MAMMALS OF KANSAS

E. LENDELL COCKRUM

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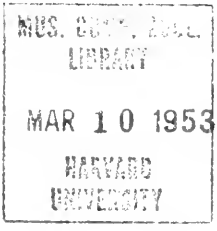

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INTRODUCTION

Kansas is the meeting ground of the Great Plains grassland fauna and the eastern, deciduous forest fauna. Here, biologically, the East meets the West. Several kinds of mammals reach their northern limits and other kinds reach their southern limits in the state. The result is that Kansas, although relatively uniform climatically and topographically, has more kinds of mammals than most states east of the Rocky Mountains.

Several reports have been published on the mammals of the state in the past 100 years. Knox (1875) published the first inclusive list of the 60 mammals then known to occur in the state. Cragin (1885) made some additions to the list, and J. A. Allen (1874, 1895) and Baker (1889) published accounts of species found and of observations made at various places in the western part of the state. Lantz (1905A, 1905B) published two accounts of the mammals of Kansas which summarized all information available to him on distribution and economic importance of the kinds known to occur in the state. Unfortunately for mammalogy, an admirable account of the mammals of the state prepared by A. Remington Kellogg as a master's thesis at the University of Kansas was never published. Hibbard (1933, 1944) published check-lists of the mammals of the state, listing 109 kinds in 1933 and 120 kinds in 1944. Although Black (1937) published the first major account of our mammals, he omitted mention of kinds believed to have become extinct within historic time. Paul B. Allen (1940) published an account of the mammals of the state but did not distinguish between species and subspecies in his discussions of geographic ranges and characteristics; thus much confusion results from the use of his paper.

In addition to the larger papers mentioned above, many shorter papers have been published, consisting chiefly of notes on life histories, new records of occurrence, extensions of recorded ranges, and mention of specimens in monographs. All such publications known to the writer are listed in the bibliography at the end of this paper.

Aims in the preparation of this account of the mammals of Kansas were: to determine the kinds of mammals that have occurred in the state within Recent time; to ascertain for each kind its geographic range and to show this range on a map; to furnish keys by which each of the species may be identified; to provide general information on the habits and economic importance of each of the species;

to provide, in so far as possible, for each kind (species and subspecies) a synonymy complete for Kansas; to catalogue and evaluate taxonomically the extent of variation (individual, specific, subspecific, and geographic); and to point out factors affecting the distribution of the various kinds of mammals in the state.

One hundred and nineteen different kinds of mammals are thought to occur, or to have formerly (within historic time) occurred, in the state. A total of 9,044 specimens was examined in the course of this study.

The completion of this paper would have been difficult, if not impossible, without the assistance, both directly and indirectly, of several persons and institutions. At the University of Kansas numerous staff members of the Museum of Natural History, and staff members, graduate students, and undergraduate students from the Department of Zoölogy added valuable specimens to the collection in the Museum of Natural History. For the loan of specimens from Kansas as well as for comparative materials from other states and for the opportunity afforded to examine these specimens, I am grateful to the authorities of each of the following institutions: Chicago Museum of Natural History; Los Angeles County Museum; United States Biological Surveys Collections; United States National Museum; Texas Cooperative Wildlife Collection; and Ottawa University, Ottawa, Kansas. The late G. C. Rinker, of Hamilton, Kansas, and the late A. J. Kirn, of Somerset, Texas, generously permitted me to examine material in their private collections. Acknowledgment is made to the Kansas Biological Survey for financial assistance in the final year of field work and in the preparation of the manuscript.

For help with the mechanics of the preparation of the manuscript in one way and another, I am grateful to several persons, especially to my wife, Irma Cockrum, and to Alice White. I am grateful to Professor E. Raymond Hall for guidance in the study and for critical assistance with the manuscript, to Professor A. Byron Leonard for similar assistance, especially in the final year of my study, and to Professors Robert W. Wilson and Charles D. Michener for valuable suggestions. Finally, I wish to express my thanks to the many other friends and associates who have given of their time, constructive criticism, and assistance.

TOPOGRAPHY

Kansas is nearly oblong in shape and is 82,276 square miles in area. The geographical center of the United States lies in Kansas, the exact point being marked by a monument standing 11 miles east and four miles north of Smith Center, Smith County.

Although Kansas is essentially a plain, its surface is not everywhere flat, horizontal, and featureless. There are innumerable hills and valleys, and, in the western and southwestern part of the state, there are canyons with steep bare rock walls. The surface of the state slopes gradually eastward at the rate of ten to 15 feet per mile. The highest point in the state has an elevation of 4,135 feet above sea level and is situated on the west border of the state in Wallace County. The lowest point in the state, slightly less than 700 feet above sea level, is at the point where the Verdigris River leaves Kansas, approximately three miles south of Coffeyville, Montgomery County.

A guide to the physiography of the state has been published by Schoewe (1949:279). A short summary of his classification follows. Two major physiographic divisions (Interior Highlands Division and the Interior Plains Division) and three physiographic provinces are recognized. The Ozark Plateaus Province, a part of the Interior Highlands Division, is present in Kansas only in the southeast corner of Cherokee County, in an area of approximately 50 square miles. Spring River marks its approximate western limits in the state. The Interior Plains Division which makes up the remainder of the state, is divided into two physiographic provinces. The Central Lowlands Province includes all of the eastern one-third of the state and extends westward in a tongue along the Arkansas River Valley to the western border of the state. The remainder of the state is included in the Great Plains Province. Each of these provinces is divided by Schoewe (*op. cit.*) into a considerable number of sections and minor subdivisions. These subdivisions seem to have little if any significance as concerns the geographic distribution of native wild mammals, and hence are not considered further in the present account.

The principal drainage of the state is from west to east. The Kansas [Kaw] River, with its main tributaries, the Republican, Solomon, Saline, and Smoky Hill rivers, drains the northern half of the state and empties into the Missouri River at Kansas City. The Arkansas River, with its tributaries, the Pawnee, Ninnescah, Chikaskia, Medicine Lodge, and Cimarron, drains the southwestern and south-central sections of the state. Most of these streams follow a general west-east direction, although the Arkansas River turns abruptly to the south before it leaves the state. The drainage pattern of the southeastern part of the state in general is from north to south. The Spring, Neosho, Verdigris, and Walnut rivers are the principal streams in this section.

CLIMATE

Notable features of the climate are frequent and abrupt changes. Summers are usually warm, often with periods of high temperatures and low relative humidity. Winters are drier than the summers. According to Flora (1948:1), Kansas has three climatic types

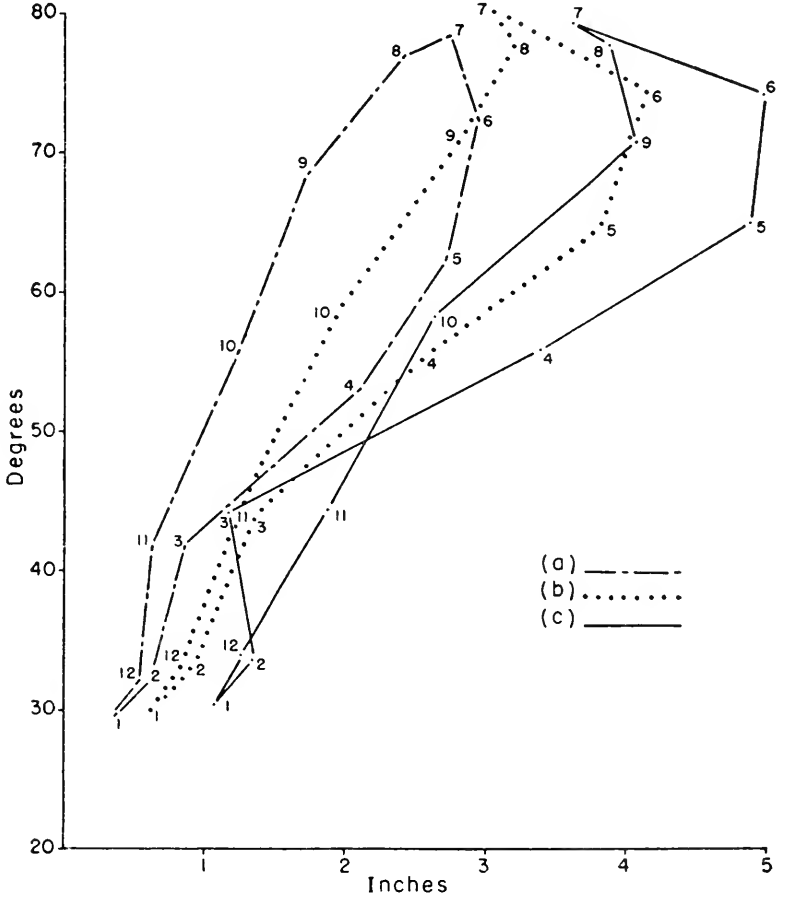

FIG. 1. Hydrothermographs of the three climatic areas of Kansas, (a) western, (b) central, and (c) eastern. Temperature is represented in degrees Fahrenheit, precipitation in inches. Numbers beside points in the figure designate months of the year.

which correspond roughly in distribution to the eastern, middle, and western thirds of the state. Flora (*loc. cit.*) pointed out that the eastern third has an average annual precipitation of 35.27 inches, a higher relative humidity, less sunshine, and less range

between day and night temperatures than other parts of the state. Its winters are somewhat milder and its growing seasons longer than areas to the west and north. In spite of this, spring and the advancement of crops, including harvest dates, are often earlier in the south-central counties than in the southeastern part of the state.

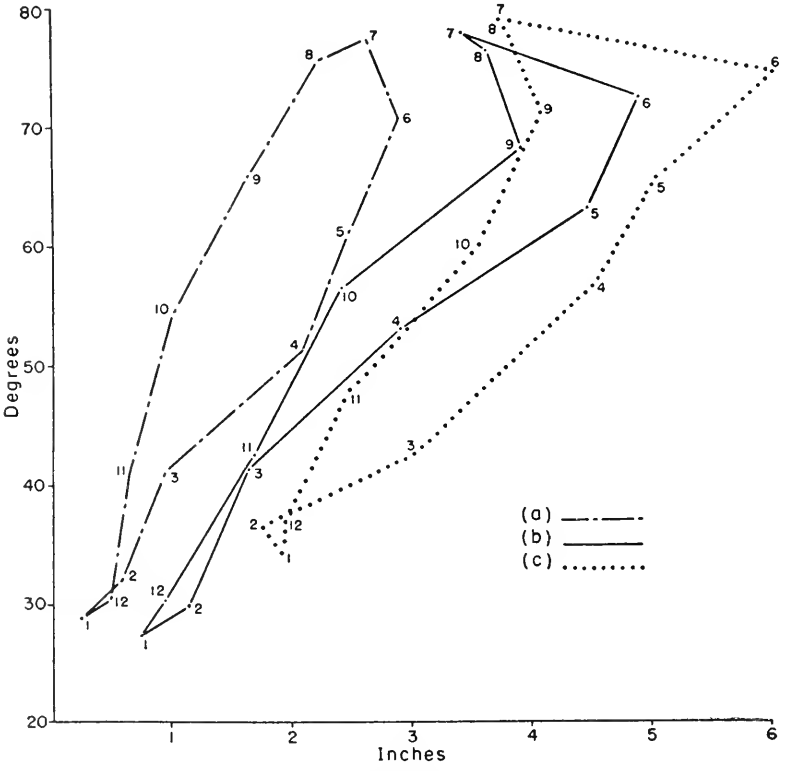

FIG. 2. Hydrothermographs of three towns in Kansas, (a) Colby, Thomas County, in the northwest, (b) Horton, Brown County, in the northeast, and (c) Columbus, Cherokee County, in the southeast part of the state. Temperature is represented in degrees Fahrenheit, precipitation in inches. Numbers beside points in the figure designate months of the year.

The middle third has an average annual precipitation of 26.45 inches. It has drier air, more sunshine, better wind movement, and a greater range between day and night temperatures than the eastern third.

The western third has an average annual precipitation of 19.01 inches. The air is dry, the amount of sunshine is great and wind movement is high. The range between day and night temperatures is considerably greater than at points farther eastward.

Hydrothermographs (figure 1), illustrating in graphic form the average monthly temperature and precipitation in the three parts, demonstrate that the main differences among them result from variations in the amounts of precipitation, rather than from variations in the average monthly temperatures. This difference is more noticeable when one compares hydrothermographs for Colby, Thomas County, in the northwestern part of the state; Horton, Brown County, in the northeastern part of the state; and Columbus, Cherokee County, in the southeastern part of the state (figure 2).

VEGETATION

Eastern Kansas is characterized by a mixture of prairies and deciduous forests. These forests occur, for the most part, on flood plains and moist hillsides and include elm (*Ulmus*), sycamore (*Platanus occidentalis*), burr oak (*Quercus macrocarpa*), eastern cottonwood (*Populus deltoides*), hackberry (*Celtis occidentalis*), redbud (*Cercis canadensis*), and buckeye (*Aesculus*) (Dice 1923A: 45). According to Williams (1946:117): "There are 1,122,626 acres of farm forest land in Kansas, including Forest Service shelterbelts and Soil Conservation Service plantings. This represents only twenty-five per cent of the forests originally found in the state when the first white settlers arrived." The prairies of eastern Kansas are characterized by the presence of blue stem, especially on the western edge of the zone, and blue grass and miscellaneous grasses on the eastern border of the state (Gates:1937).

The climax vegetation of the western three-fifths of Kansas is composed of grasses. Although a number of species of grasses occur there, Gates (1937) regarded blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) as characteristic of the western short-grass area.

A mixture of short grasses and tall grasses occurs in the central part of the state. As a result, the name "mixed-grasses area" is often applied to this region. Grasses present include the blue grama, buffalo grass, big bluestem (*Andropogon furcatus*), little bluestem (*Andropogon scoparius*), Indian grass (*Sorghastrum nutans*), and sideoat grama (*Bouteloua curtipendula*). Albertson (1937:481-547) has described the ecology of a mixed prairie in west-central Kansas.

FAUNAL DIVISIONS OF KANSAS

Topography or land form, climate, soil, and other, non-organic factors such as latitude, drainage, weathering, wind, and exposure all have interacting effects and combine to make up the basic con-

ditions for the existence of life. These non-living units plus the living units make the environment.

Variations in the several components of the environment result in differences in the composition of the fauna and flora of the state. In other words, the distribution of most kinds of living plants and animals is dependent upon a number of diverse environmental factors. Attempts have been made to divide the various parts of North America into a series of more or less homogenous units, as regards their faunal and floral composition, on the basis of differences in one or more of the above named environmental factors.

One attempt at such a division, based primarily on temperature, was made by Merriam (1894:209-213). He thought that certain temperatures were of critical importance to the distribution of plants and animals, especially during the season of growth and reproduction. He stated (*op. cit.*:213): "While it is not for a moment supposed that the subject has been disposed of in all its details, it is confidently believed that the principles controlling the geographic distribution of terrestrial animals and plants have been discovered and that they may be expressed as follows: In *northward* distribution terrestrial animals and plants are restricted by the sum of the positive temperatures for the entire season of growth and reproduction. In *southward* distribution they are restricted by the mean temperature of a brief period during the hottest part of the year." Merriam divided North America into seven "Life Zones." All of Kansas, Missouri, Iowa, Nebraska, as well as many other states and parts of states in the same general latitude all across the United States, were included in the Carolinian or Upper Austral Life Zone.

Merriam thought that temperature was the dominating force, but thought also that rainfall, and its attendant humidity, was a significant factor and later (1898:30) he divided the Upper Austral Zone, "into two large and important faunal areas—an eastern humid or *Carolinian area* and a western arid or *Upper Sonoran area,* which pass insensibly into one another in the neighborhood of the one hundredth meridian." Under this division, Kansas was divided between the Upper Sonoran and the Carolinian areas of the Upper Austral Life Zone.

A second attempt at a division of North America into relatively homogenous ecological units is the biome system developed by Weaver and Clements, Shelford, and others (see Shelford 1945: 248). The biome is based on climax vegetation and dominant animals. According to Clements and Shelford (1939:20) "the term biome . . . is . . . the exact synonym of formation and

climax when these are used in the biotic sense." As modified by Shelford (1945:249) this system divides Kansas between two biomes, the Oak-Wild Turkey Biome in the eastern part of the state and the Grama Grass-Antelope Biome in the remainder of the state.

Dice divided North America into a series of units which he designated as "biotic provinces." His divisions were made on the basis of many more ecological factors than were those of Merriam and Shelford. Dice wrote (1943:3): "Each *biotic province* . . . covers a considerable and continuous geographic area and is characterized by the occurrence of one or more important ecologic associations that differ, at least in proportional area covered, from the associations of adjacent provinces. In general, biotic provinces are characterized also by peculiarities of vegetation type, ecological climax, flora, fauna, climate, physiography, and soil."

Three biotic provinces (according to Dice, 1943) occur in Kansas: The Carolinian, characterized by deciduous hardwood forests, includes the southeastern corner of Cherokee County; the Illinoian, characterized by alternating areas of prairie and deciduous forest and an average annual precipitation range of from 23 to 40 inches that falls mainly in the growing season, includes most of eastern and central Kansas westward approximately to the one hundredth meridian; and the Kansan, characterized by short grasses, covers Kansas west of the one hundredth meridian.

Other attempts have been made to classify the assemblages of plants and animals in a given geographical area. Among these are the following.

Faunal Areas. This type of division was originally proposed by Grinnell and Swarth (1913:217) for the San Jacinto area of southern California. They thought that: "In the restricted sense in which we believe the term best employed, a fauna is a subdivision of a life zone, based upon conditions of atmospheric humidity." Grinnell (1914:63) expanded the concept and applied it to the lower Colorado River Valley. He wrote: "Every animal is believed to be limited in distribution zonally by greater or less degree of temperature, more particularly by that of the reproductive season (see Merriam, 1894). . . . Many species are kept within geographic bounds in certain directions only by an increasing or decreasing degree of atmospheric *humidity* (see Grinnell and Swarth, 1913:217). By the plotting of the ranges of many animals as well as of plants, coincidence in this regard is found in so many cases as to warrant the recognition of a number of 'faunal areas,' on the causative basis of relative uniformity in humidity."

Hall (1946:44) divided Nevada into a number of faunal areas, basing his divisions upon the presence or absence of certain kinds of mammals in given areas.

Biotic Areas. This concept, independently arrived at by Clark (1937) and Davis (1939:28-29), is that, as a result of the interaction of climatic, geographic, edaphic, and biotic factors, the assemblages of plants and animals of a given area are recognizably distinct from assemblages in adjoining areas. These are termed biotic areas.

Biotic districts. As defined by Dice (1943:3) a biotic district is: "A subdivision covering a definite and continuous part of the geographic area of a biotic province. Biotic districts are distinguished by ecologic differences of less importance than those that separate

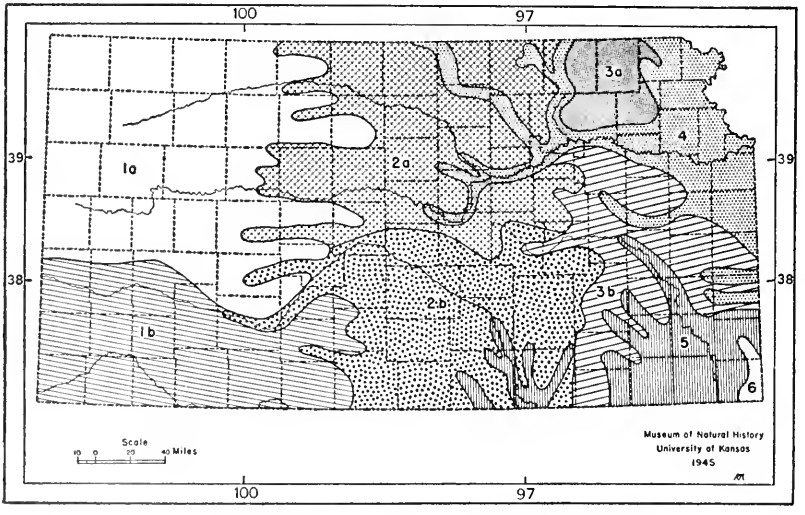

FIG. 3. Map showing biotic districts in Kansas (after Brumwell, 1941: 16-21). 1. Short-grass Plains Biotic District, a. Northern association, b. Southern association. 2. Mixed Grass Plains Biotic District, a. Northern association, b. Southern association. 3. Osage Savanna Biotic District, a. Northern association, b. Southern association. 4. Kaw Valley Biotic District. 5. Cherokee Prairie Biotic District. 6. Ozark Biotic District.

biotic provinces." According to Blair and Hubbell (1938:426), "A biotic district is a geographic unit distinguished by the presence of unique ecological associations, or more often by the presence of a unique assemblage of widely distributed associations. It is less extensive than a biotic province . . . and usually several biotic districts are distinguishable within a province."

