
Scalopus aquaticus	X			
Myotis lucifugus		X		
Myotis velifer	X			
Pipistrellus subflavus			X	X
Eptesicus fuscus		X	X	X
Plecotus townsendi		X	X	X
Tadarida brasiliensis		X	X	
Sylvilagus floridanus	X			
Lepus californicus	X			
Spermophilus tridecemlineatus	X			
Cynomys ludovicianus	X			
Sciurus niger	X			
Geomys lutescens	X			
Perognathus flavescens		X		
Perognathus flavus		X		
Perognathus hispidus	X			
Dipodomys ordii	X			
Castor canadensis	X			
Reithrodontomys montanus	X			
Peromyscus maniculatus	X			
Peromyscus leucopus	X			
Onychomys leucogaster	X			
Sigmodon hispidus			X	
Neotoma floridana			X	
Neotoma micropus	X			
Microtus ochrogaster			X	
Ondatra zibethicus	X			
Erethizon dorsatum				X
Canis latrans	X			
Procyon lotor	X			
Mustela vison	X			
Taxidea taxus	X			
Mephitis mephitis	X			
Lynx rufus	X			
Odocoileus hemionus	X			
Odocoileus virginianus	X			
Antilocarpa americana	X			

M.N.H.: University of Kansas Museum of Natural History
M.H.P.: Fort Hays State University Museum of the High Plains
P.O.: Personal observations by Stan Roth of Lawrence High School of the Schericks of southern Comanche County.

Table 2. Collecting site or probable habitat preference.

Species	Cv.	Pr.	E.D.	C.W. & G.O.	R.B. & Fp.
Didelphis virginiana					X
Cryptotis parva		X			
Scalopus aquaticus					X
Myotis Lucifugus	X				
Myotis velifer	X				
Pipistrellus subflavus	X				
Eptesicus fuscus	X				
Plecotus townsendi	X				
Tadarida brasiliensis	X				
Sylvilagus floridanus				X	X
Lepus californicus		X			
Spermophilus tridecemlineatus		X			
Cynomys ludovicianus		X			
Sciurus niger					X
Geomys lutescens		X	X		X
Perognathus flavescens		X	X		
Perognathus flavus		X	X		
Perognathus hispidus		X	X		
Dipodomys ordii					X
Castor canadensis					X
Reithrodontomys montanus		X	X	X	
Peromyscus maniculatus		X	X		
Peromyscus leucopus			X	X	
Onychomys leucogaster		X	X		
Sigmodon hispidus				X	X
Neotoma floridana				X	X
Neotoma micropus				X	X
Microtus ochrogaster		X			
Ondatra zibethicus					X
Erethizon dorsatum					X
Canis latrans		X	X		X
Procyon lotor				X	X
Mustela vison					X
Taxidea taxus		X	X		
Mephitis mephitis				X	X
Lynx rufus				X	X
Odocoileus hemionus		X	X		
Odocoileus virginianus					X
Antilocarpa americana		X			

Cv.: Caverns
Pr.: Prairie
E.D.: Eroded Drainage
C.W. & G.O.: Canyon Walls and Gypsum Outcroppings
R.B. & Fp.: River Bottom and Floodplain

List of Hypothetical Mammals

The following is a list of mammals possibly occurring within the Swartz Canyon area. These mammals are either rare transients, neighboring residents, or species expanding their range.

Antrozous pallidus, pallid bat. All recorded specimens have been collected from Barber County. Thirteen specimens collected in 1964 are in the collection at M.H.P.

Nycticeius humeralis, evening bat. Bee et al (1981), reported the bat being collected from Ford, Comanche, and Barber counties.

Dasypus novemcinctus, nine-banded armadillo. This animal is rare in Kansas, but occupies the southern part of the state, and apparently is extending its range northward.

Sylvilagus audubonii, desert cottontail. Both Cockrum (1952), and Bee et al (1981), make reference to specimens collected in Clark and Ford counties. The rabbit is well established in western Kansas.