Brumwell (1941:16-21, unpublished thesis) divided Kansas into six biotic districts, each of which he thought was characterized by assemblages of vegetational types as well as assemblages of mammals, reptiles, and amphibians. He included a map showing the extent of each biotic district, as understood by him. In the published version of Brumwell's thesis (1951:190), the listings of vegetational types and the map have been omitted. The biotic districts in Kansas, according to Brumwell (*loc. cit.*), are: Kaw Valley Biotic District, Cherokee Prairie Biotic District, Ozark Biotic District, Osage Savanna Biotic District, Mixed Grass Plains Biotic District, and the Short-Grass Biotic District. See the map, figure 3 on the facing page.

Distributional Areas in Kansas. No one of the systems of faunal divisions discussed above corresponds, except in its more general aspects, with the distribution patterns of the mammals in the state. Because of this, I have outlined distributional areas for the state. These distributional areas and their subdivisions are not based on the total fauna or flora of the area; rather, they are based upon the presence or absence of certain kinds of mammals in given areas. These distributional areas and their subdivisions correspond, in part, to the biotic districts as recognized by Brumwell (*loc. cit.*). I believe that Kansas can be divided into two distributional areas, each of which is further divisible into a number of recognizable subdivisions characterized by a particular assemblage of mammals (see map, figure 4). These assemblages are probably the result of interactions between certain edaphic, topographic, climatic, and biotic factors.

The Great Plains Distributional Area, consisting generally of the western three-fifths of the state, is distinct from the Central Lowland Distributional Area in that the genera *Corynorhinus, Antrozous, Dipodomys,* and *Onychomys* are restricted to it. Furthermore, it is characterized by the full species *Myotis velifer, Myotis subulatus, Tadarida molossa, Lepus townsendii, Sylvilagus audubonii, Citellus spilosoma, Perognathus flavescens, Perognathus flavus, Neotoma micropus, Vulpes velox,* and *Mustela nigripes* which do not occur elsewhere in the state. In addition there are 25 subspecies which are restricted, or nearly so, to the Great Plains Distributional Area. This distributional area consists of two provinces, each of which is divisible into two subcenters.

The Central Lowland Distributional Area, consisting generally of the eastern two-fifths of the state, is distinct from the Great Plains Distributional Area in that the genera *Nycticeius, Marmota, Tamias, Pitymys, Zapus,* and *Urocyon* are restricted to it. Furthermore, it is characterized by the full species *Sylvilagus aquaticus, Sciurus carolinensis, Reithrodontomys fulvescens, Peromyscus boylii,* and *Vulpes fulva* which do not occur elsewhere in the state. In addition, there are 19 subspecies which are restricted, or nearly so, to this distributional area. This Central Lowland Distributional Area consists of only two provinces, one of which is divisible into two subcenters.

The distributional areas and their provinces and subcenters are outlined as follows (see figure 4):

A. Great Plains Distributional Area
   1. Short Grass Plains Province
      a. Central High Plains Subcenter
      b. Southern High Plains Subcenter
   2. Mixed Grass Plains Province
      a. Blue Hills Subcenter
      b. Red Hills Subcenter

B. Central Lowland Distributional Area
   1. Tall Grasses Province
      a. Kansas River Valley Subcenter
      b. Osage Plains Subcenter
   2. Cherokee Prairie Province

Table 1 shows the faunal relationships of the species and subspecies of mammals in each of the subdivisions of the distributional areas in Kansas. An examination of this table reveals, as might be expected, that the relations of the fauna of the Great Plains Distributional Area are primarily with faunas of the Great Plains (this is especially pronounced in the Short-grass Plains Province, but less so in the Mixed-grass Plains Province) and that the relations of the fauna of the Central Lowlands Distributional Area are primarily with the fauna of the eastern deciduous forests. The three southern subcenters (Southern High Plains, Red Hills, and Osage Plains) all show faunal relationships with geographically more southern faunas.

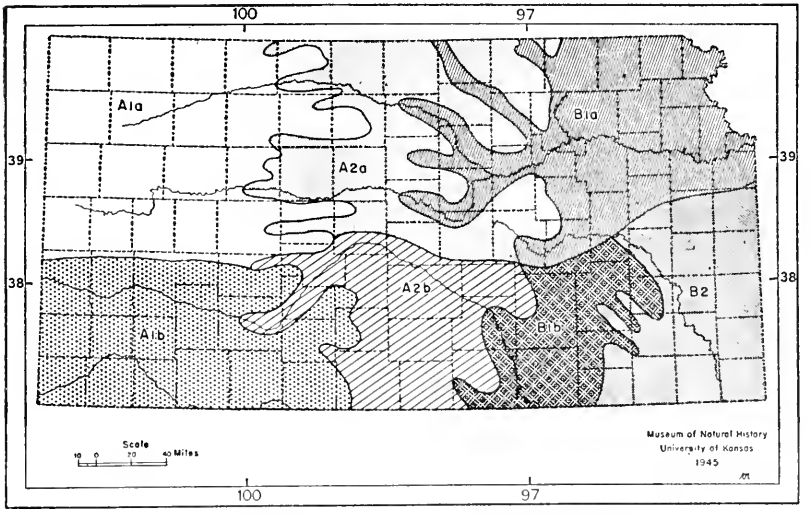

FIG. 4. Map showing mammalian distributional areas in Kansas.

TABLE 1.—FAUNAL RELATIONSHIPS OF THE SPECIES AND SUBSPECIES OF MAMMALS IN KANSAS; BASED UPON THE TAXONOMIC SIMILARITIES BETWEEN THE TOTAL KNOWN FAUNA OF EACH DISTRIBUTIONAL AREA AND THOSE OF SURROUNDING AREAS.

Distributional Area	Species and subspecies having relationships with fauna of eastern deciduous forest	Relationships with fauna of Great Plains	Southern relationships	Endemic	Widely distributed	Total number of kinds actually recorded
A1a.....	2	29	3	0	6	40
A1b.....	4	26	8	2	5	45
A2a.....	6	18	2	0	1	27
A2b.....	7	23	5	1	3	39
B1a.....	30	7	2	0	4	43
B1b.....	24	4	5	0	3	36
B2.....	20	1	4	0	3	28

PROBLEMS OF DISTRIBUTION AND SPECIATION IN KANSAS

In theory, and perhaps in practice, a single environmental factor can limit the distribution of a given kind of organism. This concept of limiting factors, of which "Liebig's Law of the Minimum" is the best known, was first stated by Liebig in 1840. He applied the concept to the yield in field crops, and thought that the nutritive constituent present in the smallest amount limits the yield. This concept has been restated several times. One of the more recent restatements was made by W. P. Taylor (1934) as follows: "The growth and functioning of an organism is dependent on the amount of the essential environmental factor presented to it in minimal quantities during the most critical year or years of a climatic cycle." Similar relations hold, at least theoretically, for maximal quantities.

However, I believe that this concept is often interpreted too strictly. In my opinion each of the factors in a given environment fluctuates continually, but not necessarily at the same rate nor in the same direction. Temperature, for example, may show daily as well as seasonal variations while the calcium content or the size of the sand grains of the soil may remain relatively stable over long periods of time. A given environment, then, is the result of the interaction of all of the factors present. A change in the rate, direction, magnitude, or mean of the fluctuation of any one factor inevitably effects all of the other factors. The original change, if isolated from other environmental factors, may not be sufficient to effect the distribution of a given kind of organism, yet, by interaction with the other factors, it may result in a new environment of composition sufficiently different to effect the distribution of a given kind of organism. An increase in temperature, for example, results in a lower relative humidity and an increased evaporation rate. In such a case, drier atmosphere, rather than higher temperature, may be the limiting factor in the distribution of a given kind of organism. An example of this sort is seen in the fluctuation of the population levels of the prairie vole, *Microtus ochrogaster,* in a mixed prairie near Hays, Ellis County. In 1931 the population was estimated at 7367 individuals per square mile; in 1933, at 2500 individuals per square mile; and in the period 1934-1939 none was found (Wooster, 1939A, Brown, 1946:448). In the five years, 1928-1932, the annual rainfall at Hays was never less than 25 inches. In 1933 the total annual rainfall dropped to 16.26 inches

and for the four succeeding years was, in effect, equally subnormal in amount. From this one might conclude that the low precipitation caused a decrease in the population level. This probably was only indirectly true: direct factors probably were decreases in the food and cover plants and increases in predation. Wooster (1935:352 and 1939A) and Albertson and Weaver (1942) showed that the little blue stem and other grasses and weeds disappeared from the prairies, thus cutting down on the food supply and exposing the runways of *Microtus*. In the exposed runways, *Microtus* were more easily taken than formerly by hawks, owls, coyotes, and other enemies. Other factors also may have contributed to the decrease in the population levels.

At the risk of losing sight of the concept that a given environment is the result of the interaction of all factors present and that a change in any one of these factors, by interaction, may result in a new environmental complex, I shall point out cases in the distributions of mammals in Kansas in which given environmental factors appear to behave as "limiting factors."

Edaphic factors and distribution. The brush mouse, *Peromyscus boylii*, is found only on or near rocky ledges and cliffs in the southeast. However, along similar rocky ledges in other parts of the state, the brush mouse does not occur, presumably because of the absence of suitable plant-life. Acorns furnish one of the main foods of the brush mouse.

The pocket gopher, *Geomys bursarius*, is found rarely, if at all, in the state southeast of a line extending from 13 miles south of Lawrence, Douglas County, to a point eight miles southwest of Toronto, Greenwood County. The area southeast of this line corresponds almost exactly with the areas indicated by Hide (1946:33) as those where moderate and heavy applications of lime are necessary on most soils. Further, this is also the area where large amounts of chert gravels are found in the soil.

Kangaroo rats (*Dipodomys ordii*), although found at least rarely in most habitats in western Kansas, reach high population levels in areas of sand or loose, sandy soils.

Topographic factors and distribution.—In east-central Kansas, where local differences in elevation are correlated with the stream patterns, soil types, availability of water, and perhaps other factors, there are great differences in vegetational types at the different elevations. On the uplands there are mixed grasses and on the lowlands, along the streams, there are westward extensions of the

forests. The types of habitats interdigitate and, as a result, eastern woodland species occur far westward along the forested streams. Examples of this are the gray squirrel, *Sciurus carolinensis,* the lemming mouse, *Synaptomys cooperi,* and pine mouse, *Pitymys nemoralis,* which occur in Riley County. Leo Brown (*in litt.*) found skulls of the lemming mouse, *Synaptomys cooperi,* in barn owl pellets taken one-fourth mile south of Hunter, Mitchell County. This locality is near Bacon Creek, a wooded tributary of the Saline River. Similarly, western grassland species occur farther eastward on divide areas. For example the prairie dog, *Cynomys ludovicianus,* has been recorded as far east as Cloud, Clay, and Dickinson counties.

In species which show subspecific differences between populations in western and eastern Kansas, individuals taken from wooded stream valleys as far west as Mitchell, Lincoln, and Ellsworth counties, while actually intergrades, show more of the characteristics of the eastern subspecies than do individuals taken from upland habitats as far east as Marion County.

The few lakes and the streams in Kansas are essential to the existence of the raccoon, *Procyon lotor,* the mink, *Mustela vison,* the beaver, *Castor canadensis,* and the muskrat, *Ondatra zibethicus.*

In a broad sense, the physiography of the state has an effect on mammalian distribution. Few of the major or minor physiographic divisions correspond however, except in a very general way, with the distributional patterns of mammals.

Flooding probably depopulates a few restricted areas each year. Scheffer (1908:130) reported that: "During the great flood of 1903 in the valleys of the Kansas and its tributaries the flood-plains of many streams were inundated from bluff to bluff. At this time observers noted hundreds of pocket gophers on the higher points of land above water and along railroad embankments. An observer near Manhattan killed 180 of the animals with a club. For a year or so after the floods the lowlands were comparatively free from gophers, but they are fast reoccupying the flats and regaining their original numbers."

The gypsum caves in Barber and Comanche counties, although a very local feature in the total environment of the state, have an effect on the distributional pattern of many bats. The long-eared bat, *Corynorhinus rafinesquii,* and Bunkers bat, *Antrozous bunkeri,* have not been taken elsewhere in Kansas and the bat, *Myotis velifer,* although recorded in surrounding areas, congregates in numbers only in the caves.

Marshes in Meade and Stafford counties support isolated populations of lemming mice, *Synaptomys cooperi.*

Climatic factors and distribution. In Kansas, climate seems to play an important part in the distribution of mammals, but because the total area of Kansas is small, in comparison to the area of geographic distribution of several kinds of mammals, and because climate in Kansas is not divisible into different zones with clear-cut boundaries, the precise effects of individual components of the climate in the state are not readily recognizable.

According to Flora (1948:5), a trend toward milder winters and warmer summers began over the state in the late 1880's and continued until the late 1930's, when a downward trend began. Flora presented graphs (*op. cit.*:176-178) of ten-year moving averages of temperatures for both summer and winter, which bear out his statements. Beginning in 1926, the ten-year moving averages of winter temperatures have been above the 1887-1945 average and since 1934 the ten-year moving averages of summer temperatures have been above the 1887-1945 average.

Perhaps this trend toward warmer summers and milder winters influenced the geographic distribution of several species. Elsewhere I have presented (Cockrum, 1948:306-312) data which show that the cotton rat, *Sigmodon hispidus,* has extended its range northward in the state. Additional evidence on this northward extension and on a westward extension are presented later in this paper. This extension can be correlated rather closely, chronologically, with the high portion of the ten-year moving averages of summer temperatures.

The armadillo, *Dasypus novemcinctus,* has been extending its range northward and eastward in the United States in the past fifty years. Taber in 1939 (pp. 489-493) summarized available data on this extension. Six recorded instances of the occurrence of the armadillo in Kansas are available. The two earlier occurrences (one in 1909 and one in the 1930's) probably represent escapes. The four later occurrences (one in 1942 and three in 1950, all in the south-central part of the state) probably represent a continuation of their northward extension from Texas and Oklahoma. Perhaps this extension into Kansas can be correlated with the milder winters of recent years. Taber (1939:492) pointed out: "Armadillos . . . are incapable of withstanding temperatures even approaching freezing, if it continues several days." To me it appears unlikely that the armadillo will become permanently estab-

lished here. One prolonged cold period would probably kill all armadillos in the state.

Precipitation has a great indirect bearing on mammalian distribution in Kansas. The normal annual precipitation varies from a low of 15.85 inches in Stanton County (southwest) to a high of 41.86 inches in Cherokee County (southeast). Most of the precipitation occurs in the warm season (April-September, inclusive). The normal precipitation in the warm season is 14.70 inches in the western one-third and 24.64 inches in the eastern one-third of the state. The normal winter precipitation (December-February, inclusive) is low, ranging from 1.57 inches in the western one-third to 3.76 inches in the eastern one-third of the state. The readings for average relative humidity in July at Dodge City (western Kansas) and St. Joseph, Missouri, at 12:30 a. m.; 6:30 a. m.; 12:30 p. m.; and 6:30 p. m. are: 63.4, 81.1; 69.9, 78.2; 36.5, 48.7; 35.3, 49.0.

The western part of the state has stronger winds than the eastern part of the state. This is more noticeable in the warm season than in the winter season, as shown in the following tabulation:

AVERAGE HOURLY WIND VELOCITY IN MILES PER HOUR

	Jan.	July	Annual
Dodge City, Kan.	11.9	12.2	12.9
Topeka, Kan.	9.1	8.3	9.2
St. Joseph, Mo.	9.0	7.4	8.7

The lower relative humidity and the greater wind velocity in western Kansas combine to give a higher rate of evaporation than exists in the eastern part of the state. This is shown in the following tabulation:

MEAN MONTHLY EVAPORATION RATES IN INCHES

	Apr.	May	June	July	Aug.	Sept.	Oct.
Hays	7.6	9.7	12.2	15.5	13.8	10.6	7.1
Manhattan	6.1	7.6	8.8	10.6	9.0	7.2	4.8
Lawrence	5.2	6.6	7.8	9.8	9.2	6.8	4.2

The greater evaporation rate and the lower amount of precipitation in western Kansas as compared with the lesser evaporation rate and greater amount of precipitation in eastern Kansas combine to make the difference in moisture available to plants in the two areas even greater than is indicated by an analysis of precipitation data alone.

According to plant ecologists, deciduous forests are characterized by large total precipitation, long growing season, hot and humid summers, cold, windy winters, and no droughts or frosts in the growing season. Grassland is characterized by low rainfall, precipi-

tation largely in the growing season, high evaporation rate, high summer temperatures, low winter temperatures, and high winds.

A glance at the data presented above shows that a climate characterizing deciduous forests is found in eastern Kansas and a climate characterizing grasslands is found in western Kansas.

In Kansas, as in other parts of the world, there have been alternately recurring wet and dry periods. Flora (1948:4) could see no regularity in intervals between these periods nor could he find any clues to suggest when they might occur in the future. Six dry periods of exceptional note have been recorded in Kansas since 1850: October, 1859 to March, 1868; from September, 1872 to summer of 1875; from 1892-1894 in western Kansas; from November, 1900 to May, 1902; from 1910 to 1918; and from 1930 to 1940. To my knowledge, no observations were recorded on the effects of the earlier dry periods on mammalian populations.

I have already pointed out how, in Ellis County, the dry period of the 1930's, interacting with other environmental factors, resulted in the almost complete elimination of the prairie vole, *Microtus ochrogaster*. Wooster (1935:351) reported that during this same time, the numbers of black-tailed jackrabbits increased. He found, in a prairie area in Ellis County, where transect-survey counts were made, three times as many black-tailed jackrabbits in March, 1935 (in the middle of the dry period), as in March, 1933 (at the beginning of the dry period in Ellis County). This increase seemed to have been general in western Kansas and Wooster (*loc. cit.*) reasoned that since the increase was general (thus eliminating the possibility of local concentrations) and since he could find no increase in predation, the increase in population of the black-tailed jackrabbit must have been caused by a lower mortality rate of the young. Normally, he explained, the chilling rains and wet soils of the spring and early summer cause many young to die but the spring and early summer of 1934 and 1935 were both dry and warm, and thus decreased the mortality rate of the young and permitted an increase in the population level.

The climate of a given region consists of a series of minor fluctuations, a warmer trend for a period of years, followed by a cooler trend for a period of years. These fluctuations are entirely apart from any long term trend toward warmness or coldness that might be apparent if information were available for thousands of years. These minor trends may be sufficient to permit populations on the edge of the range of a species to extend the range of the species,

providing, of course, that the climatic factors rather than some other environmental feature are the limiting factors. In such an instance one adverse season can halt the expansion or even reduce the range of the species. The cotton rat, *Sigmodon hispidus,* may be a case in point. *Sigmodon* was first recorded in Douglas County in 1941 and by the summer and fall of 1948, it was common, and locally numerous, in most of the county. In the winter of 1948-1949, sleet covered most of northeastern Kansas to a depth of two to three inches and remained on the ground for approximately one month. The following summer and fall, 1949, cotton rats were rare in most parts of the county. By October, 1950, the population level was again high; cotton rats were numerous in many parts of the county. Perhaps, if conditions had been slightly more severe in the winter of 1948-49, the cotton rat would have been eliminated from the county.

Biotic factors and distribution. (1) Plants. Directly and indirectly the vegetation of the state is very important in limiting the distribution of many kinds of mammals. Two major areas, each with a different type of plants, occur in Kansas, the deciduous forest in the east and the grassland in the west. The forest, even before the state was settled, did not cover all of the eastern part of the state, but rather were interspersed with tall-grass prairies. In general, trees occur on flood plains and moist hillsides along streams. Elm, sycamore, bur oak, eastern cottonwood, hackberry, redbud, and buckeye are among the kinds of trees characteristic of this area. Trees characteristic of the deciduous forest exist in river valleys almost half-way across the state.

Several kinds of mammals are restricted to the eastern wooded portion. Such restrictions may result from dependence upon the trees and shrubs for food or for cover, or both. The following mammals are limited in their distribution to this wooded portion.

Sciurus carolinensis	*Peromyscus boylii*
Marmota monax	*Pitymys nemoralis*
Tamias striatus	*Zapus hudsonius*
Glaucomys volans	*Vulpes fulva*
Reithrodontomys fulvescens	*Urocyon cinereoargenteus*

The grasslands can be roughly divided into two regions: The short grass region, primarily buffalo and grama grasses, in the western one-third of the state and the mixed grass region, with a mixture of blue-stem and short grasses, in the central one-third of the state. In the eastern one-third of the state, which is primarily a deciduous forest, two zones of characteristic grasses occur: (1) the

zone of blue grass and miscellaneous grasses in three tiers of counties along the eastern border and (2) the zone of blue stem grasses, extending from Marshall County on the northern border southward to Chautauqua County, on the southern border (Gates, 1936). These latter two zones, the blue stem and the blue grass zones, are mixed in with deciduous forest areas.