Spermophilus spilosoma, spotted ground squirrel. This small mammal occurs in dry, arid regions of western Kansas. A specimen collected in Meade County in 1941 is recorded at M.N.H.

Pappogeomys castanops, yellow-faced pocket gopher. This gopher is found in southwestern Kansas just north of the Red Hills. It is known to prefer heavy, clay soils in both bottomlands and uplands (Bee et al, 1981).

Reithrodontomys megalotus, western harvest mouse. The mouse is well established in northern and western Kansas, but is uncommon in the south-central and southeast. A specimen collected in Meade County in 1942 is recorded at M.N.H.

Vulpes vulpes, red fox. This fox is uncommon in the west, but has been recorded as close as Meade County (Bee et al, 1981).

Vulpes velox, swift fox. The swift fox inhabits the open prairie of the western third of the state and has been recorded in Meade County by Cockrum (1952).

Bassariscus astutus, ring-tailed cat. This mammal is rare in Kansas but is occasionally reported in the southcentral and southeastern parts of the state. The mammal is nocturnal and prefers rocky outcroppings, hills, and ridges (Bee et al, 1981).

Mustela frenata, long-tailed weasel. This weasel is common throughout most of the state but has not been recorded in the Red Hills.

Spilogale putorius, eastern spotted skunk. The skunk has been recorded in most regions of Kansas. A specimen at S.M.N.H. was collected south of the Red Hills in Major County, Oklahoma, in 1968.

Birds of Swartz Canyon Area

The following tables 3, 4, and 5 include all the birds observed during this study. By examining data from Johnston (1965) and my date of observation, the list has been separated into three tables, two of which include summer and winter residents (Tables 3 and 4), and migrants and transients (Table 5). Tables 3 and 4 also refer to preferred habitat-type of each bird.

Table 3. Summer residents observed during this study in Swartz Canyon area and their preferred habitat.

Great Blue Heron L	Scissor-tailed Flycatcher G
Green Heron L	Great Crested Flycatcher W
Mallard Duck L	Eastern Pheobe W
Wood Duck L	Horned Lark G
Turkey Vulture U	Bank Swallow U
Mississippi Kite W	Barn Swallow U
Red-tailed Hawk W	Rough-winged Swallow U
Swainson's Hawk G	Blue Jay W
Northern Harrier G	American Crow W
Prairie Falcon G	Black-capped Chickadee W
American Kestrel W	Bewick's Wren W
Lesser Prairie Chicken G	Rock Wren X
Northern Bobwhite W	Northern Mockingbird W
Ring-necked Pheasant U	Gray Catbird W
Rio Grande Turkey W	Brown Thrasher W
Killdeer L	American Robin W
Upland Sandpiper G	Eastern Bluebird W
Yellow-billed Cuckoo W	Loggerhead Shrike W
Ring-billed Gull U	Bell's Vireo W
Franklin's Gull U	Warbling Vireo W
Least Tern L	Yellow Warbler W
Mourning Dove W	Eastern Meadowlark G
Rock Dove U	Western Meadowlark G
Great Horned Owl W	Red-winged Blackbird L
Barn Owl U	Northern Oriole W
Burrowing Owl G	Common Grackle W
Eastern Screech Owl W	Brown-headed Cowbird W
Common Poor-will G	Blue Grosbeak W
Common Nighthawk U	Painted Bunting W
Ruby-throated Hummingbird U	Dickcissel G
Belted Kingfisher L	Northern Cardinal W
Hairy Woodpecker W	American Goldfinch W
Downy Woodpecker W	Rufous-sided Towhee W
Northern (Red Shafted) Flicker W	Lark Bunting G
Red-headed Woodpecker W	Grasshopper Sparrow G
Red-bellied Woodpecker W	Lark Sparrow W
Eastern Kingbird W	Clay-colored Sparrow W
Western Kingbird W	Field Sparrow G

W: wooded areas
L: limnic
G: grassland
X: xeric areas
U: unanalyzable, show use of more than one habitat type

Table 4. Winter residents observed during this study in Swartz Canyon area and their preferred habitat.