As pointed out by Clements and Shelford (1939:260-264), in the area listed above as the short-grass zone the climax vegetation is believed to be a mixture of short grasses and grasses of mid-height, but the mid-height grasses have been removed by overgrazing and a disclimax of short grasses has resulted. In fenced areas protected from grazing, the mid-height grasses again become abundant. Larson (1940:113-121) noted that under natural conditions the bison and other grazing animals must have had much the same effect as domestic live stock and concluded that the vegetation of the plains is not very different now from what it was before the bison was eliminated.

The following species of mammals are limited in their distribution to the grasslands. Those species marked with an asterisk are found only in the short-grass region; the remainder occur in both the short-grass and mixed-grass regions.

Lepus townsendii•	*Dipodomys ordii*
Sylvilagus audubonii•	*Onychomys leucogaster*
Cynomys ludovicianus	*Neotoma micropus*
Citellus spilosoma•	*Vulpes velox* (extinct)
Perognathus flavescens	*Mustela nigripes* (extinct?)
Perognathus flavus•	*Antilocapra americana* (extinct)

The pocket mouse, *Perognathus hispidus,* usually characteristic of grasslands, has been taken in the blue stem zone of the eastern part of the state.

Among those species of mammals which occur in both the eastern wooded sections and in the western grassland sections several have differentiated into subspecies, one characteristic of the western grasslands and a second one characteristic of the eastern woodlands.

(2). Other biotic factors. The occurrence and distribution of the large carnivores that formerly occurred in the state, especially the grizzly bear, *Ursus horribilis,* and the wolf, *Canis lupus,* were probably more influenced by the presence or absence of the large herbivores, such as the bison, antelope, and deer, than by any other one environmental factor. When man destroyed the large herbivores, the grizzly bear and the wolf were doomed for extinction in

the state. Man hastened this extinction by poisoning, trapping, and shooting as many of the large carnivores as possible.

The distribution of the black-footed ferret, *Mustela nigripes*, was greatly influenced by the presence or absence of the prairie dog, *Cynomys ludovicianus*. It fed upon these rodents and used their burrows for shelter. Continuous warfare has been waged against the prairie dog since the state was first settled. Poisons, gases, and traps have taken heavy toll of the prairie dog and have exterminated the black-footed ferret in the state.

To some extent the distribution, and definitely the population levels, of the prairie dog are influenced by biotic factors. The prairie dog requires hard-packed ground and short grass. The immense herds of bison that formerly roamed western Kansas packed down the soil and in many places overgrazed the grasslands so that only short grasses were able to exist. There was thus provided an ideal habitat for the prairie dog. Mead (1899:281) reported that in the 1850's the divide between the Saline and Solomon rivers in Ellsworth County and westward was a continuous prairie dog town for miles. When the buffalo were killed, the ground ceased to be tramped hard, the short grass was replaced by weeds and tall grass, and the prairie dogs perished. The breaking of the prairie sod for the planting of wheat further restricted the available habitat. Areas utilized as range land, especially when overgrazed, still furnish suitable habitat for the prairie dog. A striking example of this was given by Mead (1885:92). Cattle raised in Texas were driven northward through Oklahoma (then Indian Territory) to the railroad in Kansas. Mead reported (*loc. cit.*) that because of overgrazing and packing of the soil: "The great Chisholm Texas cattle trail through the Indian Territory, a hundred yards wide, became a Dogtown almost its entire distance."

Land use and distribution. Certainly, in his use of the land, man has influenced the distribution of many mammals. The American Indian had relatively little effect on mammalian distribution; the White Man, however, has had a great effect on the abundance and distribution of many kinds of native mammals.

The large herbivores and large carnivores were exterminated soon after the state was settled, although in recent years deer have again become established. The bison, antelope, and deer not only furnished food for man but also competed with him for the use of the land. Obviously herds of cattle or grain fields could not exist in the midst of a great bison range. As the large herbivores were exterminated the large carnivores probably began to prey more

heavily on domestic animals and thus, were also doomed for extermination by the herders who were bent on protecting their domestic animals.

When large tracts of the prairie sod were turned for the planting of wheat, suitable habitat for many mammals either no longer existed or was greatly restricted. The white-tailed jackrabbit, *Lepus townsendii,* once numerous in the northwest, became scarce; population levels of the cottontail rabbits probably never reached the high levels formerly possible, and certainly the number of prairie dogs in the state decreased.

Some kinds of native mammals have become more numerous and have increased their ranges as a result of changes in land use. The black-tailed jackrabbit, *Lepus californicus,* was formerly rare in the northwestern part of the state. Apparently it was able to adapt itself more readily to the changed conditions than was the white-tailed jackrabbit, and became more abundant in the northwest.

The opossum, *Didelphis virginiana,* the fox squirrel, *Sciurus niger,* and the spotted skunk, *Spilogale interrupta,* were formerly rare or absent over most of western Kansas. With the change in land use, these mammals have either become more numerous or have actually extended their ranges westward from eastern woodlands. This was made possible by an increase in available foods, by the planting of trees on the western grasslands, and by the growth of trees along stream courses after prairie fires seldom occurred.

The following species of mammals in Kansas have been influenced by changes in land use.

Increased in numbers, in extent of range, or both.

Didelphis virginiana	*Sciurus niger*
Lepus californicus	*Spilogale interrupta*

Decreased in numbers, in extent of range, or both.

Lepus townsendii	*Lutra canadensis*[•]
Cynomys ludovicianus	*Felis concolor*[•]
Erethizon dorsatum	*Lynx rufus*
Canis lupus[•]	*Cervus canadensis*[•]
Canis niger[•]	*Odocoileus hemionus*
Vulpes velox[•]	*Odocoileus virginianus*
Ursus horribilis[•]	*Antilocapra americana*[•]
Ursus americanus[•]	*Bison bison*[•]
Mustela nigripes[•]	

Speciation. To me it seems evident that, in general, speciation in the class Mammalia is a population phenomenon. It results from

[•] Extinct in the state.

the separation, either temporally or geographically, of a population (or series of adjacent populations) from the parent population (or populations), and the differentiation and reproductive isolation of these groups by natural selection or random fixation (Wright, 1931 and elsewhere) of mutations that occur or are already available in the population as stored variability (Mather and Harrison, 1949). In actual practice exact data to show whether or not members of given population samples are reproductively isolated from each other are usually lacking; thus the degree of morphological difference must be used as a basis for judging whether or not differences between two population samples are the result of individual variation, geographic variation within one species, or species differences. Herein lies one of the greatest difficulties of mammalian taxonomy, for the interpretations made for a given case vary with knowledge, experience, and personal convictions.

A given species is composed of a series of actually or potentially interbreeding populations. Individuals in these various populations vary, not only due to differences in age and sex but also because of differences in genetic composition, resulting in different reactions to environment. In addition, even two individuals of the same litter are exposed to different microenvironments in their life history. This, also, may result in individual variation. For example, one individual may secure more food at a critical stage in its life history while a second may, at the same time, secure only a minimum amount of food.

This individual variation is usually relatively small and falls in a normal distribution curve around a given modal value. The distribution curves of individual variation for two populations, separated only by a plowed field, are often somewhat different. In general, however, populations in a major environmental type, such as the wooded eastern part of Kansas, are close, morphologically, whereas populations in a second major environmental type, such as the grasslands of western Kansas, tend to cluster around a slightly different modal point. When morphological differences between two such series of populations are of such a magnitude that 75 per cent or more of the individuals in each series are separable from the other series, then each series is considered to be a subspecies.

In Kansas, color of pelage, for example, differs between eastern and western subspecies of many species. In general, subspecies in the eastern part of the state have a much darker pelage; those in the west are pale. The following species are examples:

Name of the species	Eastern, dark subspecies	Western, pale subspecies
Scalopus aquaticus	*machrinoides*	*caryi*
Eptesicus fuscus	*fuscus*	*pallidus*
Sylvilagus floridanus	*mearnsii*	*llanensis*
Geomys bursarius	*majusculus*	*jugossicularis*
Perognathus flavescens	*copei*	*flavescens*
Perognathus hispidus	*spilotus*	*paradoxus*
Reithrodontomys montanus	*griseus*	*albescens*
Peromyscus maniculatus	*bairdii*	*nebrascensis*
Peromyscus leucopus	*noveboracensis*	*tornillo*
Neotoma floridana	*osagensis*	*campestris*
Microtus ochrogaster	*ochrogaster*	*haydenii*

Perhaps I should point out now that, in my view, subspecies are not necessarily incipient species. Any population, or series of populations, in the range of a species, whether recognized as a subspecies or not, is a potential species. If, by chance, one population or series of populations (of one or more subspecies) be separated geographically from the rest of the species, I can see how, in time, the two groups might become reproductively isolated. If the ranges of the two again come together, or overlap, they might not interbreed. These, then, I would consider to be separate species.

Perhaps the population of lemming mice, *Synaptomys cooperi*, that appears to be geographically isolated at present in marsh areas in Meade County, if it continues to exist, may, in time, become sufficiently different, genetically, that reproductive isolation will result. However, rather minor fluctuations of climatic and ecological conditions would again permit lemming mice to occur over most of the state, the geographic isolation would no longer exist and the genetic constitution of the population, by interbreeding with adjacent populations and the resultant gene-flow, would again approach the modal value of the species. Another, equally likely possibility is that changes in ecological conditions might easily exterminate the population now existing in Meade County.

In Kansas, most species that occur over any large part of the state are divisible into two or more subspecies. In all such cases the subspecific differences are associated with minor differences in the environment. Since, in Kansas, different environments grade almost imperceptibly into each other, it is not at all surprising that there are no sharp lines between the ranges of various subspecies. Rather, the subspecies, like the environments, grade into each other over wide geographic zones. These zones I consider to be areas of intergradation. For the purpose of constructing distribution maps I have, in many cases, arbitrarily referred specimens from these areas of intergradation to a given subspecies.

In general, the range of individual variation is slightly greater in areas of intergradation. A given population in such an area may contain individuals that more nearly resemble the norm of one or the other of the intergrading subspecies in one or more morphological characteristics. The majority of the individuals, however, tend to have morphological characteristics intermediate between those of the two subspecies and thus are, in truth, intergrades.

METHODS

The arrangement of the major taxonomic categories, from suborders to genera, follows Simpson (1945:48-162), except for certain generic names. In arranging the species, G. S. Miller (1924), has been followed except for genera revised since the time of his work, the order of arrangement of the latest revision is followed. The arrangement of the subspecies is from north to south and west to east within the state.

Under each species is included a common or vernacular name as well as general notes on natural history and economic importance. Each vernacular name applies to all of the subspecies of its species.

The following is a list of abbreviations used in this account and an explanation of their meaning.

AJK—Collection of the late A. J. Kirn, formerly of Somerset, Texas.
AMNH—American Museum of Natural History.
CNHM—Chicago Natural History Museum.
GCR—Collection of the late Dr. Glen C. Rinker, of Hamilton, Kansas.
KU—University of Kansas Museum of Natural History.
MVZ—Museum of Vertebrate Zoology, University of California, Berkeley.
MZ—Museum of Zoology, University of Michigan.
OU—Ottawa University Collection, Ottawa, Kansas.
USBS—United States Biological Surveys Collection.
USNM—United States National Museum.
WGF—Collection of W. Gene Frum.

Each subspecies is treated under the following headings:

1. The *synonymy*, in which the first citation is to the original description, followed by the designation of the type locality. The second entry cites the first usage of the combination (generic, specific, and subspecific) employed in the present work, unless the combination is the same as that used by the original author. The remainder of the citations refer to the different name combinations, arranged chronologically, that have been applied to specimens taken in Kansas. A pure synonym is recognizable because the citation is followed by the designation of the type locality. Throughout the synonymy, a comma is placed between the scientific name and the author if he did not originally propose the name in the work referred to; conversely, the absence of a comma indicates that the author did propose the name in that work.

2. The *distribution* within the state.

3. The *remarks* begin with measurements (in millimeters, unless otherwise stated) of the total length (tip of the nose to the distal end of the fleshy part of the tail), length of tail (from point where tail may be bent at a right angle with the back to the distal end of the fleshy part of the tail, not including the hairs which project beyond the tip), length of hind foot (from back of

heel to tip of longest claw when foot is laid out flat), and length of ear (measured from notch). These measurements are given in the order mentioned. Any other measurements given are explained at the place where they are recorded. These measurements are followed, in most cases, by notes referring to the subspecies concerned, in contrast to remarks applying to that species as a whole.

4. Under *specimens examined* there is given, first, the total number of specimens available to me. This number is followed by a list of the localities from which these specimens were taken. Unless otherwise indicated, specimens are in the collection of the Museum of Natural History at the University of Kansas.

The order of listing is first by counties, beginning in the northwest corner of the state and ending in the southeast corner of the state, in the following order:

Cheyenne	Lincoln	Edwards
Rawlins	Ottawa	Stafford
Decatur	Saline	Reno
Norton	Dickinson	Harvey
Phillips	Geary	Butler
Smith	Morris	Greenwood
Jewell	Wabaunsee	Woodson
Republic	Shawnee	Allen
Washington	Osage	Bourbon
Marshall	Douglas	Stanton
Nemaha	Johnson	Grant
Brown	Greeley	Haskell
Doniphan	Wichita	Ford
Sherman	Scott	Kiowa
Thomas	Lane	Pratt
Sheridan	Ness	Kingman
Graham	Rush	Sedgwick
Rooks	Barton	Elk
Osborne	Ellsworth	Wilson
Mitchell	Rice	Neosho
Cloud	McPherson	Crawford
Clay	Marion	Morton
Riley	Chase	Stevens
Pottawatomie	Lyon	Seward
Jackson	Coffey	Meade
Atchison	Franklin	Clark
Jefferson	Anderson	Comanche
Leavenworth	Miami	Barber
Wyandotte	Linn	Harper
Wallace	Hamilton	Sumner
Logan	Kearny	Cowley
Gove	Finney	Chautauqua
Trego	Gray	Montgomery
Ellis	Hodgeman	Labette
Russell	Pawnee	Cherokee

Within a county, localities are listed from north to south; where two localities are on the same parallel the western one precedes the eastern.

5. Under *additional records* are listed specimens that have been mentioned in literature but that have not been examined by me. With each is given a citation to the source of the record.

6. In *tables of cranial measurements* I have listed measurements (given in millimeters and tenths thereof as taken with dial calipers) of the skulls of the various kinds of mammals found in the state. Unless otherwise stated, these measurements are those of the skulls of adult specimens.

CHECK-LIST OF THE MAMMALS OF KANSAS

The 119 kinds (species and subspecies) are grouped in eight orders, 23 families, 55 genera, and 80 (full) species.

Class MAMMALIA—mammals

Order MARSUPIALIA—marsupials

Family Didelphidae—opossums

		PAGE
Didelphis virginiana virginiana Kerr	Virginia opossum	39

Order INSECTIVORA—insectivores

Family Soricidae—shrews

Blarina brevicauda brevicauda (Say)	Short-tailed shrew	42
Blarina brevicauda carolinensis (Bachman)	Short-tailed shrew	43
Cryptotis parva parva (Say)	Little short-tailed shrew	45

Family Talpidae—moles

Scalopus aquaticus caryi Jackson	Common mole	50
Scalopus aquaticus machrinoides Jackson	Common mole	51
Scalopus aquaticus intermedius Elliot	Common mole	52

Order CHIROPTERA—bats

Family Vespertilionidae—common bats

Myotis lucifugus lucifugus (LeConte)	Big myotis	58
Myotis velifer incautus (J. A. Allen)	House bat	60
Myotis subulatus subulatus (Say)	Small-footed myotis	63
Lasionycteris noctivagans (LeConte)	Silver-haired bat	65
Pipistrellus subflavus subflavus (F. Cuvier)	Pipistrelle	67
Eptesicus fuscus fuscus (Beauvois)	Big brown bat	70
Eptesicus fuscus pallidus Young	Big brown bat	71
Nycticeius humeralis humeralis (Rafinesque)	Evening bat	72
Lasiurus cinereus cinereus (Beauvois)	Hoary bat	74
Lasiurus borealis borealis (Muller)	Red bat	76
Corynorhinus rafinesquii pallescens Miller	Long-eared bat	79
Antrozous bunkeri Hibbard	Bunker bat	81

Family Molossidae—free-tailed bats

Tadarida mexicana (Saussure)	Mexican free-tailed bat	84
Tadarida molossa (Pallas)	Big free-tailed bat	85

Order EDENTATA—sloths, anteaters and armadillos

Family Dasypodidae—armadillos

Dasypus novemcinctus mexicanus Peters	Nine-banded armadillo	89

Order LAGOMORPHA—hares, rabbits, and pikas

Family Leporidae—hares and rabbits

		PAGE
Lepus townsendii campanius Hollister	White-tailed jackrabbit	98
Lepus californicus melanotis Mearns	Black-tailed jackrabbit	100
Sylvilagus floridanus similis Nelson	Florida cottontail	102
Sylvilagus floridanus mearnsi (Allen)	Florida cottontail	103
Sylvilagus floridanus alacer (Bangs)	Florida cottontail	105
Sylvilagus floridanus llanensis Blair	Florida cottontail	104
Sylvilagus audubonii baileyi Merriam	Audubon cottontail	106
Sylvilagus audubonii neomexicanus Nelson	Audubon cottontail	107
Sylvilagus aquaticus aquaticus (Bachman)	Swamp rabbit	107

Order RODENTIA—rodents

Family Sciuridae—squirrels

Sciurus carolinensis carolinensis (Gmelin)	Gray squirrel	113
Sciurus niger rufiventer Geoffroy	Fox squirrel	115
Marmota monax bunkeri Black	Woodchuck	118
Cynomys ludovicianus ludovicianus (Ord)	Prairie dog	121
Citellus tridecemlineatus arenicola Howell	Striped ground squirrel	124
Citellus tridecemlineatus tridecemlineatus (Mitchell)	Striped ground squirrel	125
Citellus tridecemlineatus texensis (Merriam)	Striped ground squirrel	126
Citellus spilosoma major (Merriam)	Spotted ground squirrel	128
Citellus spilosoma obsoletus (Kennicott)	Spotted ground squirrel	127
Citellus franklinii (Sabine)	Franklin ground squirrel	129
Tamias striatus venustus Bangs	Eastern chipmunk	132
Tamias striatus griseus Mearns	Eastern chipmunk	131
Glaucomys volans volans (Linnaeus)	Flying squirrel	134

Family Geomyidae—pocket gophers

Geomys bursarius lutescens Merriam	Pocket gopher	141
Geomys bursarius majusculus Swenk	Pocket gopher	141
Geomys bursarius jugossicularis Hooper	Pocket gopher	142
Geomys bursarius industrius Villa-R. and Hall	Pocket gopher	142
Geomys bursarius major Davis	Pocket gopher	143

Family Heteromyidae—pocket mice and kangaroo rats

Perognathus flavescens flavescens Merriam	Plains pocket mouse	145
Perognathus flavescens copei Rhoads	Plains pocket mouse	146
Perognathus flavus flavus Baird	Baird pocket mouse	148
Perognathus hispidus spilotus Merriam	Hispid pocket mouse	150
Perognathus hispidus paradoxus Merriam	Hispid pocket mouse	149
Dipodomys ordii richardsoni (Allen)	Ord kangaroo rat	153

Family Castoridae—beavers

Castor canadensis missouriensis Bailey	American beaver	157

Family Cricetidae—native rats and mice		PAGE
Onychomys leucogaster arcticeps Rhoads	Grasshopper mouse	161
Onychomys leucogaster breviauritus Hollister	Grasshopper mouse	162
Reithrodontomys fulvescens aurantius Allen	Golden harvest mouse	163
Reithrodontomys megalotis dychei Allen	Western harvest mouse	166
Reithrodontomys megalotis aztecus Allen	Western harvest mouse	167
Reithrodontomys montanus albescens Cary	Pygmy harvest mouse	168
Reithrodontomys montanus griseus Bailey	Pygmy harvest mouse	169
Peromyscus maniculatus nebrascensis (Coues)	Deer mouse	172
Peromyscus maniculatus bairdii (Hoy and Kennicott)	Deer mouse	174
Peromyscus leucopus aridulus Osgood	Wood mouse	177
Peromyscus leucopus noveboracensis (Fischer)	Wood mouse	177
Peromyscus leucopus tornillo Mearns	Wood mouse	179
Peromyscus leucopus texanus (Woodhouse)	Wood mouse	179
Peromyscus boylii attwateri (Allen)	Brush mouse	181
Sigmodon hispidus texianus (Audubon and Bachman)	Hispid cotton rat	186
Neotoma floridana campestris Allen	Florida wood rat	189
Neotoma floridana osagensis Blair	Florida wood rat	189
Neotoma micropus canescens Allen	Gray wood rat	191
Neotoma micropus micropus Baird	Gray wood rat	191
Synaptomys cooperi gossii (Coues)	Cooper lemming mouse	195
Synaptomys cooperi paludis Hibbard and Rinker	Cooper lemming mouse	196
Ondatra zibethicus cinnamominus (Hollister)	Muskrat	198
Ondatra zibethicus zibethicus (Linnaeus)	Muskrat	199
Pitymys pinetorum nemoralis (Bailey)	Woodland pine mouse	200
Microtus ochrogaster ochrogaster (Wagner)	Prairie vole	203
Microtus ochrogaster haydenii (Baird)	Prairie vole	203
Microtus ochrogaster taylori Hibbard and Rinker	Prairie vole	205
Family Muridae—Old World rats and mice		
Rattus rattus rattus (Linnaeus)	Black rat	209
Rattus rattus alexandrinus (Geoffroy)	Roof rat	209
Rattus norvegicus norvegicus (Berkenhout)	Norway rat	210
Mus musculus subsp.	House mouse	211
Family Zapodidae—jumping mice		
Zapus hudsonius pallidus Cockrum and Baker	Hudsonian jumping mouse,	215
Family Erethizontidae—porcupines		
Erethizon dorsatum bruneri Swenk	Porcupine	218