Red-tailed Hawk W	Downy Woodpecker W
Rough-legged Hawk G	Northern (Red-shafted) Woodpecker W
Sharp-shinned Hawk W	Red-headed Woodpecker W
Northern Harrier G	Red-bellied Woodpecker W
Golden Eagle G	Horned Lark G
Prairie Falcon G	Blue Jay W
American Kestrel W	American Crow W
Cooper's Hawk W	Black-capped Chickadee W
Lesser Prairie Chicken G	Bewick's Wren W
Northern Bobwhite W	Loggerhead Shrike W
Ring-necked Pheasant U	Eastern Meadowlark G
Rio Grande Turkey W	Western Meadowlark G
Rock Dove U	Northern Cardinal W
Great Horned Owl W	American Goldfinch W
Barn Owl U	Rufous-sided Towhee W
Eastern Screech Owl W	Dark-eyed Junco (Slate-colored) W
Belted Kingfisher L	Harris' Sparrow W
Hairy Woodpecker W	White-crowned Sparrow W

W: wooded areas G: grassland
L: limnic U: unanalyzable

Table 5. Transients and migrants observed during this study in Swartz Canyon area.

Transients	Migrants
Olive-sided Flycatcher	Canada Goose
Orange-crowned Warbler	Sandhill Crane
Nashville Warbler	
Yellow-rumped Warbler	
Wilson's Warbler	
Brewer's Blackbird	
Yellow-headed Blackbird	

Information from Johnston (1965) and Robbins (1966) was used to separate birds not observed during this study, but expected to inhabit the Swartz Canyon area, into two tables. These birds have been recorded in Kansas Ornithological Society check-lists for Comanche and Barber counties. Table 6 is a listing of birds that probably do inhabit the Swartz Canyon area, but were not observed during this investigation. Table 7 list birds not commonly found in the area, but that have been recorded and could possibly occur again. Both tables also give the source of reference and season of residence for each bird listed.

Table 6. Birds expected to inhabit the Swartz Canyon area that were recorded in Comanche and Barber County check-lists by the Kansas Ornithological Society, but not by the writer.

Bird	Season of Residence	Source of Reference: Stan Roth	Source of Reference: Johnston (1965)
Roadrunner	S/W	X	X
Chuck-will's Widow	S		X
Northern (Yellow-shafted) Flicker	S/W	X	
Cliff Swallow	S		X
Black-billed Magpie	S/W	X	X
Brown Creeper	W		X
Cedar Waxwing	W		X
Pine Siskin	W		X
Savannah Sparrow	W		X
Cassin's Sparrow	S		X
Song Sparrow	W		X
Chestnut-collared Longspur	W		X

Stan Roth: Biology instructor at Lawrence High School
Johnston (1965): A Directory to the Birds of Kansas
S: Summer resident
W: Winter resident

Table 7. Birds not commonly, but possibly, inhabiting the Swartz Canyon area that were recorded in Comanche and Barber County check-lists by the Kansas Ornithological Society, but not by the writer.

Bird	Season of Residence	Source of Reference: Stan Roth	Source of Reference: Johnston (1965)
Western Wood Pewee	S		X
Chihuahuan Raven	S		X
White-breasted Nuthatch	W		X
Townsend Solitaire	S	X	
Mountain Bluebird	S	X	
Orchard Oriole	S		X
Black-headed Grosbeak	S		X
Baird's Sparrow	W	X	
Rufous-crowned Sparrow	S		X
Lapland Longspur	W		X

Stan Roth: Biology instructor at Lawrence High School
Johnston (1965): A Directory to the Birds of Kansas
S: Summer residents
W: Winter residents

DISCUSSION

Mammals

Cockrum (1952), the only biologist to address the mammalian fauna of the Red Hills, provided information (Table 8) which shows the total number of species actually recorded in the Red Hills and a separation of species into areas of faunal relationships based on taxonomic and distributional origins.