Order CARNIVORA—carnivores

Family Canidae—wolves, coyotes, and foxes

Canis latrans nebracensis Merriam	Coyote	226
Canis latrans latrans Say	Coyote	227
Canis lupus nubilus Say	Wolf	229
Canis niger rufus Audubon and Bachman	Red wolf	230
Vulpes fulva fulva (Desmarest)	Red fox	233
Vulpes velox velox (Say)	Swift fox	235
Urocyon cinereoargenteus ocythous Bangs	Gray fox	237

Family Ursidae—bears

Ursus horribilis horribilis Ord	Grizzly bear	239
Ursus americanus americanus Pallas	Black bear	240
Ursus americanus amblyceps Baird	Black bear	240

Family Procyonidae—raccoons and allies

Procyon lotor hirtus Nelson and Goldman	Raccoon	242

Family Mustelidae—weasels, skunks, and allies

Mustela vison letifera Hollister	Mink	245
Mustela frenata neomexicana (Barber and Cockerell)	Long-tailed weasel	248
Mustela frenata longicauda Bonaparte	Long-tailed weasel	247
Mustela frenata primulina Jackson	Long-tailed weasel	247
Mustela nigripes (Audubon and Bachman)	Black-footed ferret	250
Taxidea taxus taxus (Schreber)	American badger	253
Mephitis mephitis avia Bangs	Striped skunk	257
Mephitis mephitis varians Gray	Striped skunk	256
Mephitis mephitis mesomelas Lichtenstein	Striped skunk	257
Spilogale interrupta (Rafinesque)	Spotted skunk	259
Lutra canadensis interior Swenk	River otter	260

Family Felidae—cats

Felis concolor hippolestes Merriam	Puma	262
Lynx rufus rufus (Schreber)	Bobcat	265
Lynx rufus baileyi (Merriam)	Bobcat	264

Order ARTIODACTYLA—artiodactyls

Family Cervidae—wapiti, elk, deer, and allies

Cervus canadensis canadensis Erxleben	Wapiti	270
Odocoileus hemionus hemionus (Rafinesque)	Black-tailed deer	272
Odocoileus virginianus macrourus (Rafinesque)	White-tailed deer	274

Family Antilocapridae—Prong-horn

Antilocapra americana americana (Ord)	Prong-horned antelope	275

Family Bovidae—cows, bison, and allies

Bison bison bison (Linnaeus)	Bison	278

ACCOUNTS OF SPECIES AND SUBSPECIES

The class Mammalia is divided into approximately 32 orders, 14 of which are extinct. Nine of the 18 living orders are now native to Kansas. Man is the only native representative of the order Primates in Kansas and is not considered in this account. The following key gives diagnostic characters of the remaining orders:

1. Inner toe of hind foot without nail and opposable; ten upper incisors ..... MARSUPIALIA, p. 34
1′. Inner toe of hind foot, if present, with nail and not opposable; fewer than ten upper incisors 2
2.(1′) Fingers lacking claws (thumb has one), longer than the forearm, and supporting a leathery membrane which serves as a wing, CHIROPTERA, p. 54
2′. Fingers with claws, shorter than forearm, and not supporting a leathery membrane for flight 3
3.(2′) Body covered with bony plates forming a hard shell dorsally; no teeth present in anterior one-fourth of upper or lower jaw, EDENTATA, p. 87
3′. Body covered with fur; at least incisors present in the anterior one-fourth of lower jaw 4
4.(3′) Skull with canine teeth; a true diastema absent 5
4′. Skull without canine teeth; a true diastema present 6
5.(4) Total length less than 200 mm.; canine teeth little or no larger than the adjacent teeth ..... INSECTIVORA, p. 40
5′. Total length more than 250 mm.; canine teeth conspicuously larger than the adjacent teeth ..... CARNIVORA, p. 219
6.(4′) Feet with claws (not hooves); incisors totaling 2 or 4 above 7
6′. Feet with hooves (not claws); incisors absent above, ARTIODACTYLA, p. 268
7.(6) Ears shorter than tail vertebrae; total of 2 upper incisors, RODENTIA, p. 110
7′. Ears longer than tail vertebrae; total of 4 upper incisors, LAGOMORPHA, p. 90

Order MARSUPIALIA

Marsupials

The marsupials, or "pouched mammals", are so called because the female has an external abdominal pouch or marsupium. The young, which are born in an incomplete stage of development, are carried and nourished in this pouch until they are developed sufficiently to move about by themselves.

The marsupials are, for the most part, found in the Australian region (kangaroos, wombats, etc.) but are represented in North America by the opossums. One family (Didelphidae) is represented in Kansas by one species.

Genus **Didelphis** Linnaeus

Opossum

This genus occurs from southeastern Canada southward, through eastern and central United States, Mexico, Central America, and southward through most of South America.

Generic characteristics include: Hind limb short; feet with five distinct toes, each provided with a claw, except first toe of hind foot which is large, opposed to the others in grasping and without a claw; tail long, prehensile and partly naked; skull with sagittal and occipital crests greatly developed. The dental formula is: i. $\frac{5}{4}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{4}{4}$.

Didelphis virginiana

Virginia Opossum

The first available reference to the occurrence of the opossum in Kansas is Knox's (1875:22) statement that it was "not rare in eastern parts of the state". Actual specimens collected before 1900, are available from Douglas County (KU no. 1887 and 1894) and Chautauqua County (1892, USNM), both in the eastern part of the state. However, in 1905 and 1906 specimens were taken at Wakeeney (KU), in western Kansas. Lantz (1905B:333) indicated that the opossum was "common in the wooded parts of the state and westward along the streams." This indicates that perhaps, in 1875, either (a) Knox did not have sufficient material to determine if the opossum occurred in western Kansas or (b) the opossum was not present in the western part of the state. Knox probably did not have records to show accurately the geographic range of the opossum in the state but the available evidence indicates that the opossum then actually did not occur in the western part of the state.

J. A. Allen spent the summer of 1871 in the vicinity of Fort Hays, now Ellis County, and two weeks of the following winter in northwestern Kansas. While there he collected several kinds of mammals and also made observations on others. When reporting on this trip in 1874, he made no mention of the opossum. Baker (1889) in reporting on the mammals of western Kansas failed to mention the opossum. J. A. Allen (1895A) in reporting on the collection of mammals and field notes made by Walter Granger, who spent six weeks (Sept. 14 to Nov. 2, 1894) at Long Island and three days at Pendennis (May 8 to May 10, 1894) made no mention of the opossum.

More recently Schaffner (1929:61-62) wrote: "The opossum is now quite common all through the region [northwestern part of Clay County] while in the early years the writer never heard of one being seen, although raccoons and badgers were frequently

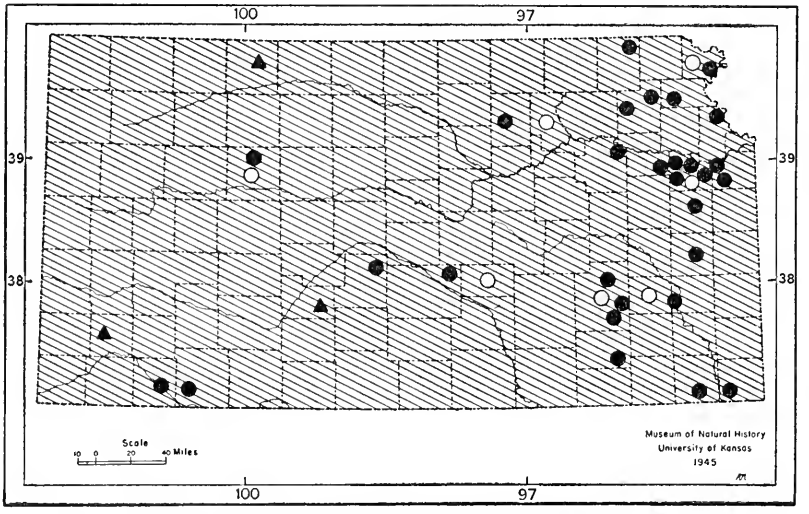

FIG. 5. Distribution of *Didelphis virginiana virginiana* in Kansas. The symbols for locality records are as follows: circles, specimens examined; triangles, specimens reported but not examined; solid symbols, precise localities; hollow symbols, localities known only to county.

taken by him and others. Its original range in the region probably did not extend farther than the southeastern part of the county where oaks are still common. The writer long ago heard his father say that the opossum was present in the southeastern part. The progress of the opossum toward the northwest is probably due to the much more certain food supply under civilized conditions. There is corn part of the year, to say nothing of poultry and eggs, especially in the fall and winter when food must have been exceedingly scarce for the opossum in a region where acorns and other nuts and fruits are absent. . . . The opossum will probably enjoy the blessings of civilization for a long time to come."

From August 14 to August 23, 1926, W. H. Burt was a member of a party which was collecting museum specimens in Morton County, Kansas. In unpublished notes concerning this trip, Burt makes no mention of the opossum, although he does record observations of other animals which were not taken.

H. Leo Brown, in correspondence with Donald F. Hoffmeister (1945), reported sight observations of opossums in several counties in north-central and south-central Kansas. The most westerly

counties in which he indicated that he had seen opossums were Norton County (three miles east of Norton) in September, 1938, and in Edwards County (one mile north of Fellsburg) in December, 1937. Irvin S. Baird (personal communications) reported having seen opossums dead on the highway in Greeley and Hamilton counties in 1943.

Specimens of the opossum from western Kansas are few but in the collection of the University of Kansas Museum of Natural History are specimens from Seward County (taken in 1934) and Meade County (taken in 1942). On July 19, 1950, I saw an opossum dead on the highway four miles west of Ulysses, Grant County. This was some miles from the nearest rough land or any great numbers of trees. Residents of Stanton and Morton counties state that opossums are seen occasionally in that area.

In southeastern Kansas, as in most of the southern states, opossum hunting, with dogs and lanterns, is a sport enjoyed by many. "Playing 'possum" is a common expression in the language of the people and this expression is based on this animal's habit of pretending to be dead when it is cornered—a ruse which often enables it to escape from its enemies.

Many thousands of opossums are trapped each year for their fur. Table 2 shows the number of pelts that have been sold in Kansas in several recent years. The opossum ranks second in number of individuals killed and sold for fur each year, being exceeded only by the skunk.

TABLE 2.—NUMBER OF PELTS OF THE OPOSSUM REPORTED AS SOLD IN KANSAS.

Based on data in the Biennial Reports of the Kansas Forestry, Fish and Game Commission: Second (1926-1928) p. 67; Third (1928-1930) pp. 14 and 32; Fourth (1930-1932) p. 37; and Fifth (1932-1934) p. 25 and on data released by the United States Fish and Wildlife Service (Anon. 1939:8; 1940:8; 1945:8; 1946:8; and Ashbrook, 1950:9; 1951:10). These data are reports made by fur buyers in Kansas and do not account for any shipped out of state by the trapper.

YEAR	Number	YEAR	Number
1928	350,286	1941	148,322
1929	349,469	1942	133,652
1930	316,297	1943	147,852
1931	317,984	1944	118,314
1932	303,261	1945	98,645
1933	297,631	1946	74,000
1934	265,000	1947–8	124,042
1938	78,440	1948–9	61,424
1940	155,945	1949–50	47,318

The opossum is nocturnal in habit, a fact which coupled with its slow-moving gait, often leads to its death on the highways. On an extended trip along the highways, a dead opossum on the road is not an uncommon sight, especially in the eastern part of the state. Robert W. Hankins (unpublished manuscript) counted 14 dead opossums on the highway between Topeka, Shawnee County, and Winfield, Cowley County, Kansas, a total of 186 miles of highway, in August, 1948. This interested Hankins who decided to count the animals seen dead on State Highway No. 10 between Sunflower, Johnson County, and Lawrence, Douglas County, a distance of 14 miles. Hankins made observations six days a week from September 14, 1948, to January 14, 1949, and in this period he saw 11 opossums dead on the highway. In this same period and along the same highway, Hankins observed a total of 113 rabbits dead on the highway. Black (1935B:223) pointed out that the opossum seems to be able to survive after more severe injuries than can any other Kansas mammal. More than one third of the series of skeletons of opossums examined by Black revealed bones that had been broken and healed. These injuries ranged from minor breaks to injuries involving such vital parts as the skull, pelvic girdle, and vertebral column; six or more broken ribs were not at all uncommon.

The opossum is omnivorous. In addition to the persimmon for which the opossum's love is well known, it eats fruits, corn, crayfish, insects, insects' eggs, any vertebrates that it can catch, and carrion. The last item makes up an important part of the opossum's diet, and even badly decomposed carcasses are utilized as food.

The gestation period of the opossum is notably brief, being only 13 days. The young (three to 17 per litter), which are completely naked and grublike in appearance, are more immature when born than the young of placental mammals. At this time each is approximately the size of a pea and weighs only 1/10,000 as much as the mother. The forelimbs are sufficiently developed to permit the young opossum to crawl into the pouch of its mother where further development occurs after it attaches to a teat. When four to five weeks of age the young is sufficiently developed to leave the pouch for short periods although it stays with the mother for 90 to 100 days. Reynolds (1945:361-379) studied the breeding habits, food habits, and other aspects of the natural history of the opossum in Missouri. Most of his findings would probably apply equally well in eastern Kansas.

Three factors (large litters, omnivorous diet, and ability to recover from severe injuries) have enabled the opossum to thrive in

spite of the inroads made on its population by accidents, hunters, and trappers. In fact the opossum has expanded its range greatly since the coming of the white man to North America and Frye and Lay (1942:14) believed it to be more abundant now than at any time in history.

Didelphis virginiana virginiana Kerr

Didelphis virginiana Kerr, Animal Kingdom, p. 193, 1792, type from Virginia; Lantz, Trans. Kansas Acad. Sci., 19:172, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:333, 1905.

Didelphis virginiana virginiana, Dice, Jour. Mamm., 4:107, 1923; Miller, U. S. Nat. Mus. Bull., 128:3, 1924; Linsdale, Jour. Mamm., 9:140, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:231, 1933; Black, Jour. Mamm., 16:223, 1935; Black, Kansas State Board Agric., 30th Biennial Rept., p. 136, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:505, 1939; Allen, Kansas State Teachers College Emporia, Bull. Inf., Nat. Hist. Surv., 20(5):18, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:62, 1944; Lowrance, Jour. Morph., 85:569, 1949; Brumwell, Amer. Midland Nat., 45:208, 1951.

Didelphys Virginianus, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Didelphys virginiana, Schaffner, Trans. Kansas Acad. Sci., 31:61, 1929.

D[idelphis]. californica, Lantz, Kansas State College Exp. Sta. Bull., 129:333, 1905.

Distribution.—State wide; more common in the eastern than in the western part of the state. See map, figure 5.

Remarks.—External measurements of two males and two females from Douglas County, are: ♂ 860, 698, ♀ 718, 645; 330, 318, 300, 253; 53, 70, 64, 60; 38, — —, 48, — —. One male weighed 6½ pounds.

Specimens examined.—Total, 285, distributed as follows: *Nemaha County:* Sabetha, 6. *Doniphan County:* Geary, 1; Unspecified, 2. *Clay County:* 6 mi. SW Clay Center, 2. *Riley County:* Unspecified, 1. *Jackson County:* 4 mi. SW Muscotah, 1; 10½ mi. WSW Holton, 1. *Atchison County:* 5 mi. SW Effingham, 1. *Leavenworth County:* Ft. Leavenworth, 1. *Trego County:* Wakeeney, 7; Unspecified, 1. *Wabaunsee County:* 3 mi. NE Maple Hill, 1. *Shawnee County:* Richland, 2. *Douglas County:* 2½ mi. W Lawrence, 1; near Lawrence, 1; 1 mi. N Lawrence, 1; Lawrence, 12; 2 mi. SE Lawrence, 1; 4 mi. SE Lawrence, 1; 6½ mi. SE Lawrence, 1; 7 mi. SW Lawrence, 21; 7½ mi. SW Lawrence, 39; 8 mi. SW Lawrence, 4; Washington Creek, 1; 10 mi. SW Lawrence, 1; 11 mi. SW Lawrence, 3; Sibley, 1; Clinton, 7; Unspecified, 65. *Johnson County:* Gardner, 1; 15 mi E Lawrence, 1. *Franklin County:* S of Ottawa, 1. *Anderson County:* 4 mi. S Garnett, 2; 6 mi. S Garnett, 2. *Stafford County:* Little Salt Marsh, 3. *Reno County:* 3 mi. N, 5½ mi. E Hutchinson, 1; 2 mi. N, 2 mi. E Hutchinson, 2. *Greenwood County:* 3 mi. E Hamilton, 1 (GCR); Hamilton, 1 (GCR); 2½ mi. SW Hamilton, 1 (GCR); 8 mi. SW Toronto, 6; S of Toronto, 2; Unspecified, 2. *Harvey County:* Unspecified, 1. *Woodson County:* Unspecified, 1. *Allen County:* 1 mi. N, 1 mi. W Neosho Bridge, Humboldt, 1. *Elk County:* Longton, 1. *Seward County:* 1 mi. E Arkalon, 1. *Meade County:* 14 mi. SW Meade, 1. *Labette County:* 10 mi. SW Oswego, 3. *Cherokee County:* 8 mi. SW Columbus, 3; 9 mi. SW Columbus, 1; 10 mi. SW Columbus, 1. *Eastern Kansas:* no precise locality, 58.

Additional records.—Norton County: 3 mi. E Norton (see text). *Edwards County:* 1 mi. N Fellsburg (see text). *Grant County:* 4 mi. W Ulysses (see text).

TABLE 3.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF DIDELPHIS.

Sex	Number averaged or catalogue number	Condylobasal length	Length of nasals	Zygomatic breadth	Postorbital constriction	Palatal length	Upper tooth-row, C—M4	Upper molar series
		D. *virginiana virginiana*, Douglas County						
♂	3610	110.6	48.7	62.1	11.0	64.6	46.5	21.9
♂	2980	110.5	52.2	59.7	11.8	65.9	46.7	21.8
♂	11482	.....	48.1	56.5	11.2	62.6	44.7	21.6
♀	4517	103.5	51.2	53.2	11.0	63.0	44.8	20.9
♀	3150	99.5	45.0	56.1	11.5	60.9	41.8	20.7
♀	2	107.8	51.2	58.3	12.5	65.4	42.4	20.7

Order INSECTIVORA

Insectivores

Members of this order feed mainly upon insects and thus have earned the name, insectivores. Earthworms, snails, and to some extent vertebrates, usually carrion, are also used as food. All members of this order are comparatively small and, for the most part, are nocturnal and terrestrial in habit. Representatives are found throughout the temperate and tropical climates of the world with the exception of Australia and most of South America.

Only two families of this large order occur in North America. These are the moles (Family Talpidae) and the shrews (Family Soricidae). The following key will be of aid in separating those kinds found in Kansas.

1. Total length more than 150 mm.; forelegs modified for digging; skull more than 30 mm. in length.....*Scalopus aquaticus*, p. 47
1′. Total length less than 150 mm.; forelegs not modified for digging; skull less than 30 mm. in length.....2
2.(1′) Total length more than 100 mm.; hind foot more than 11 mm.; total number of teeth 32 .....*Blarina brevicauda*, p. 41
2′. Total length less than 100 mm.; hind foot less than 11 mm.; total number of teeth 30.....*Cryptotis parva*, p. 44

Genus Blarina Gray

Short-tailed Shrews

This genus occurs in southeastern Canada and eastern United States. Kansas is on the western edge of the range of this genus. The dental formula is generally given as: i. $\frac{4}{2}$, c. $\frac{1}{0}$, p. $\frac{2}{1}$, m. $\frac{3}{3}$.

Blarina brevicauda

Short-tailed Shrew

The short-tailed shrew occurs in suitable habitats throughout the eastern two-thirds of the state, where it is especially common in woodlands and moist areas.

The earliest record known to me of the occurrence of this shrew in the state is Knox's (1875:21) terse comment that "*Blarina Carolinensis*" was "Rare," although today the short-tailed shrew is common in most of the eastern part of the state.

Leo Brown examined pellets of the barn owl that he collected in a barn one-fourth of a mile south of Hunter, on August 17, 1932, and August 10, 1933. He found (unpublished notes) that *Blarina* and *Cryptotis* together comprised 4 per cent (36 individuals) of the total number of skulls in the pellets.

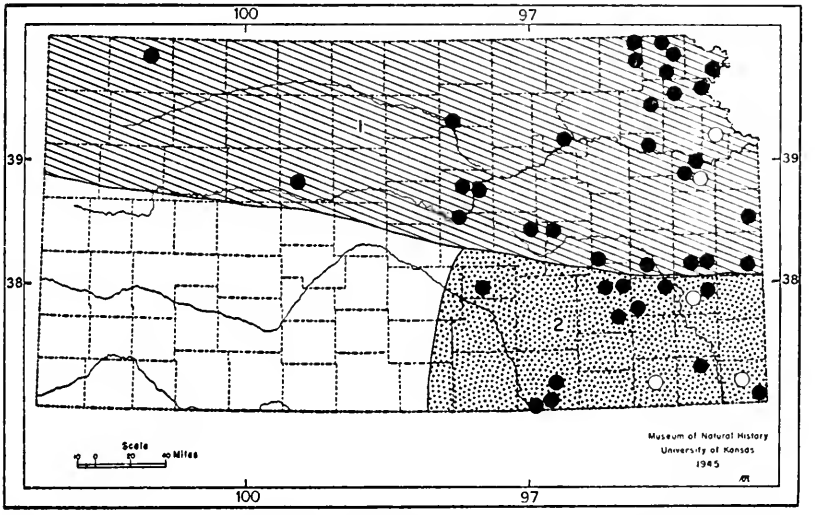

FIG. 6. Distribution of *Blarina brevicauda* in Kansas. 1. *B. b. brevicauda.* 2. *B. b. carolinensis.* See figure 5 for explanation of symbols.

Short-tailed shrews usually make their own runways but often utilize those made by moles and microtine rodents. The comments about the food habits and appetites of the small shrew, *Cryptotis parva,* apply equally well to this shrew.

Pearson (1944:43) has published the results of an intensive study of reproduction in this species. Most of his materials were from Pennsylvania, New York, and Massachusetts. According to him, "pregnant females may be captured from April through September, but most authors record a reduction or cessation of breeding activi-

ties in late July and August." It is not known how many litters an adult female will produce in one season. The period of gestation is 21 or 22 days.

No intensive work has been done on the reproductive cycle of *Blarina* in Kansas. On April 7, 1949, I found a nest of the short-tailed shrew under a log one-half mile west of the University of Kansas Campus, Lawrence. The nest rested on the surface of the ground, was approximately eight inches in diameter, and had been constructed of dry leaves of elm and honey locust trees. It contained six young that were approximately half grown. One specimen (KU No. 16237), captured on August 31, 1945, in McPherson County, was lactating.

Blarina brevicauda brevicauda (Say)

Sorex brevicaudus Say, Long's Exped. Rocky Mts., 1:164, 1823, type from west bank of Missouri River, near Blair, formerly Engineer Cantonment, Washington County, Nebraska.

Blarina brevicauda brevicauda, Dice, Ecology, 4:44, 1923; Dice, Jour. Mamm., 4:108, 1923; Miller, U. S. Nat. Mus. Bull., 128:35, 1924; Linsdale, Jour. Mamm., 9:140, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:231, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 142, 1937; Wooster, Trans. Kansas Acad. Sci., 42:515, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):20, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:63, 1944; Brumwell, Amer. Midland Nat., 45:208, 1951.

Blarina Carolinesis [sic.], Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Blarina talpoides, Knox, Trans. Kansas Acad. Sci., 5:65, 1877.

Blarina brevicauda, Baird, Mamm. N. Amer., p. 42, 1858; Merriam, N. Amer. Fauna, 10:13, 1895; Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905; Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:137, 1947.

Distribution.—Northern half of the state; south, certainly to Marion, Anderson, and Linn counties. See map, figure 6.

Remarks.—External measurements of four males and two females from Lawrence are: ♂ 107.2 (94-120), ♀ 104, 112; 22.2 (21-24), 20, 20; 14.2 (13-16), 14, 14.

Specimens examined.—Total, 103, distributed as follows: *Rawlins County:* 2 mi. S Ludell, 1. *Nemaha County:* 6 mi. N Sabetha, 1; 2½ mi. S Sabetha, 2; ¾ mi. E, 3½ mi. S Sabetha, 3. *Brown County:* 7½ mi. N, ½ mi. E Hiawatha, 1; 3 mi. N Hiawatha, 1; 5 mi. S Hiawatha, 1; 1 mi. N Horton, 1. *Doniphan County:* Geary, 1. *Cloud County:* Bullock Farm, 4 mi. E Glasco, 1. *Riley County:* Manhattan, 1. *Jackson County:* 5½ mi. E Holton, 2. *Atchison County:* 1½ mi. S Muscotah, 7; 1⅘ mi. N Atchison, 1. *Leavenworth County:* Unspecified, 1. *Ellis County:* 3½ mi. W Ft. Hays State College Campus, 1; 3½ mi. W, ¾ mi. S Hays, 2150 ft., 1. *Saline County:* 4 mi. W Salina, 2; 4 mi. E Salina, 3. *Shawnee County:* 3 mi. W, 4½ mi. N State Capitol Bldg., Topeka, 1. *Douglas County:* 2 mi. N Lawrence, 1; Lawrence, 25; 7 mi. SW Lawrence, 7; 7½ mi. SW Lawrence, 3; 5⅖ mi. W, ½ mi. S Clinton, 1; Unspecified, 22. *McPherson County:* Smoky Hill R., 1 mi. S,

½ mi. W Lindsborg, 1. *Marion County:* 1 mi. N, ½ mi. E Lincolnville, Clear Creek, 1. *Chase County:* 9 mi. E Lincolnville, 1. *Lyon County:* 15 mi. S Plymouth, 1. *Coffey County:* 2½ mi. S Burlington, 2. *Anderson County:* 7 mi. S Garnett, 1; 1 mi. W Welda, 1. *Miami County:* 11 mi. SSE Paola, 2. *Linn County:* ½ mi. N, 4 mi. W Prescott, 1.

Blarina brevicauda carolinensis (Bachman)

Sorex carolinensis Bachman, Jour. Acad. Nat. Sci. Philadelphia, 7(2): 366, 1837, type from eastern South Carolina.

Blarina brevicauda carolinensis, Merriam, N. Amer. Fauna, 10:13, 1895; Black, Kansas State Board Agric., 30th Biennial Rept., p. 142, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):20, 1940.

Blarina brevicauda hulophaga, Hibbard, Trans. Kansas Acad. Sci., 36:232, 1933; Hibbard, Trans. Kansas Acad. Sci., 47:63, 1944.

Distribution.—Southeastern part of the state, north certainly to Greenwood and Allen counties and west certainly to Cowley and Harvey counties. See map, figure 6.

Remarks.—External measurements of two males and one female from 3 mi. SE Arkansas City are: ♂ 92, 96, ♀ 95; 20, 24, 23; 14, 17, 18.

Blair (1939:99), writing about *Blarina brevicauda hulophaga* in Oklahoma, stated: "This race is known from only 4 specimens, all of which agree in being paler and more brownish in color than the race *carolinensis.* In size and cranial characters it does not differ appreciably from *carolinensis.* It seems likely that this is a slight local race, developed through partial isolation in the Arbuckle Mountains." And in writing about *B. b. carolinensis* he stated: "Specimens from the northern part of the Osage Savanna district are clearly referable to *carolinensis* rather than to the subspecies *hulophaga* of the Arbuckle Mountains in the southern part of the district." On the basis of this observation of Blair's I am applying the name, *Blarina brevicauda carolinensis,* to animals of southeastern Kansas.

Specimens of *B. b. brevicauda* from northeastern Kansas are measurably larger than specimens of *B. b. carolinensis* from southeastern Kansas. Specimens from intermediate geographic localities show a gradual gradation from one to the other—a cline in which no great step exists.

Specimens examined.—Total, 68, distributed as follows: *Harvey County:* 1 mi. E, ½ mi. N Halstead, 1. *Greenwood County:* 1 mi. W Virgil, 3 (GCR); Hamilton, 42 (GCR); 1 mi. S Hamilton, 2; 8½ mi. SW Toronto, 1. *Woodson County:* Neosho Falls, 2; 2½ mi. N Toronto, 1; 2 mi. S Toronto, 1. *Allen County:* Moran, 2; Unspecified, 1. *Cowley County:* 6 mi. N, 12 mi. E Arkansas City, 1; 8.1 mi. E Arkansas City, 2; 3 mi. SE Arkansas City, 5. *Montgomery County:* Unspecified, 1. *Labette County:* 2 mi. SW Parsons, 600 ft., 1. *Cherokee County:* ½ mi. S Galena, 1; Unspecified, 1.

Genus **Cryptotis** Pomel

Little Short-tailed Shrews

This genus occurs through most of eastern and central United States, southward through Mexico and Central America into northern South America. The dental formula is generally given as: i. $\frac{3}{2}$, c. $\frac{1}{0}$, p. $\frac{2}{1}$, m. $\frac{3}{3}$.

Cryptotis parva

Little Short-tailed Shrew

The little short-tailed shrew probably occurs in suitable habitats in most of the state although there are few records for the western part of Kansas. Two individuals, taken at Dry Willow Creek, Yuma County, Colorado, were reported by F. W. Miller (1924:199).

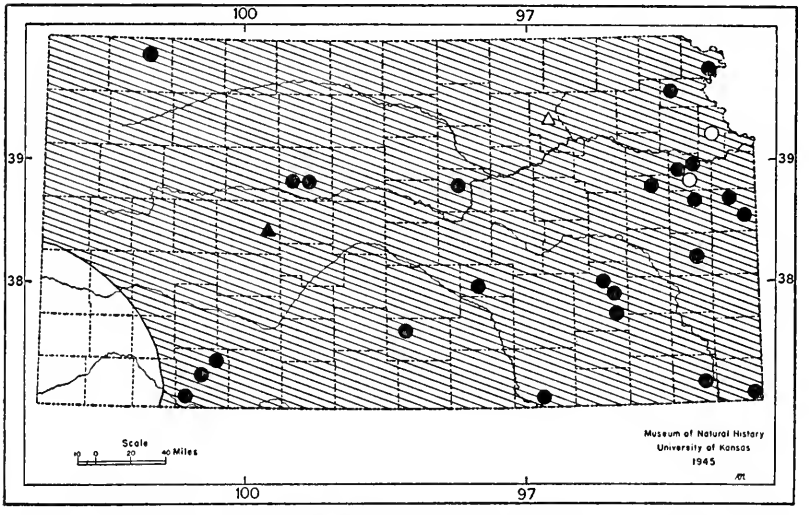

FIG. 7. Distribution of *Cryptotis parva parva* in Kansas. See figure 5 for explanation of symbols.

The little short-tailed shrew is the smallest mammal in the state, having a total length of approximately three inches and a weight of less than an ounce. The shrew occurs in grasslands, woodlands, along fence rows and almost anywhere that it can find sufficient cover and insect food. It burrows in the ground, under leaves and logs, and often utilizes the runways and burrows of mice.

Shrews in general are noted for their remarkable appetites. Many well authenticated records exist to show that the shrews can eat two or three times their own weight in one twenty four hour period

and that without food, they will starve to death overnight. However, under natural conditions, a shrew probably requires approximately three-fourths of its weight in food each day (Hamilton, 1944:3). Of the habits of *Cryptotis parva* in Texas, Davis and Joeris (1945:138) wrote: ". . . digestion is rapid. After changing the diet of our shrews from insects to hamburger, the fecal pellets changed in consistency within 2 hours. This rapid metabolic rate requires a large intake of food. In a period of 12 hours, one of our captive shrews ate 3 crickets, 25-30 sow bugs, 1 beetle about three-fourths of an inch long, and it was still hungry."

Young, which are born from April to late fall, are usually four to six in number although records of two to eight are available. Several litters may be produced each year. Black (1937:141) made observations on a nest of this shrew. He wrote: "The only nest of this species of which I have direct knowledge was one containing eight young shrews, attended by the male, which was exposed when a large rock . . . was turned over by a plow. The nest was composed of grass and leaves, and arranged in a compact ball."

Of five females taken between October 11 and October 15, 1945, in Lawrence by Walter W. Dalquest, one contained two embryos, another was lactating while the remaining three showed no signs of reproductive activity.

This shrew, like the other insectivores, is an asset to the farmer and gardener. Its insect-eating habits and its phenomenal appetite make the shrew a formidable enemy of insects.

Cryptotis parva parva (Say)

Sorex parvus Say, Long's Exped. Rocky Mts., Vol. 1, p. 163, 1823, type from west bank of Missouri River, near Blair, formerly Engineer Cantonment, Washington County, Nebraska.

Cryptotis parva parva, Hibbard and Rinker, Univ. Kansas Sci. Bull., 29:258, 1943; Hibbard, Trans. Kansas Acad. Sci., 47:63, 1944.

Cryptotis parva, Linsdale, Jour. Mamm., 9:140, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:231, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 141, 1937; Sprague, Jour. Mamm., 19:246, 1938; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:506, 1939; Wooster, Trans. Kansas Acad. Sci., 42:515, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):19, 1940; Rinker, Trans. Kansas Acad. Sci., 45:376, 1942; Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:137, 1947; Brumwell, Amer. Midland Nat., 45:208, 1951.

Blarina parvula, Cragin, Bull. Washburn College Lab. Nat. Hist., 1:47, 1885.

Blarina parva, Merriam, N. Amer. Fauna, 10:13, 1895; Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905.

Sorex, Knox, Trans. Kansas Acad. Sci., 6:65, 1877.

Blarina exilipes, Baker, Trans. Kansas Acad. Sci., 11:57, 1889.

Distribution.—Probably occurs in suitable habitats in most of the state although no records exist for the extreme western part. Common in the eastern one-third of the state. See map, figure 7.

Remarks.—External measurements of five adults of each sex from Lawrence are: ♂ 77.5 (71-80), ♀ 78.5 (77-81); 17.2 (16-18), 17.5 (17-18); 11 (11-11), 11 (11-11).

Specimens from Meade County are lighter than those from the eastern part of the state. Of two specimens examined from Saline County, one approached the light color of the Meade County specimens, lacking, however, the reddish tinge found in the latter but the second was darker and fitted well into a series from Douglas County. Both of these specimens were taken on October 3, 1948, by A. J. Kirn. When more material is available for all seasons and age groups, the populations of *Cryptotis parva* in western Kansas may be found to differ subspecifically from *Cryptotis parva parva* of eastern Kansas.

TABLE 4.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF SHREWS.*

Sex	Catalogue number or number averaged	Condylobasal length	Palatal length	Cranial breadth	Least interorbital constriction	Maxillary breadth	Maxillary tooth-row
	Blarina b. brevicauda, Lawrence, Douglas County						
♂	4551	22.1	9.9	11.7	6.0	8.0	8.5
♂	4345	21.9	10.1	11.5	5.6	7.5	8.5
♂	1748	21.9	9.4	....	6.1	7.9	7.9
♀	1740	21.9	9.8	12.2	6.0	7.9	8.3
♀	2984	22.5	10.0	12.7	6.1	8.0	8.6
♀	1735	22.2	10.2	12.6	6.0	7.8	8.5
	B. b. carolinensis, 3 mi. SE Arkansas City, Cowley County						
♂	12925	21.1	9.4	11.3	5.5	7.4	8.1
♂	12927	20.2	9.2	10.8	5.4	7.1	8.1
♀	12926	20.5	8.5	11.2	5.4	7.1	8.3
	Cryptotis parva parva, Lawrence, Douglas County						
♂	5	15.6	6.2	7.7	3.5	4.9	5.5
	min.	15.4	6.1	7.5	3.3	4.7	5.4
	max.	16.1	6.4	8.0	3.7	5.0	5.6
♀	5	15.7	6.5	7.8	3.5	5.0	5.5
	min.	15.3	6.0	7.7	3.3	4.8	5.5
	max.	16.1	6.8	8.0	3.6	5.2	5.5

* Measurements taken in manner described by Jackson (1928:13), except that I have measured *least* interorbital constriction.

Specimens examined.—Total, 169, distributed as follows: *Rawlins County:* 2 mi. S Ludell, 1. *Doniphan County:* Geary, 2. *Atchison County:* 1½ mi. S Muscotah, 1. *Leavenworth County:* Unspecified, 1. *Ellis County:* Fort Hays State College, Hays, 2; 4 mi. W, ½ mi. S Hays, 2250 ft., 1. *Saline County:* 8½ mi. E Salina, 2 (AJK). *Osage County:* 3 mi. SE Carbondale, 1. *Douglas County:* 4½ mi. N Lawrence, R19E, T12S, Sec. 1, 1; 2 mi. W Lawrence, 1; Lawrence, 25; ¾ mi. S Lawrence [Univ. Kansas Campus], 5; 2 mi. SW Lawrence, 1; 7½ mi. SW Lawrence, 2; Unspecified, 14. *Franklin County:* 4 mi. N, ½ mi. E Ottawa, 1; 4 mi. N Ottawa, 1. *Anderson County:* 3 7/10 mi. S Garnett, 1. *Miami County:* 9 mi. N Paola, 2; 11 mi. SSE Paola, 1. *Harvey County:* Halstead, 1. *Greenwood County:* Hamilton, 77 (GCR); 5 mi. SE Hamilton, 1 (GCR); 8½ mi. SW Toronto, 2. *Kingman County:* Kingman County Quail Farm, Calista, 2. *Meade County:* 1½ mi. N Fowler, 9; 1 mi. SW Meade, 1; 17 mi. SW Meade, 6. *Cowley County:* 8.1 mi. E Arkansas City, 1. *Labette County:* Oswego, 2. *Cherokee County:* 1⅓ mi. N, 6 mi. E Baxter Spgs., 1.

Additional records.—Riley County: Unspecified, 4 (MZ). *Ness County:* 10 mi. E Bazine, 1 (MVZ).

Genus **Scalopus** Geoffroy

Moles

This genus occurs in eastern North America, from southern Ontario, southward through eastern and central United States, into northeastern Mexico. The dental formula of adults of this genus is: i. $\frac{3}{2}$, c. $\frac{1}{0}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$.

Scalopus aquaticus

Common Mole

Moles occur in favorable habitats throughout the state. Because they live mostly underground moles are only rarely seen and consequently often are confused with other small mammals, such as the shrews, meadow mice, and pocket gophers. The presence of broad, horizontally flattened front feet, the absence of external ears, and the absence of openings through the skin for the eyes readily distinguish the mole from other small mammals.

The mole lives in cultivated ground, in soft, moist ground along streams and in lawns. The presence of the mole in an area is easily detected by the presence of characteristic ridges made when it pushes up the soil to construct a system of surface runways. Surface runways are used mainly for feeding and are often abandoned after a relatively short time. The more permanent tunnels are usually well below the surface (six to ten inches) and in their construction no telltale ridge of earth is left. These permanent runways are often found under fence rows, hedge rows, or other places where the soil has not been disturbed by man.

The mole spends most of its life in these underground tunnels. However, when it does leave the burrows, probably only at night,

it is exposed to many enemies, among which are owls. Leo Brown (unpublished notes) examined pellets of barn owls obtained on August 17, 1932, and on August 10, 1933, from a barn one-fourth of a mile south of Hunter and found the skulls of 13 moles among the 802 skulls of small mammals; moles made up approximately 1.6 per cent of the total. These findings differ from those of Silver and Moore (1933:10) who reported: "Among birds of prey, hawks and owls take only a small toll from the mole tribe. Examination of the stomach contents of more than 2,000 of these birds disclosed the remains of only 13 moles. . . . of 3,005 skulls of small mam-

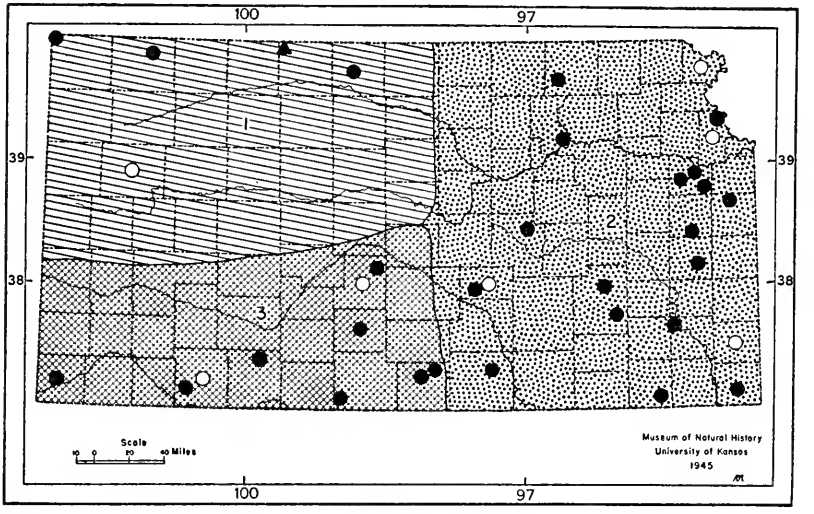

FIG. 8. Distribution of *Scalopus aquaticus* in Kansas. 1. *S. a. caryi.* 2. *S. a. machrinoides.* 3. *S. a. intermedius.* See figure 5 for explanation of symbols.

mals found in pellets disgorged by the barn owl, only 2 were of the mole."