Table 8. Faunal relationships of the species of mammals in Kansas; based upon the taxonomic similarities between the total known fauna of each distributional area and those of surrounding areas.

	Areas of Faunal Relationships					
Distributional Area	EDF	GP	S	En	WD	Total #
Central High Plains	2	29	3	0	6	40
Southern High Plains	4	26	8	2	5	45
Blue Hills	6	18	2	0	1	27
Red Hills	7	23	5	1	3	39
Kansas River Valley	30	7	2	0	4	43
Osage Plains	24	4	5	0	3	36
Cherokee Prairie	20	1	4	0	3	28

EDF: Eastern Deciduous Forest
GP: Great Plains
S: Southern
En: Endemic
WD: Widely Distributed

A total of 39 species was actually recorded by Cockrum in the Red Hills. He did not define these 39, but did offer information as to the faunal relationships of these species. In this study a total of 39 species was also recorded as inhabiting the Red Hills, but they are not the same 39 mentioned by Cockrum. As shown in Table 9, the faunal relationships of the mammals of this investigation differ from those relationships mentioned by Cockrum in Table 8. This difference could be due to a variety of reasons. Cockrum based his data on those species actually collected from the area, whereas data of this investigation were based on both observations and collections. Cockrum also published his

Table 9. Faunal relatinships of species of mammals from Swartz Canyon, based on taxonomic and distributional origins.

Species	EDF	GP	S	En	WD
Didelphis virginiana	X				
Cryptotis parva	X				
Scalopus aquaticus	X				
Myotis lucifugus			X		
Myotis velifer			X		
Pipistrellus subflavus	X				
Eptesicus fuscus		X			
Plecotus townsendi				X	
Tadarida brasiliensis			X		
Sylvilagus floridanus	X				
Lepus californicus		X			
Spermophilus tridecemlineatus		X			
Cynomys ludovicianus		X			
Sciurus niger	X				
Geomys lutescens		X			
Perognathus flavescens		X			
Perognathus flavus		X			
Perognathus hispidus		X			
Dipodomys ordii		X			
Castor canadensis					X
Reithrodontomys montanus		X			
Peromyscus maniculatus		X			
Peromyscus leucopus	X				
Onychomys leucogaster		X			
Sigmodon hispidus			X		
Neotoma floridana	X				
Neotoma micropus			X		
Microtus ochrogaster		X			
Ondatra zibethicus					X
Erethizon dorsatum		X			
Canis latrans		X			
Procyon lotor					X
Mustela vison					X
Taxidea taxus		X			
Mephitis mephitis					X
Lynx rufus					X
Odocoileus hemionus		X			
Odocoileus virginianus	X				
Antilocarpa americana		X			

EDF: Eastern Deciduous Forest
GP: Great Plains
S: Southern
En: Endemic
WD: Widely Distributed

investigations in 1952. Within the past 32 years changes in the Red Hills mammalian fauna have apparently occurred. By examining this study, a few minor changes have been detected. In Cockrum (1952) the pronghorn antelope, Antilocarpa americana, was considered extinct in Kansas. Since 1952 a number of antelope releases by the Kansas Fish and Game Commission have occurred throughout the state. The antelope observed during this study was probably a descendent of the herd of Colorado antelope released east of Pratt, Kansas in 1956 and 1966 (Personal Communication with the Kansas Fish and Game). Species such as the desert cottontail, Sylvilagus audobonii, spotted ground squirrel, Spermophilus tridecemlineatus, and western harvest mouse, Reithrodontomys megalotus, all have ranges which border on the western edge of the Red Hills. Records of these species inhabiting the Red Hills have not been found since those recorded in Cockrum (1952). Either ranges of these species have receded away from the Red Hills or there has not been enough research into them within the last 32 years.

Since Cockrum did not provide a listing of the 39 species inhabiting the Red Hills, it is difficult to qualitatively compare his data to those of this study. By using his table on faunal relationships (Table 8), statistical comparison can be compared among the species within the different faunal relationships (eastern deciduous forest, great plains, southern...). There was no significant difference between the two sets of data.

Minor changes have occurred within Red Hills mammalian fauna since Cockrum's work in 1952. But these changes do constitute a significant difference.

The preferred habitat of most species observed during this study was

the river bottom and floodplain area. Eighteen species commonly inhabited this area while 16 predominated in the prairie area (Fig. 12).

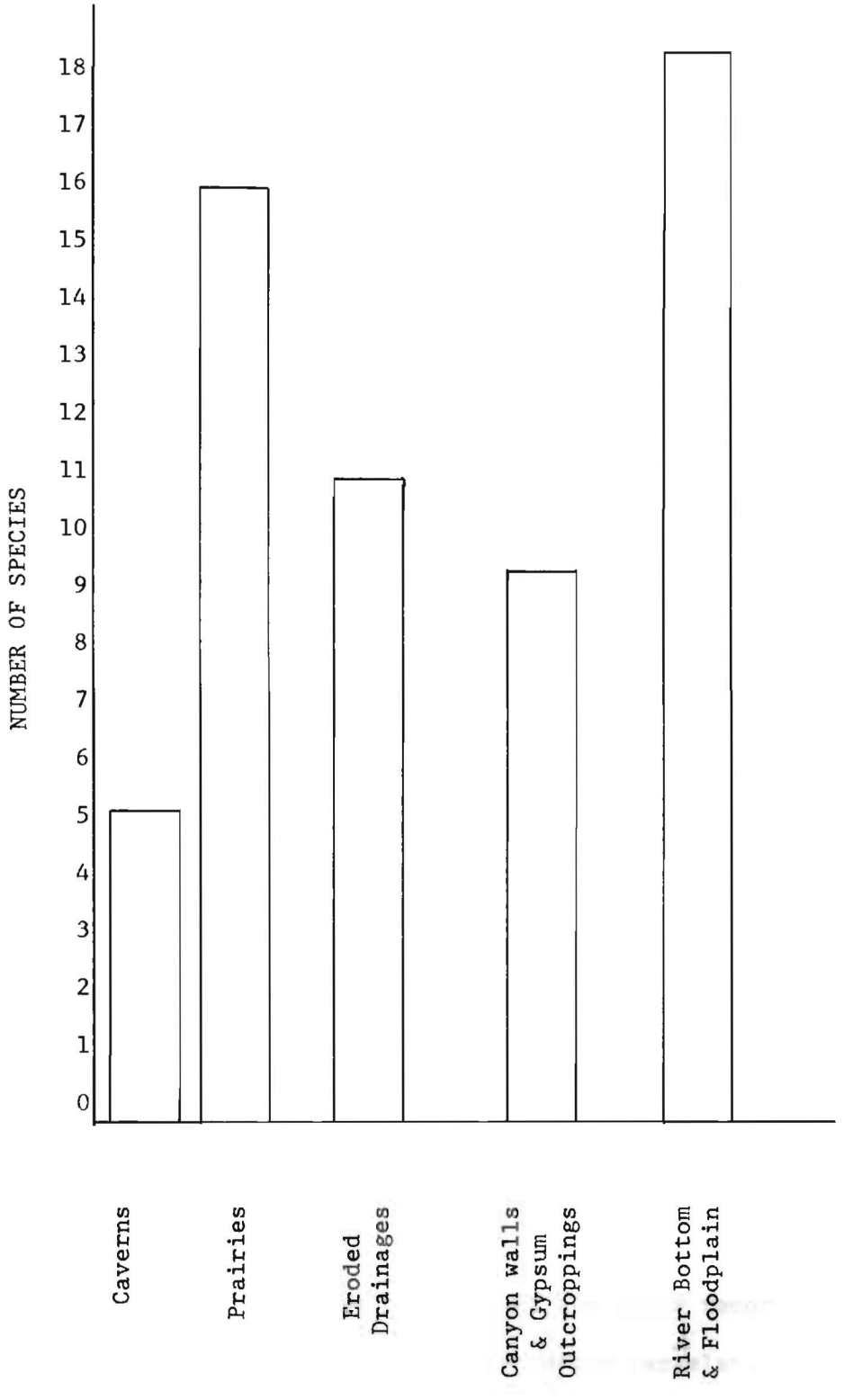
Canyon walls and gypsum outcroppings provide cover and habitat for nine mammal species. Eleven species inhabited the small ledges and bluffs of the eroded drainages, while six bats inhabited Swartz Canyon caverns.