During the breeding season one or more enlargements in the tunnel system may contain a nest of half-dried grasses. Scheffer (1912:161) described the nest of the mole [presumably in Riley County] as follows: "In my excavations I have unearthed at least a half-dozen nests, each in a chamber four to six inches in diameter and about a foot beneath the surface of the ground. In all cases the nesting material consisted mainly of closely cropped pasture grasses with fine fibrous roots attached. It is probable that this grass stubble had been pulled down by the roots into the shallow surface burrows and carried from those to the nesting chambers.

That the mole seeks some materials above ground for its nests, however, is evident from the fact that there was a large admixture of leaves in the only two nests that were near trees." Scheffer (*op. cit.*:162) in autumn made a total of 449 breaks in 50 runways of the mole in the early evening and recorded the hour at which the breaks were repaired. He concluded that the mole does not have "the periodical feeding habits commonly ascribed to him; moreover, that in his daily activities he may not be classed as diurnal, nocturnal or crepuscular. To what extent, if any, he may vary from these observed habits in the summer season remains to be determined by further investigation."

Moles have a relatively low reproductive rate. Underground habitat protects the mole from a great many enemies; hence a high reproductive rate is not needed to maintain the population level of the species. Only one litter of 3-5 (usually four) is born each year. In Kansas this litter is born in March or the first half of April. Scheffer (1911C:121-123) examined 101 females taken in one year near Manhattan and found no evidence of pregnancy prior to February 27 nor evidence of young having been recently born later than April 22. Since the young mole does not leave the nest until it is almost as large as the parent, very few young are seen.

Moles feed chiefly upon earthworms and insects that inhabit the ground. One of the earliest studies of the food habits of the mole in Kansas was made by Dyche (1903:183-186) who examined the stomachs of 67 moles between January, 1894 and October, 1902. These moles were taken, for the most part, in Lawrence. From his examination the food of the mole was found to consist, by bulk, of: earthworms, 43.2 percent; insect eggs, ants, myriopods, 7.6 per cent; vegetable food (corn and seeds) 3.7 per cent.

Scheffer (1911C:119-131) examined the stomachs of 100 moles from in and near Manhattan. He found that "The proportions of the various articles of food do not vary with the season as they do in . . . birds, for in some form the insects, worms and grubs . . . are about as abundant in the soil at one time of the year as at another. . . . I have not attempted to compute the actual percentages of each article of food. . . . Such figures would be mere approximations at best. . . . While plant fibers or rootlets show up in forty-three cases, *in no case was the amount of identifiable plant tissue more than might have been taken in incidental to the ingestion of other food.*"

Hisaw (1923:19) studied the food preferences of the moles in captivity. He found that: "The mole is predominantly carnivorous in its food habits, but will eat certain seeds and vegetables even when supplied simultaneously with an over-abundance of insects and worms. Of the foods most commonly eaten, the following preferences are shown: 1, earthworms and white grubs; 2, insect larvae other than white grubs; 3, adult insects; 4, corn; 5, ripe tomatoes; 6, Irish potatoes and apples."

The mole often does considerable damage to lawns and gardens by the physical disruption of the soil and the root systems of plants. The number of moles in any given area is difficult to regulate unless a person has some knowledge of their habits. The mole's suspicions are aroused when its sensitive nose encounters anything foreign in the runway, and the mole will burrow around or under an ordinary trap set in its tunnel. However, it is not suspicious of soil blocking the runway and will immediately reopen such a blockade. This permits the use of specially designed traps which straddle, encircle or are held suspended above the runway and with the trigger hidden in a blockade of soil.

Scalopus aquaticus caryi Jackson

Scalopus aquaticus caryi Jackson, Proc. Biol. Soc. Washington, 27:20, 1914, type from Neligh, Antelope County, Nebraska; Jackson, N. Amer. Fauna, 38:49, 1915; Hibbard, Trans. Kansas Acad. Sci., 36: 231, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 138, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):19, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:63, 1944.

Distribution.—Northwestern Kansas as far east as Smith County and as far south as Logan County. See map, figure 8.

Remarks.—This is the smallest and the lightest colored of the three subspecies of moles found in Kansas. External measurements of two males and one female from two miles northeast of Ludell are: ♂ 139, 146, ♀ 155; 23, 30, 25; 21, 20, 21. The skull is small in all measurements except width of the interorbital region and breadth of the rostrum. In these two measurements, *S. a. caryi* is slightly larger than *S. a. intermedius* but smaller than *S. a. machrinoides*. (See table 5). One immature specimen from Smith Center (KU no. 3457) is, in color, more nearly like *S. a. machrinoides* but, in cranial characters, is like *S. a. caryi*—to which it is referred.

Specimens examined.—Total, 6, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 1. *Rawlins County:* 2 mi. NE Ludell, 3. *Smith County:* Smith Center, 1. *Logan County:* Unspecified, 1.

Additional records.—Phillips County: Long Island, 3 (AMNH).

Scalopus aquaticus machrinoides Jackson

Scalopus aquaticus machrinoides Jackson, Proc. Biol. Soc. Washington, 27:19, 1914, type from Manhattan, Riley County, Kansas; Jackson, N. Amer. Fauna, 38:46, 1915; Hisaw, Jour. Mamm., 4:12, 1923; Linsdale, Jour. Mamm., 9:140, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:231, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 138, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):18, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:63, 1944; Brumwell, Amer. Midland Nat., 45:208, 1951.

Scalops argentatus, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Scalopus aquaticus machrinus, Dyche, Trans. Kansas Acad. Sci., 18:183, 1903; Lantz, Trans. Kansas Acad Sci., 19:178, 1905.

Scalopus aquaticus intermedius, Scheffer, Trans. Kansas Acad. Sci., 23: 119, 1911.

Scalopus aquaticus, Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1: 137, 1947.

Distribution.—Eastern Kansas, as far west as Cloud, Saline, and Harvey counties. See map, figure 8.

Remarks.—This is the largest and darkest of the three subspecies of moles found in Kansas. External measurements of three males and six females from Fort Leavenworth are: ♂ 179.3 (166-187), ♀ 178.2 (174-182); 35.0 (33-37), 33.0 (29-39); 24.3 (23-27), 23.0 (23-23). The skull is larger than that of *S. A. caryi* or *S. a. intermedius.*

Scheffer (1911C:119) reported on the measurements and color of 100 individuals (45 males and 55 females) taken at Manhattan. He computed average measurements for males and females and found them to be: ♂ 176, ♀ 168; 30, 30; and weight, in ounces, 4, 3. As to variation in size and color he wrote (*op. cit.*): "The variation in size among individuals taken in the same locality is not especially marked. . . . In contrast to the slight variation in size among moles taken in the same locality is the marked variation in color. The dominant shade is a mingling of lead color and brown, but some specimens are darker than this and on the other hand, some are a beautiful silver gray, or, perhaps, are tinged with purplish. I have taken at least two that were suffused all over with rich golden brown. On the average, about one-half of the moles taken here have certain regions of the body—particularly the nose, chin and breast—washed with a tinge of orange, or have distinct patches of this color on the head or belly. Some of these patches are yellowish or golden brown instead of orange, and occasionally one is nearly white."

The following tabulation indicates some of the variations in color found by Scheffer (*loc. cit.*).

	Males	Females	Total
Number examined	45	55	100
Number marked on nose only	5	12	17
Number having orange or rusty-brown markings	27	23	50
Number suffused or washed in part	18	2	20
Number having well defined patches	6	9	15

Two specimens from Saline County, in the collection of A. J. Kirn, were referred to this subspecies by Hall and Hoffmeister on August 2, 1946 (*in litt.*), but both specimens showed some evidence of intergradation with *S. a. caryi* and *S. a. intermedius.* In one (no. 471 AJK, from six miles south of Solomon) they noted: "Skull keys to *caryi* or *intermedius* but color is dark" while in the other (no. 420 AJK, from Debold Farm, Salina) they noted that: "Skull keys to *caryi* or *intermedius* and skin is pale but not so pale as in *caryi* from Rawlins Co., Kans." One specimen from six miles northeast of Wellington is referable to *S. a. machrinoides* but shows some intergradation with *S. a. intermedius.*

Specimens examined.—Total, 130, distributed as follows: *Marshall County:* Blue Rapids, 1. *Doniphan County:* Unspecified,1. *Riley County:* Manhattan, 6. *Leavenworth County:* Ft. Leavenworth, 9; Ft. Leavenworth (Engineers Hill), 3; Unspecified, 1. *Douglas County:* 3 mi. W Lawrence, 1; Lawrence, 34; 7 mi. SW Lawrence, 2; 7½ mi. SW Lawrence, 3; 3 mi. E Baldwin, 1; Unspecified, 29. *Marion County:* ½ mi. E Lincolnville, 1; 1 mi. E Lincolnville, 1. *Franklin County:* Richmond, 1. *Anderson County:* 6 mi. S Garnett, 1. *Miami County:* 3 mi. SW Springhill, 2. *Harvey County:* Halstead, 1; Unspecified, 1. *Greenwood County:* Hamilton, 23 (20 GCR); 8½ mi. SW Toronto, 2. *Neosho County:* 3 mi. NW Chanute, 5. *Crawford County:* Unspecified, 1. *Sumner County:* 6 mi. NE Wellington, 1. *Montgomery County:* Coffeyville, 1. *Cherokee County:* 4 mi. S Columbus, 1; Shole Creek, 1.

Additional records.—Clay Co.: 20 mi. W Ft. Riley, 1 (Baird, 1858:64). *Pottawatomie Co.:* Onaga, 2 (Jackson, 1915:46). *Saline County:* Debold Farm, Salina, 1 (AJK, see text); 6 mi. S Solomon, 1 (AJK, see text). *Coffey Co.:* Burlington, 1 (Jackson, 1915:46). *Woodson Co.:* Neosho Falls, 2 (Jackson, 1915:46).

Scalopus aquaticus intermedius Elliot

Scalopus machrinus intermedius Elliot, Field Columbian Mus., publ. 37, Zool. Ser., 1:280, 1899, type from Alva, Woods County, Oklahoma.

[*Scalopus aquaticus*] *intermedius*, Elliot, Field Columbian Mus., publ. 45, Zool. Ser., 2:390, 1901.

Scalopus aquaticus intermedius, Hibbard, Trans. Kansas Acad. Sci., 36:231, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 138, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:506, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):19, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:63, 1944.

Distribution.—Southwestern Kansas east certainly to Sumner County and north certainly to Stafford County. See map, figure 8.

Remarks.—This subspecies is intermediate in size between *S. a. caryi* and *S. a. machrinoides* in all cranial measurements taken except interorbital breadth and rostral breadth, both of which are smaller than in either *S. a. caryi* or *S. a. machrinoides.* External

measurements of 15 males and six females from 14 to 17 miles southwest of Meade are: ♂ 153.0 (139-168), ♀ 149.5 (132-162); 28.1 (24-34), 25.5 (23-31); 21.1 (19-23), 20.6 (20-22). In color *S. a. intermedius* is closer to *S. a caryi* than to *S. a. machrinoides.* It has a silvery sheen above, a silvery plumbeous color below, and a suffusion of ochraceous on the nose and wrists.

Seven specimens from Little Salt Marsh are intergrades between *S. a. caryi, S. a. machrinoides* and *S. a. intermedius;* the specimens most nearly resemble *S. a. intermedius,* to which they are here referred.

Of two specimens from one mile north of Harper, one closely resembles *S. a. machrinoides* in color but in size it more nearly resembles *S. a. intermedius* to which it is here referred.

Specimens examined.—Total, 62, distributed as follows: *Stafford County:* Little Salt Marsh, 6; Unspecified, 1. *Pratt County:* Pratt, 3; Unspecified, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 7. *Meade County:* 13 mi. SW Meade, 6; 14 mi. SW Meade, 10; Meade State Park, 19 (6, GCR); 16 mi. SW Meade, 2; Unspecified, 2. *Clark County:* 7 mi. S Kingsdown, 1. *Barber County:* 1 mi. W Aetna, 1; Aetna, Wells Ranch, 2. *Harper County:* 4 mi. NE Harper, 1; 1 mi. N Harper, 2.

TABLE 5.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF SCALOPUS.[•]

Sex	Number averaged or catalogue number	Greatest length of skull	Palatal length	Mastoid breadth	Interorbital breadth	Maxillary breadth	Rostral breadth	Depth of skull	Length of orbit
	S. a. caryi, 2 mi. NE Ludell, Rawlins County								
♂	11903	34.7	15.0	17.6	8.0	11.0	5.0	10.3	8.5
♂	12029	33.0	14.1	17.3	8.0	10.9	5.0	10.1	7.7
♀	11743	33.0	14.3	17.1	8.0	10.5	4.5	10.0	7.8
	S. a. machrinoides, Ft. Leavenworth, Leavenworth County								
♂	3	37.0	15.9	19.2	8.0	11.5	5.4	10.4	8.8
	min.	36.0	15.7	18.7	7.9	11.0	5.0	9.9	8.7
	max.	37.9	16.2	19.7	8.1	12.2	5.6	10.9	9.0
♀	6	37.3	16.1	19.3	8.2a	11.6	5.4	10.4a	9.1
	min.	36.7	15.6	18.8	7.8	11.1	5.2	10.1	8.6
	max.	38.1	16.5	20.0	8.5	12.1	5.9	10.7	9.6
	S. a. intermedius, 13 to 17 mi. SW Meade, Meade County								
♂	17	34.5	14.6	18.1	7.8	10.7	4.7	10.2	8.3
	min.	33.1	14.0	17.0	7.6	10.2	4.4	10.0	7.9
	max.	36.3	15.2	18.9	8.3	11.1	5.0	10.5	9.0
♀	6	33.2	14.1	17.6	7.7	10.4	4.5	9.9	7.8
	min.	32.5	13.5	17.0	7.5	10.1	4.3	9.8	7.6
	max.	33.9	14.7	18.0	8.0	10.7	4.7	10.0	8.0

[•] Measurements as taken by Palmer (1937:287).
a. 5 specimens averaged.

Order CHIROPTERA

Bats

The 14 kinds (13 species, nine genera) of bats known to occur in Kansas are members of two families, Vespertilionidae and Molossidae, both in the suborder Microchiroptera.

Little is known about bats in Kansas. A glance at the distribution maps of the species occurring in the state reveals that there are relatively few records of occurrence.

The species of bats which occur in the state are insectivorous; they feed exclusively on flying insects. Bailey (1931:375) pointed out that: "With such highly beneficial food habits the bats are probably almost as essential to successful agriculture as are the birds." In spite of their usefulness, bats are often persecuted. As Black (1937:144) pointed out: "Wherever they are found in large numbers . . . there are evidences of . . . wanton destruction of the bats on one pretense or another." Wholeheartedly I agree with his plea: "This needless and foolish killing . . . should be outlawed at once, and these bats protected as stringently as any game bird or mammal in the state."

Bats often congregate to roost in the attics or between the walls of houses. Under these conditions control may be desirable. Silver (1935:3) has pointed out: "As bats individually are almost wholly beneficial, and at a distance are in no way objectionable, they should not be destroyed except as a last resort. It is only the bat roosts that have been established in occupied buildings that should be eliminated. This can usually be accomplished in either of two ways: (1) Excluding the bats by closing the openings through which they gain entrance; or (2) evicting them by treating their roost with a chemical substance to which they object." He recommends (*op. cit.*:4) the use of napthalene flakes as a repellant: "The flakes should be thrown liberally around or into the spaces occupied by the bats. Ordinarily 2 to 5 pounds are required for the average bat roost in dwellings. The bats will not return so long as a strong napthalene odor remains, but they may return after several weeks."

The following key will aid in the separation of the kinds of bats known to occur in the state:

1. Tail not extending more than 3 mm. behind uropatagium; anterior border of ear lacking horny excrescences; anterior border of palate truncate or rounded. Family VESPERTILIONIDAE, 3

1'. Tail extending behind uropatagium for approximately one half its total length; anterior border of ear with six to eight horny

excrescences; anterior border of palate with a distinct emargination. Family MOLOSSIDAE 2

2.(1′) Well developed pocket in membrane at angle of tibia and femur; ears when laid forward extending well beyond nose; two incisors on each side below; condylobasal length of skull more than 18 mm. ..... *Tadarida molossa*, p. 85

2′. No pocket in membrane at angle of tibia and femur; ears when laid forward not extending beyond nose; two and generally three incisors on each side below; condylobasal length of skull less than 18 mm. ..... *Tadarida mexicana*, p. 82

3.(1) Ears more than 20 mm. 4

3′. Ears less than 20 mm., rarely more than 15 mm. 5

4.(3) Prominent lump above nostrils; forearm less than 50 mm. in length; two upper incisors on each side, *Corynorhinus rafinesquii*, p. 78

4′. No lump above nostrils; forearm more than 50 mm. in length; one upper incisor on each side ..... *Antrozous bunkeri*, p. 79

5.(3′) One upper incisor on each side 6

5′. Two upper incisors on each side 8

6.(5) Upper surface of interfemoral membrane completely furred; total number of teeth 32 7

6′. Upper surface of interfemoral membrane entirely bare or furred slightly at extreme base; total number of teeth 30, *Nycticeius humeralis*, p. 72

7.(6) Color of body hoary (brown mixed with grayish white); length more than 120 mm. ..... *Lasiurus cinereus*, p. 73

7′. Color of body on upper parts reddish brown or yellowish brown; length less than 120 mm. ..... *Lasiurus borealis*, p. 75

8.(5′) Dorsal surface of interfemoral membrane entirely bare or furred slightly at extreme base; total number of teeth 38 or 32 9

8′. Dorsal surface of interfemoral membrane furred from ⅓ to ½ of its length; total number of teeth 34 or 36 13

9.(8) Tip of tail extending slightly beyond the interfemoral membrane; total length more than 105 mm.; total number of teeth 32, *Eptesicus fuscus*, p. 68

9′. Tip of tail not extending beyond the interfemoral membrane; total length less than 105 mm.; total number of teeth 38 10

10.(9′) Size small, forearm less than 41 mm. 11

10′. Size larger, forearm more than 43 mm. (Pale whitish below, with hairs on flanks pure white to base; elsewhere plumbeous at base; color pale olive brown to dull rufescent brown.) *Myotis velifer*, p. 58

11.(10) Belly whitish, very pale yellowish-buff dorsally, face and ears dark brown, forming a very prominent facial mask; forearm less than 35 mm. ..... *Myotis subulatus*, p. 61

11′. Belly buff; plumbeous underfur on belly prominent, dorsal fur bright olive to almost black; forearm more than 35 mm.; no prominent facial mask 12

12.(11′) Ear when flattened against the head (base not pushed forward but in normal position) reaching 3-4 mm. beyond tip of nose.

(Not yet reported from Kansas but probably rare in NE Kansas.) ..... *Myotis keenii*, p. 279

12'. Ears not extending beyond tip of nose..... *Myotis lucifugus*, p. 56

13.(8') Color sooty, frosted with white; length of forearm more than 36 mm.; total number of teeth 36..... *Lasionycteris noctivagans*, p. 65

13'. Color yellowish brown; length of forearm less than 36 mm.; total number of teeth 34..... *Pipistrellus subflavus*, p. 66

Family VESPERTILIONIDAE

Members of this family are characterized by their small size, simple muzzles and lips, and separate ears with well-developed tragi. The tails are long and extend to the edge of the interfemoral membrane. The ulna is fused to the head of the radius; the shaft of the ulna is reduced to an ossified fibrous strand. Eight genera of this family occur in Kansas.

Genus **MYOTIS** Kaup

Mouse-eared Bats

The members of this genus that occur in Kansas are small and brownish. They are not truly migratory although they often move some distance from their summer home to a hibernation site. They are gregareous, especially in the winter. Several thousand individuals of a single species have been found in a cave in Comanche County in winter. The females of at least some species are colonial when the young are born. The dental formula, i. $\frac{2}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$, is diagnostic for this genus in Kansas.

Myotis lucifugus

Big Myotis

This bat is the most common species over most of the eastern United States. It ranges from coast to coast, north into Canada and Alaska, and south in the United States at least to a line connecting Tennessee, Arkansas, New Mexico and California. The females spend the summer in colonies of various sizes in hollow trees, under rock ledges, in shallow caves, and in the attics of buildings. The males are not usually associated with the females in the spring and early summer, but live a solitary life, spending their days in secluded spots around trees, buildings, and rock ledges.