The majority of the mammals documented in this study are common residents of the Red Hills and Swartz Canyon. A few would not be classified as common and deserve further explanation. As previously mentioned, the pronghorn antelope recorded in this study was the only antelope observed. The pronghorn are not common but are occasionally observed in the Swartz Canyon area (Personal communication with Scherichs, 1984). Mink and muskrat were also recorded once during this investigation. Both were recorded early in the summer when the Salt Fork River was still flowing strong. These semi-aquatic mammals could not be permanent residents of the area due to the periodic drying of this branch of the river. The beaver had apparently, at one time, wandered from the receding river and had found a spring-fed cavern in which to live. Porcupine documented in this study were occasionally observed by the landowners, Mr. and Mrs. Scherich, and Stan Roth. They are most often observed gnawing the bark from cottonwood trees.

Birds

Birds recorded in this investigation are comparable to birds previously recorded in and around the study area. Johnston (1965) was the most recent to address distribution and habitat of the birds mentioned in this study. He did not refer to distributional areas as did Cockrum (1952), but defined the probable habitat-type and distributional range of Kansas birds. No species observed during this study was found to

Figure 12. Number of species inhabiting different habitats.


NUMBER OF SPECIES
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Caverns
Prairies
Eroded Drainages
Canyon walls & Gypsum Outcroppings
River Bottom & Floodplain

conflict with the information he provided on range and distribution. However, there were birds, not recorded in this study, that Johnston reported as inhabiting the area in and around Swartz Canyon. Those birds are shown in Table 6. Table 7 is a listing of birds Johnston classified as rare but possibly occurring in and around the study area. A number of the winter residents shown in Table 6 were not observed during this study probably because of the lack of field work conducted during the winter months.

Johnston (1965) designated the Kansas birds as occupying four basic habitat-types: woodland, limnic, grassland, and xeric. He also classified some birds as unanalyzable because they exhibit an indiscriminate use of more than one habitat-type. The birds observed in this study were classified in this same manner (Table 10).

Table 10. Ecological analysis of the birds of the Swartz Canyon area.

Species	Permanent residents	Summer residents	Winter residents	Total residents
Woodland	21: 39 %	23: 43 %	9: 17 %	53: 57 %
Limnic	1: 13 %	7: 87 %		8: 9 %
Grassland	6: 33 %	9: 47 %	4: 22 %	19: 20 %
Xeric	1: 50 %	1: 50 %		2: 2 %
Unanalyzed	3: 25 %	9: 75 %		12: 13 %
Total	32: 34 %	49: 52 %	13: 14 %	94: 100 %

Unanalyzed: Bird use of more than one habitat-type.

Fifty-three species are classified as woodland; 19 species as grassland; and 12 species as unanalyzed; eight species are limnic; and two species are xeric.

Woodland species constituted 57 % of all the birds recorded. Despite the fact that the Red Hills area was predominantly rangeland, the rough topography provides sheltered drainages and canyons. Trees and other woody vegetation were quite dense along stream beds and watersheds within

these low lying areas. The major rivers running east and west, like the Arkansas, have provided avenues of dispersal for woodland birds, making it possible for them to reach areas like Swartz Canyon. Grassland species comprised 20 % of the avifauna observed. This percentage appears low, particularly when compared to the 53 % for woodland species. Johnston (1965) found 15 % of the Kansas avifauna to be grassland species. The 5 % increase shown in the data of this study seems appropriate when considering the location of the study area. Unanalyzable species such as swallows, gulls, and turkey vultures constituted 13 % of the birds observed. These birds could not be assigned to any one habitat-type, yet they were observed during this investigation. All the limnic species were observed at or near the Salt Fork River. The river was generally too swift and shallow for ducks and geese, and too intermittent for wading birds. Two xeric species, the rock wren who inhabits crevices in gypsum outcroppings, and the roadrunner who inhabits sand and sagebrush areas, comprised 2 % of the total avifauna observed. Johnston (1965) reported three xeric species occurring in Kansas; the third, the scaled quail, is found just west of the Red Hills.

Johnston (1965) also provided a list of birds who reach their distributional limits in Kansas. Birds of this study in this category are listed in Table 11. Those reaching northern and western limits in this state constitute the majority of birds recorded in the study area. When habitat-types of these birds are analyzed (Table 12), reasons for reaching distributional limits become apparent. Birds reaching their northern and western limits are primarily woodland species. Those at their eastern limit are also woodland birds that are commonly found in the coniferous forests of western United States. Those reaching southern limits are woodland species and are chiefly of sub-boreal distribution (Johnston, 1965).

Table 11. Species of this study that reach distributional limits in Kansas.

NORTHERN LIMIT	EASTERN LIMIT
Mississippi Kite	Common Poor-Will
Lesser Prairie Chicken	Northern (Red-shafted) Flicker
Roadrunner	Western Kingbird
Chuck-will's Widow	Chihuahuan Raven
Scissor-tailed Flycatcher	Rock Wren
Painted Bunting	Black-headed Grosbeak
Cassin's Sparrow	
SOUTHERN LIMIT	**WESTERN LIMIT**
Black-capped Chickadee	Wood Duck
Cedar Waxwing	Ruby-throated Hummingbird
	Red-bellied Woodpecker
	Great Crested Flycatcher
	Wilson's Warbler
	Eastern Meadowlark
	Rufous-sided Towhee

Table 12. Analysis of the habitat-type of birds recorded in this study reaching distributional limits in Kansas.

Distributional Limits	Habitat-types				
	Woodland	Grassland	Limnic	Xeric Scrub	Total
Western	4	2	1		7
Northern	4	3			7
Eastern	4	1		1	6
Southern	2	–	–	–	2
Totals	14	6	1	1	22

SUMMARY

Investigation of the Swartz Canyon avian and mammalian fauna resulted in the following summary statement.

1. A total of 39 mammal and 94 bird species was documented as inhabiting the Swartz Canyon area.

2. Both bird and mammal data recorded in this study were qualitatively and quanitatively compared to related data of other studies. Data were found to be both agreeable and comparable to the reference literature investigated. Minor changes in the mammalian fauna were found to have occurred since Cockrum's (1952) investigation of Red Hills mammals.

3. Birds and mammals listed in this study were found to be agreeable with and characteristic to those fauna mentioned in other studies and literature as inhabiting the Red Hills.

4. Habitat preference for recorded mammal species was analyzed. Mammals were grouped on the basis of habitat preference; these groups were further analyzed and discussed.

5. Habitat-types and distributional limits, described by Johnston (1965), were investigated and assigned to appropriate bird species recorded in this study. Probable affinities between the two characteristics were compared and discussed.

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LITERATURE CITED

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