Cagle and Cockrum (1943:474-492) reported on the habits of a summer colony of this species, which consisted of several thousand individuals in the attic of a building at Carbondale, Jackson County,

Illinois. Bats were first noted in the colony on April 1; all were females. Six hundred adult females were taken in the month of May while in this same period only four adult males were taken. The young, one to each female, were born between May 17 and July 12, with the peak in the last part of June. In July adult males were more common in the colony. After the young were born the number of individuals in the colony diminished rapidly until, by September, few remained in the colony. The last bat observed in the colony was taken on November 10.

In winter these bats hibernate in caves, often gathering in clusters of several hundred, or even several thousand individuals in ideal

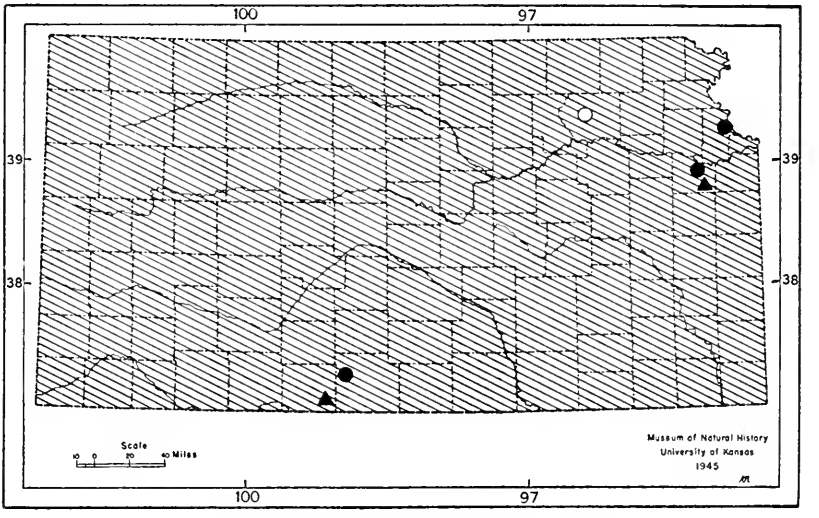

FIG. 9. Distribution of *Myotis lucifugus lucifugus* in Kansas. See figure 5 for explanation of symbols.

situations. Hitchcock (1949:53) found that this species selected warm, draftless locations for hibernation. The temperature of caves in which he found this species ranged from 37 to 40° F. and the relative humidity ranged from 78 per cent to 90 per cent. Griffin (1945:22) found that in this species in New England: "The migration from cave to summer colony may be as short as five to ten miles or at least as long as 168 miles, and it may be in almost any direction. Flights as long as 125 miles from one cave to another occurred during the winter months. There were also a few recoveries of bats that had moved from one summer colony to another; but the great majority of returns was retaken at the original place of banding."

Individuals of this species may live for several years. Cockrum

(1949:433-4) reported an individual, adult when banded, that was recovered seven years later and that was at least eight years old at that time. However, Hitchcock (1949:55) states: "Although seven or eight years may represent an old age for such bats, it is not the maximum for *M. l. lucifugus,* as Griffin has recovered this species after thirteen years (personal correspondence)."

Myotis lucifugus lucifugus (LeConte)

Vespertilio lucifugus LeConte, McMurtrie's Cuvier, Animal Kingdom, 1:431, type from Georgia, probably from the LeConte Plantation, near Riceboro, Liberty County; Cragin, Bull. Washburn College Lab. Nat. Hist., 1:47, 1885.

Myotis lucifugus lucifugus, Miller, Bull. New York St. Mus., 8(38):149, 1900; Hibbard, Trans. Kansas Acad. Sci., 36:232, 1933; Hibbard, Trans. Kansas Acad. Sci., 37:236, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 145, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20 (5):20, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:64, 1944; Brumwell, Amer. Midland Nat., 45:209, 1951.

Myotis lucifugus, Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905.

Distribution.—Probably occurs throughout the eastern two-thirds of the state. See map, figure 9.

Remarks.—External measurements of four males and two females from Lawrence are: ♂ 90 (87-95), ♀ 89, 89; 37.3 (36-40), 38, 35; 10.5 (10-11), 10, 11; 14.1 (12.5-15), 14, 12.

Specimens examined. — Total, 9, distributed as follows: *Pottawatomie County:* Unspecified, 1 (OU). *Leavenworth County:* Cave on Missouri R., 1 mi. SE Leavenworth, 1. *Douglas County:* Lawrence, 6. *Barber County:* 4½ mi. SW Sun City, 1.

Additional records.—Comanche County: Double Entrance S cave, 1 (Hibbard, 1934C:236). *Douglas County:* Baldwin, 1 (Kellogg, 1915:unpublished thesis).

Myotis velifer

House Bat

This species ranges from Kansas and western Texas westward to southern Utah and southern California and southward through Mexico to Guatamala.

Like other species of *Myotis* this bat spends its winters in hibernation. In McMoran Cave (Double Entrance S Cave of Hibbard, 1934C:235 and elsewhere), 17 miles east and 14 miles south of Coldwater, Comanche County, thousands of these bats congregate every fall. This cave, like many others in the area, developed in the Medicine Lodge gypsum. It is the largest of ten or 12 caves in Swartz Canyon.

On March 26th and 27th, 1948, Dr. A. B. Leonard, A. B. Williams, and I visited this cave. Several thousand bats of this species were

in crevices in the ceiling or were hanging from the ceiling in clusters of two to several hundred individuals. Some of the larger clusters were estimated to contain at least 1,000 individuals. When we first entered the cave at approximately 8:30 p. m., March 26th, no bats were observed flying. All of the bats were torpid and did not fly even when handled. When disturbed the bats began to breathe rapidly and later flew away.

Natural enemies take their toll, even when the bats are hibernating. Raccoon tracks were extremely numerous all of the way through the cave. At 11:30 p. m., we saw a pack rat, *Neotoma micropus*, approximately fifty yards from the mouth of the cave carrying a bat toward the entrance of the cave. Perhaps one of the bats disturbed by us had settled in a crevice within reach of the pack rat. It is likely that raccoons and pack rats feed on any bat

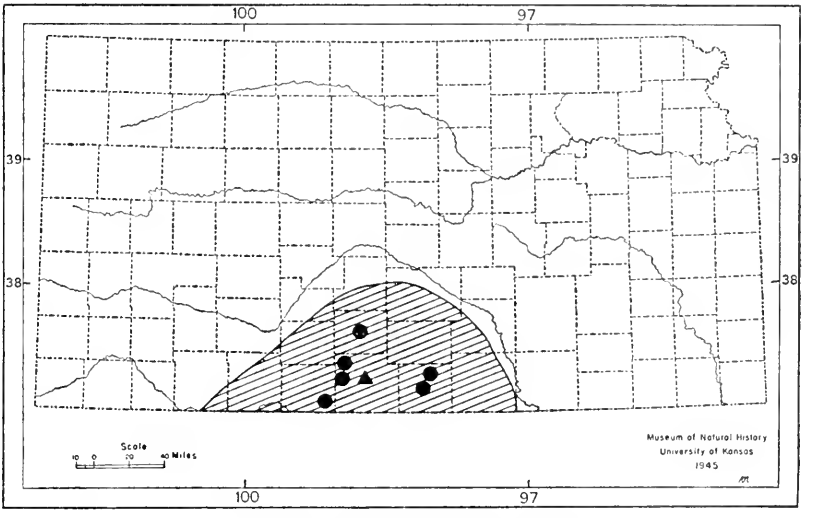

FIG. 10. Distribution of *Myotis velifer incautus* in Kansas. See figure 5 for explanation of symbols.

that they can reach, either living or dead. If this is true, then it is not surprising that we did not find any dead bats on the floor of the cave. However, Doctor Leonard counted six or seven dead bats hanging to the roof of the cave. In some cases these dead bats were actually mummified, yet they were still hanging to the ceiling. One wonders what the rate of mortality among the hibernating bats really is.

A total of 2,000 individuals of this species in the cave was banded with United States Fish and Wildlife Service aluminum bird bands,

size 0. One of these bands was placed on a forearm of each of the bats. The 2,000 bats banded represented only a small fraction of the population of this one cave. The sex ratio of those banded was 1,110 males to 890 females.

Although I have not visited this cave since the bats were banded, six of the banded bats have been recovered. Three were taken in hibernation in a cave three and one-half miles south and one mile west of Aetna, Barber County, by R. B. Loomis on April 10, 1949. This point of recovery is two miles east of the point of banding. The remaining three were reported to me by the United States Fish and Wildlife Service. One was recovered August, 1948, in a barn near Protection, Comanche County, 28 miles west-northwest of the point of banding. The second was retaken on October 23, 1948, at Mooreland, Woodward County, Oklahoma, a point 43 miles south-southwest of the banding point. The third was recovered on October 6, 1948, 14 miles southwest of Medicine Lodge, Barber County, a point 13 miles east-northeast of the place of banding.

Myotis velifer incautus (J. A. Allen)

Vespertilio incautus J. A. Allen, Bull. Amer. Mus. Nat. Hist., 8:239, 1896, type from San Antonio, Bexar County, Texas.

Myotis velifer incautus, Lantz, Trans. Kansas Acad. Sci., 28:241, 1918; Miller and Allen, Bull. U. S. Nat. Mus., 144:92, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:232, 1933; Hibbard, Trans. Kansas Acad. Sci., 37:235, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 146, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):20, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:64, 1944.

Myotis velifer, Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905.

Distribution.—Known only from Pratt, Comanche, Barber, and Harper counties in the south-central part of the state. See map, figure 10.

Remarks.—The average and extreme external measurements of eight males and four females from 17 miles east and 14 miles south of Coldwater are: ♂ 105 (99-111), ♀ 106 (102-110); 45.8 (40-51), 44.8 (42-50); 11.4 (10.5-13), 11.1 (11-12); 15.6 (15-16), 15.9 (15.5-16).

Specimens examined.—Total, 98, distributed as follows: *Pratt County:* Pratt, 2. *Comanche County:* 6 mi. NW Aetna [= 17 mi. E, 14 mi. S Coldwater] "S" cave, 12. *Barber County:* Sun City, 1; 4 mi. SW Sun City, 2; 4½ mi. SW Sun City, 43; 5 mi. SW Sun City, 1; Havard Cave, 27. *Harper County:* Harper, 7; Unspecified, 3.

Additional records.—Barber County: Medicine Lodge, 1 (Miller and Allen, 1928:93); Sun City, 3 (Kansas State Agric. College, Kellogg, 1915; unpublished thesis); Sun City, 18 (Miller and Allen, 1928:93).

Myotis subulatus

Small-footed Myotis

This species ranges from New England westward to eastern Washington and Oregon and southward to Baja California, southern Arizona, and northern Sonora, Mexico. However, as pointed out by Bailey (1926:216): "Over a wide strip of prairie country from the Gulf of Mexico to Manitoba there are very few records of its occurrence, while to the eastward and westward in rough country where caves are more numerous, the map shows many records." In Kansas

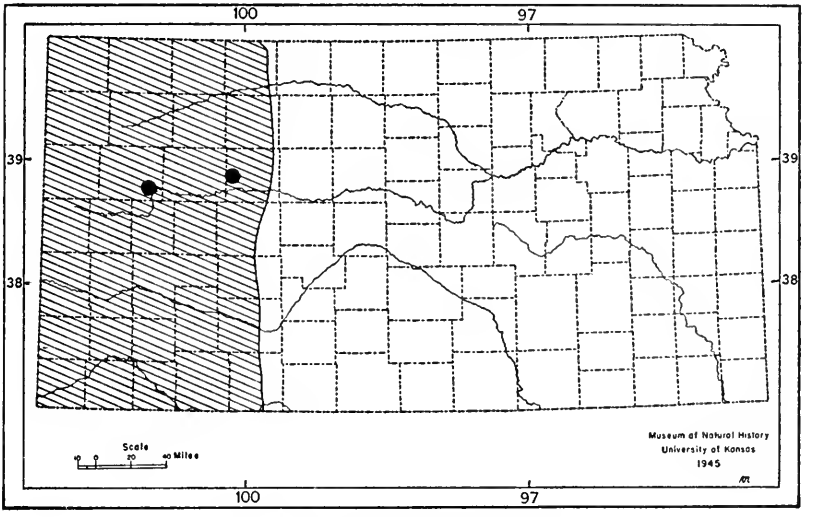

FIG. 11. Distribution of *Myotis subulatus subulatus* in Kansas. See figure 5 for explanation of symbols.

this bat is known only from Logan and Trego counties.

Like others of this genus, *Myotis subulatus* hibernates in caves in the winter months. To date, however, it has not been taken in Kansas in winter. This bat was first taken in the state in August, 1884, in the Chalk Cliffs near Castle Rock by A. B. Baker. These specimens were sent to C. H. Merriam who described (1886:2) the bat as a new species, *Vespertilio ciliolabrum*. Later work showed that these bats are actually the same as *Myotis subulatus subulatus* (Say). Baker (1889:57) gave the following information about this bat: "Found in clefts of the rocks, and in swallows' nests. The first individuals captured of this species were taken in August, 1884,

when scores of them were seen. None have been seen here since that time."

No further records of this bat are available from the state until August 28, 1926, when a collecting party from the University of Kansas Museum of Natural History took three adult males near Castle Rock probably in nearly the identical spot that Baker had taken them 42 years previously. C. D. Bunker (*in litt.*) pointed out: "The fact that they [*Myotis subulatus subulatus*] were not seen from 1884 to 1926 merely means that no one looked for them at the right time of the evening. They fly much later than all other bats I have known. Baker, no doubt, got his from a crevice in the rocks in the daytime and their time of flight was never noticed until . . . 1926."

The following summer another collecting party from the University of Kansas Museum of Natural History visited this same locality and succeeded in taking two adult females on July 30, 1927. Then, on August 6th, 7th and 9th, they secured four additional specimen from five miles west of Elkader, Logan County. The stomachs were saved from the four specimens taken in Logan County. Bunker (*in litt.*) pointed out that the bats had been shot soon after coming out of their hiding places, yet, when C. C. Sperry (of the Food Habits Research Division of the Biological Survey) examined these stomachs, one was full, one was half full, and two were empty. This is in keeping with Bailey's findings (1931:391) for this same species in New Mexico: "In a very short time after their first appearance their stomachs are found well distended with food, so that under normal conditions their rapid flight and quick motions enables them to obtain an ample food supply. Almost invariably when shot their stomachs are found to be full of food, but of so finely pulverized insect remains that very little can be determined as to the species eaten." C. C. Sperry (*in litt.*) was able to determine that the contents of the half-filled stomach were: "Bits of a bug (Jassidae), 2 per-cent; remains of flies, Anthomyidae (probably *Hylemyia*), 98 per cent," and in the full stomach "A finely ground mass of insect remains among which were found several *Agallia* sp., one or more *Piesma cinerea,* minute Scarabaeidae, Staphylinidae (1), Anthicidae (1), and fragments of ants and a fly."

As far as I know, no data are available as to movements or longevity of individual *Myotis subulatus.* The reproductive habits of this species are especially in need of further study. Bailey (1926: 216) found that in North Dakota this species had two young per

litter. This information led Asdell (1946:87-88) to state: "From a physiological standpoint the nomenclature of this western North American bat probably needs revising. *Myotis subulatus subulatus* Say has two as the usual number of young, while *M. subulatus melanorhinus* Merriam has one. Subspecies conform so regularly in their litter size that the incorporation of these two into one species is open to question."

Myotis subulatus subulatus (Say)

Vespertilio subulatus Say, Long's Exped. Rocky Mts., 2:65, 1823, type from Arkansas River, near La Junta, Otero County, Colorado; Cragin, Bull. Washburn College Lab. Nat. Hist., 1:47, 1885.

Myotis subulatus subulatus, Miller and Allen, Bull. U. S. Nat. Mus., 144:168, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:232, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 147, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):21, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:64, 1944.

Myotis subulatus, Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905; Lantz, Trans. Kansas Acad. Sci., 19:178, 1905.

Vespertilio ciliolabrum Merriam, Proc. Biol. Soc. Washington, 4:2, 1886, type from near Banner, Trego County, Kansas, in a bluff on Hackberry Creek, about one mile from Castle Rock; Baker, Trans. Kansas Acad. Sci., 11:57, 1889.

M[yotis] californicus ciliolabrum, Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905.

Myotis californicus ciliolabrum, Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:257, 1901; Lantz, Trans. Kansas Acad. Sci., 19:178, 1905.

Distribution.—Probably occurs throughout western Kansas although records are available only from Logan and Trego counties. See map, figure 11.

Remarks.—External measurements of three males and one female from five miles west of Elkader are: ♂ 83.3 (78-89), ♀ 86; 39.0 (35-42), 40; 7.3 (7-8), 8; 16 (15-18), 16.

Specimens examined.—Total, 13, distributed as follows: *Logan County:* 5 mi. W Elkader, 5. *Trego County:* Castle Rock, Hackberry Creek, 8.

Additional records.—Trego County: Banner, 6 (Miller and Allen, 1928: 169).

Genus **Lasionycteris** Peters

Silver-haired Bat

This genus, which is found only in North America, has only one species. It is distributed throughout North America north of Mexico and south of the Hudsonian Life-Zone. Its breeding range is in the Transition and Canadian life-zones across the entire continent. Well established records show that this bat migrates southward after the breeding season. It is mainly a forest bat and is usually found in localities where trees are abundant. In summer, in the

breeding range, it has been found in the day-time under loose bark and in hollow trunks of dead trees.

The dental formula, i. $\frac{2}{3}$, c. $\frac{1}{1}$, p. $\frac{2}{3}$, m. $\frac{3}{3}$, and the color, black with silver-white hair tips, serve to distinguish this bat from others found in Kansas. The females have two axillary mammae. The usual number of young is shown by embryos to be two, and less commonly one.

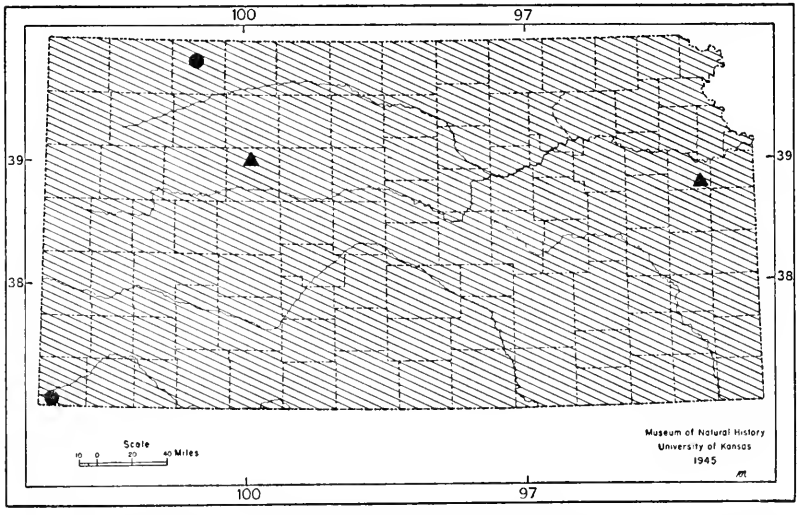

FIG. 12. Distribution of *Lasionycteris noctivagans* in Kansas. See figure 5 for explanation of symbols.

Specimens, in the University of Kansas Museum of Natural History, from the mountains of Georgia, were killed on January 14, 1933, while flying in the daytime. It is likely that these bats take advantage of the fact that insects fly about on warm days in the winter, while during the colder evenings, very few, if any, insects move about, even in the latitude of Georgia.

Perhaps the silver-haired bat moves far enough south that it does not need to hibernate but more probably it becomes dormant in periods of cold weather and scant food supply, even in the southern part of its winter range. Hamilton (1943:83) reported that it has been found hibernating in skyscrapers, churches, and other buildings in New York City between December and March. He reports also that one individual was found hibernating beneath the loose bark of a tree in British Columbia.

Lasionycteris noctivagans

Silver-haired Bat

Before 1950 *Lasionycteris* was known in Kansas only from two specimens, both of which are apparently no longer in existence. Baker (1889:57) reported, in writing of the mammals taken near Wakeeney: "Only one individual taken; captured indoors; attracted probably by the light." I have been unable to find the date on which it was taken nor have I been able to determine if it was preserved. The second record is the one examined by Remington Kellogg (1915:unpublished thesis) in the collection of Baker University. This specimen, taken at Baldwin, was destroyed by a fire.

In the fall of 1950, three examples of this bat were taken in Kansas and added to the collection of the University of Kansas Museum of Natural History. One of these was taken in September at Oberlin and two were taken in Morton County, one on September 19 and one on October 6.

Probably the silver-haired bat will be found to be a migrant in the state—passing through the state to the more wooded states to the north in the late spring and returning southward in early autumn. It has been recorded as a summer resident of North Dakota (Bailey, 1926:213).

Lasionycteris noctivagans (LeConte)

Vespertilio noctivagans LeConte, McMurtrie's Cuvier, Animal Kingdom, 1:431, 1831, type from eastern United States; Cragin, Bull. Washburn College Lab. Nat. Hist., 1:47, 1885.

Lasionycteris noctivagans, H. Allen, Monogr. Bats N. Amer. (1893), p. 105, 1894; Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:232, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 147, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):21, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:64, 1944.

Scotophilus noctivagans, Baker, Trans. Kansas Acad. Sci., 11:57, 1889.

Distribution.—Probably throughout the state in migration seasons. See map, figure 12.

Remarks.—External measurements of one female from Elkhart are: 105; 44; 10; 18.

Specimens examined.—Total, 3, distributed as follows: *Decatur County:* Oberlin, 1. *Morton County:* 1 mi. W Elkhart, 1; Elkhart, 1.

Additional records.—*Trego County:* Wakeeney, 1, (Baker, 1889:57). *Douglas County:* Baldwin, 1, (Kellogg, 1915:unpublished thesis).

Genus **Pipistrellus** Kaup

Pipistrelles

This genus occurs in North America, Europe, Asia, and Africa. In North America it occurs from southern Canada to Honduras and from the Atlantic Ocean to the Pacific Ocean. Generic characteristics include: ears longer than broad, tapering, tip narrowly rounded; tragus nearly straight; interfemoral membrane slightly furred on basal third; and two upper incisors subequal and outer one lacking a concavity on surface facing canine. The dental formula is: i. $\frac{2}{3}$, c. $\frac{1}{1}$, p. $\frac{2}{2}$, m. $\frac{3}{3}$.

Pipistrellus subflavus

Pipistrelle

This is the smallest of the bats that occur in the state. The total length varies from 77 to 89 mm. and the color varies from Snuff Brown to Sayal Brown.

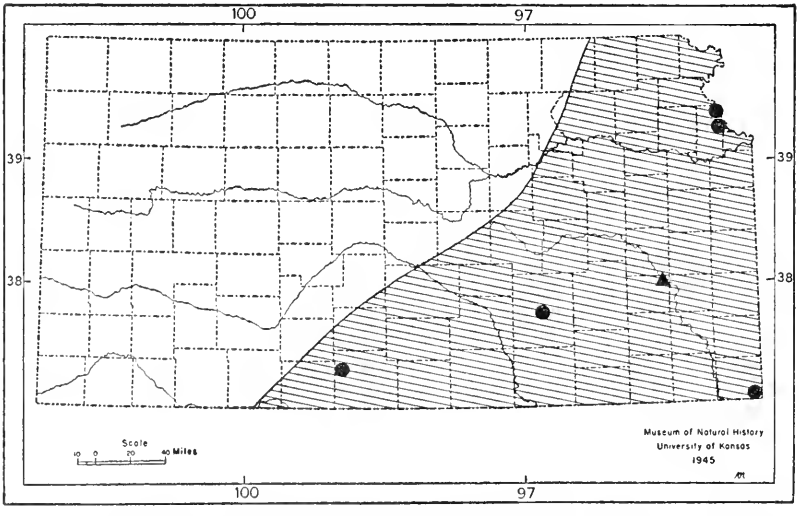

FIG. 13. Distribution of *Pipistrellus subflavus subflavus* in Kansas. See figure 5 for explanation of symbols.

As now understood, *P. subflavus* ranges in eastern North America from Quebec, Canada, southward to Honduras, in central America. Hall and Dalquest (1950:599) pointed out that this range is exceptional in that it passes from the Canadian Life-zone in the north, south to the Tropical Life-zone in Honduras. In winter this species hibernates in caves, at least in the northern part of its range.

It usually selects warm, draftless spots where it hibernates in clusters of less than 50 individuals and often singly. In summer few pipistrelles are found in caves and some have been collected miles from the nearest cave. D. R. Griffin (1945:20) records the recovery of an individual in summer at Katonah, New York, approximately 65 air-line miles from a cave near Sheffield, Massachusetts, where it had been banded in winter. M. J. Guthrie (1933:8), studying cave bats near Columbia, Boone County, Missouri, found that: "*Pipistrellus* is always isolated and has not been found in crevices. Specimens occur in very moist places and are beautiful objects as the light flashes on them when they are covered with droplets of water. Some appear frosted under these conditions and doubtless are the "white" bats sometimes reported by casual observers." Further (*op. cit.*:17-18) she noted that: "Individuals entered the cave in the middle of October and became very torpid. . . . Until the end of April, both sexes were present in equal numbers . . .; by the middle of May only males were found, and they were feeding. This situation continued throughout May." No bats were seen in the cave after May but one was shot near the entrance sometime in the month of June.

Female pipistrelles have one to three, with an average of two, young which in central and northern states are born between mid-June and mid-July. In the first few days of their life the young are carried with the mother on her evening flight but after this time they are left behind while the mother seeks food. The young are able to fly when they are approximately three weeks of age. Individuals of this species may live for at least six years (Hitchcock, 1949:56).

As shown below, few records of this bat are available from the state; only eighteen specimens have been taken. Hibbard (1934C: 236) observed in Barber County, Kansas, that: "These little bats were not common in any of the caves. They were found singly, and in the most obscure places, occupying a much drier habitat than *Myotis velifer incautus*."

Pipistrellus subflavus subflavus (F. Cuvier)

V[*espertilio*] *subflavus* F. Cuvier, Nouv. Ann. Mus. Hist. Nat. Paris, 1:17, 1832, type from eastern United States, probably Georgia.

Pipistrellus subflavus subflavus, Miller, Bull. U. S. Nat. Mus., No. 128:75, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:233, 1933; Hibbard, Trans. Kansas Acad. Sci., 37:236, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 148, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):21, 1940; Hibbard, Trans. Kansas Acad. Sci.,

47:64, 1944; Hall and Dalquest, Univ. Kansas Publs., Mus. Nat. Hist., 1:599, 1950.

Pipistrellus subflavus, Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905.

Vespertilio Georgianus, Cragin, Bull. Washburn College Lab. Nat. Hist., 1:47, 1885.

Distribution.—Probably throughout the eastern half of the state although definite records are available from only Leavenworth, Butler, Barber, Woodson, and Cherokee counties. See map, figure 13.

Remarks.—External measurements of two males and one female from Butler County, are: ♂ 83, 89, ♀ 88; 39, 43, 40; 10, 9, 11; 14, 13, 14.

Two individuals from Fort Leavenworth are much darker than any of the other examples of this species in the collection of the University of Kansas Museum of Natural History.

Specimens examined. — Total, 20, distributed as follows: *Leavenworth County:* Ft. Leavenworth, 2; Cave on Missouri R., 1 mi. SE Leavenworth, 1. *Butler County:* 5 mi. S El Dorado, 1; 6 mi. S El Dorado, 6. *Barber County:* 4½ mi. SW Sun City, 6; 5½ mi. SW Sun City, 1; ½ mi. N Natural Bridge, 1. *Cherokee County:* 1½ mi. S Galena, 2.

Additional records.—Woodson Co.: Neosho Falls, 1 (Cragin, 1885:47).

Genus **Eptesicus** Rafinesque

Brown Bats

This genus occurs in Asia, Africa, and Australia, and in the western hemisphere it ranges from southern Canada to northern South America.

The black, naked ears, the black, nearly naked membranes, the medium size and the uniformly dark brown body are characteristics that distinguish this bat from others found in the state. From *Nycticeius* and *Myotis,* with which *Eptesicus* might be confused, it is distinguished by its larger size and by its dental formula, i. $\frac{2}{3}$, c. $\frac{1}{1}$, p. $\frac{1}{2}$, m. $\frac{3}{3}$.

Eptesicus fuscus

Big Brown Bat

Many individuals of this species remain in the state throughout the year. In winter they hang in sheltered spots and remain more or less inactive. I have taken this species in November and in February in dark, sheltered spots under the stadium at the University of Kansas campus in Lawrence. Black (1937:149) reported that: "The big brown bat has been found to hibernate in the storm, or flood sewers underneath Lawrence, coming into these drains sometime in November and remaining until early spring. They almost

invariably hang singly, but will bunch in groups of three in a crevice, and we have found as many as six hanging together where a brick had fallen out. In caves I have never found more than a single specimen at a place." Rysgaard (1942:254) found that in caves in Minnesota the males tend to hang in clusters more readily

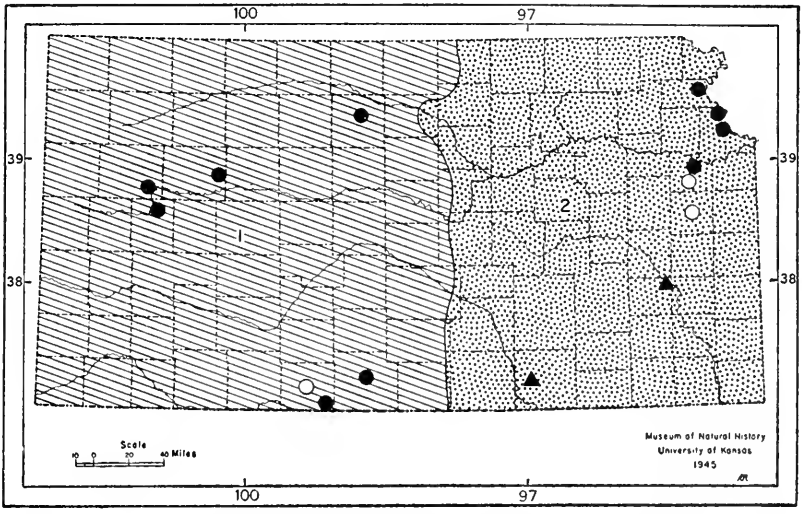

FIG. 14. Distribution of *Eptesicus fuscus* in Kansas. 1. *E. f. pallidus*. 2. *E. f. fuscus*. See figure 5 for explanation of symbols.

than the females. He found as many as 29 individuals in a single cluster; only two of these were females. In one cave he found 117 males and 17 females hanging in clusters and in the same cave he found 18 males and 48 females hanging singly. *Eptesicus* was found either in artificial sandstone caves or in the cooler part of caves (35 to 46° F.) which were avoided by other species.

On February 19th, 1950, Gene Frum, Phillip Krutzsch, and I visited some man-made caves in Leavenworth. Three artificial caves, dug in the face of a north facing limestone bluff in the block bounded on the south by Walnut Street and on the east by Fourth Street, were examined. Two of the caves had large openings and were relatively cold and dry. Eight *Eptesicus fuscus* were taken in cracks of the ceiling within 50 feet of the entrances. A mass of earth had partly filled the entrance of the third cave, making it much darker than either of the other two. Ground water seeped in at the back and the floor was covered with water. Two *Eptesicus* were taken here and, in the warmer, more humid depths of the cave two *Pipistrellus subflavus* were taken.

In the southeast part of Leavenworth, approximately 100 yards west of the Missouri Pacific Railroad, is an abandoned rock quarry which consists of approximately one-half mile of interconnected rooms and chambers tunneled in the side of a bluff. Several large holes, large enough for the entrance of trucks, open to the outside along the east edge of this series of chambers and two or three similar openings are on the west edge. Ground water seeps through the walls and ceilings of a few of the chambers and in some, water to a depth of ten to 12 inches covers the floor. Twenty-five *Eptesicus fuscus* were observed, hanging singly, in various parts of the cave. Sixteen (nine females and seven males) were taken as specimens. In the warmer, more humid parts of the cave we took three *Pipistrellus* (two males and one female) and one *Myotis lucifugus* (female).

In summer *Eptesicus fuscus* is usually solitary although summer colonies have been found. Hibbard (1936:167) reported taking the big brown bat in association with *Tadarida mexicana* in the belfry of an old school building at Medicine Lodge. In the attic of the County Court House in Osborne there is a summer colony of several hundred big brown bats. The caretaker of the building reports that the bats are numerous in this attic every summer, but that they disappear in the winter.

The number of young per female varies from one to four but two is the usual number. *Eptesicus* flies late in the evening and near the ground; thus it is often noticed more than the other, higher flying, bats. Hamilton (1933:155) found its food to be mainly beetles, hymenoptera, and diptera. Individuals have been known to live as long as nine years (Hitchcock, 1949:56).

Eptesicus fuscus fuscus (Beauvois)

Vespertilio fuscus Beauvois, Catal. Raisonne Mus. Peale, Philadelphia, p. 18, 1796, type from Philadelphia, Pennsylvania; Cragin, Bull. Washburn College Lab. Nat. Hist., 1:45, 1885; Miller, N. Amer. Fauna, 13:96, 1897; Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905.

Eptesicus fuscus fuscus, Hall, Jour. Mamm., 4:193; Miller, Bull. U. S. Nat. Mus., 128:76, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:233, 1933; Hibbard, Trans. Kansas Acad. Sci., 37:237, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 149, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):22, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:65, 1944; Brumwell, Amer. Midland Nat., 45:209, 1951.

[*Eptesicus fuscus*] *fuscus*, Engels, Amer. Midland Nat., 17:653, 1936.

Adelonycteris fuscus, H. Allen, Bull. U. S. Nat. Mus., 43:121, 1897.

Distribution.—Occurs throughout the eastern one-third of the state. See map, figure 14.

Remarks.—The average and extremes of external measurements of six adult males from Leavenworth County are: 114.1 (110-117); 46.1 (40-54); 10.0 (9-12); 17.1 (14-19).

The differences between the various populations of *Eptesicus fuscus* in Kansas are small. Most individuals from the western part of the state are paler than most individuals from the eastern third of the state. No significant differences were found between the skulls of individuals from the western and eastern parts of the state. On the basis of color alone *Eptesicus* in Kansas is separable into the darker, eastern race, *Eptesicus fuscus fuscus*, and the paler western race, *Eptesicus fuscus pallidus.*

Specimens examined.—Total, 60, distributed as follows: *Atchison County:* Atchison, St. Benedicts College, 1 (WGF). *Leavenworth County:* Leavenworth, 2; cave on Missouri R., 1 mi. SE Leavenworth, 7; Ft. Leavenworth, 9. *Douglas County:* Lawrence, 35; Unspecified, 5. *Franklin County:* Unspecified, 1 (OU).

Additional records.—*Cowley County:* Winfield, 1 (CNHM). *Woodson County:* Neosho Falls, 1 (USNM).

Eptesicus fuscus pallidus Young

Eptesicus pallidus Young, Proc. Acad. Nat. Sci. Philadelphia, p. 408, 1908, type from Boulder, Boulder County, Colorado.

Eptesicus fuscus pallidus, Miller, N. Amer. Land Mamm. 1911, p. 62, 1912; Black, Kansas State Board Agric., 30th Biennial Rept., p. 150, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:65, 1944.

Eptesicus fuscus, Hibbard, Jour. Mamm., 17:167, 1936.

[*Eptesicus fuscus*] *fuscus,* Engels, Amer. Midland Nat., 17:653, 1936.

Distribution.—Occurs throughout the western two-thirds of the state. See map, figure 14.

Remarks.—External measurements of nine adult males and nine adult females from Barber County, are: ♂ 114.3 (104-123), ♀ 117.8 (115-122); 45.7 (39-50), 47.1 (42-50); 11.1 (10-13), 11.8 (10-14); 16.8 (15-18), 17.2 (16-18).

Several individuals taken on August 3 and August 5, in a series from five miles west of Elkader, show signs of molting.

Specimens examined.—Total, 107, distributed as follows: *Osborne County:* Court House, Osborne, 14. *Logan County:* 5 mi. W Elkader, 35. *Gove County:* Castle Rock, 8 (GCR). *Scott County:* State Park, 1 (GCR). *Comanche County:* 6 mi. NW Aetna, "S" cave, 2; Unspecified, 1. *Barber County:* Medicine Lodge, 46.

Genus **Nycticeius** Rafinesque

Evening Bats

The genus occurs in North America, Asia, Australia, and Africa. In North America, it ranges from southeastern Canada southward through the eastern and central United States to northeastern Mexico. The dental formula is: i. $\frac{1}{3}$, c. $\frac{1}{1}$, p. $\frac{1}{2}$, m. $\frac{3}{3}$.

Nycticeius humeralis

Evening Bat

This species is found in the austral zones of the eastern United States west to Kansas and southern Texas. Hamilton (1943:101) states that: "It occurs as a summer resident from Pennsylvania to southern Michigan and Illinois but reaches its maximum abundance in the south." In size and color this species resembles *Myotis lucifugus* but it has fewer teeth.

The habits of this bat are little known. Hamilton (1943:101) states that the breeding season is August, and that two young are born in late May.

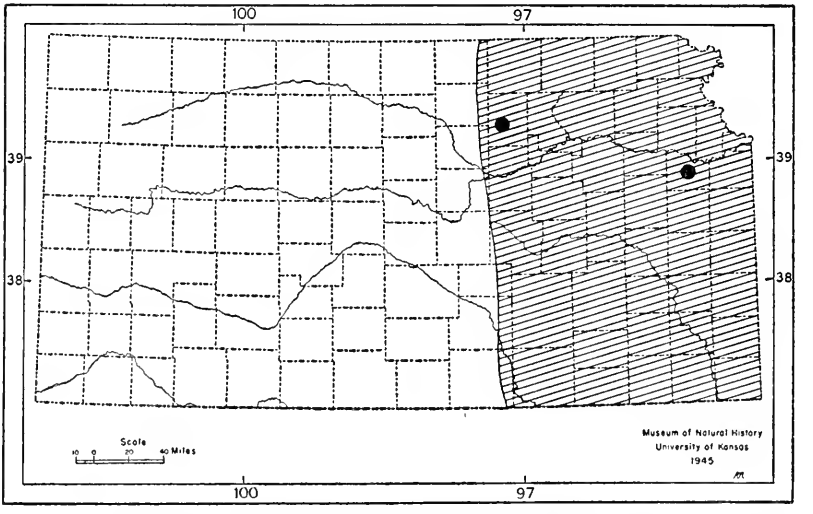

FIG. 15. Distribution of *Nycticeius humeralis humeralis* in Kansas. See figure 5 for explanation of symbols.

Actual specimens of this bat have not been previously reported from the state. The five specimens now reported were found among the *Myotis lucifugus* in the collection of the University of Kansas Museum of Natural History. No observations have been made on the habits of these bats in Kansas.

Nycticeius humeralis humeralis (Rafinesque)

Vespertilio humeralis Rafinesque, American Monthly Magazine, 3:445, 1818, type from Kentucky.

Nycticeius humeralis humeralis, Peterson, Jour. Mamm., 27:166, 1946.

N[ycticeius] humeralis, Rafinesque, Jour. de physique, 88:417, 1819.

Nycticeius humeralis, Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:248, 1933; Brumwell, Amer. Midland Nat., 45:209, 1951.

Atalapha crepuscularis, Cragin, Bull. Washburn College Lab. Nat. Hist., 1:47, 1885.

Distribution.—Probably occurs throughout the eastern third of the state; known only from Clay and Douglas counties. See map, figure 15.

Remarks.—The four animals taken in Clay County were females and all were taken in the last week of June, 1937. In total length they range from 85 to 91 mm. which is less than the corresponding measurement of 99 mm. for the male from Douglas County. The Douglas County specimen weighed 15.7 grams. A note by the collector, W. W. Dalquest, on the specimen label indicated that 5.0 grams of fatty tissues were removed from the body.

Specimens examined.—Total, 5, distributed as follows: *Clay County:* 6 mi. SW Clay Center, 4. *Douglas County:* 7½ mi. SSW Lawrence, 1.

Genus **Lasiurus** Gray

Hairy-tailed Bats

Two species of this genus occur in Kansas. They may be distinguished from other species by the interfemoral membrane which is densely furred over all its dorsal surface. The dental formula is: i. $\frac{1}{3}$, c. $\frac{1}{1}$, p. $\frac{2}{2}$, m. $\frac{3}{3}$. The two species in Kansas occur over most of North America, are migratory, solitary and tree dwellers.

Lasiurus cinereus

Hoary Bat

The yellowish-brown to dark mahogany-brown hair frosted with silver gives this bat a pronounced hoary appearance. The color and the large size serve readily to distinguish this bat from all others in the state. Like the red bat, *Lasiurus borealis,* the hoary bat migrates southward in the autumn, spends the winter in the southern territories, and returns to the north in the spring. In Kansas, females have been taken as early as May 10 (KU no. 9322, Lawrence) and as late as August 18 (KU no. 13219, State Park, Meade County). Adult males seem to arrive in Kansas much later than the females, the earliest record being June 30 (KU no. 3174, Lawrence). The species has been taken as late as September 4 (OU no. 16, Pottawatomie County).

The females apparently give birth to their young in mid-June. Two is the usual number of young. Five pregnant females each had two embryos, and of eight females taken with their young, five

had two young each and three had only one young each. The sex ratio of twelve of these young for which sex was recorded is five males to one female. The sex ratio for all young hoary bats in the collection of the Museum of Natural History taken in Kansas between June 17 and July 20 is three males to one female.

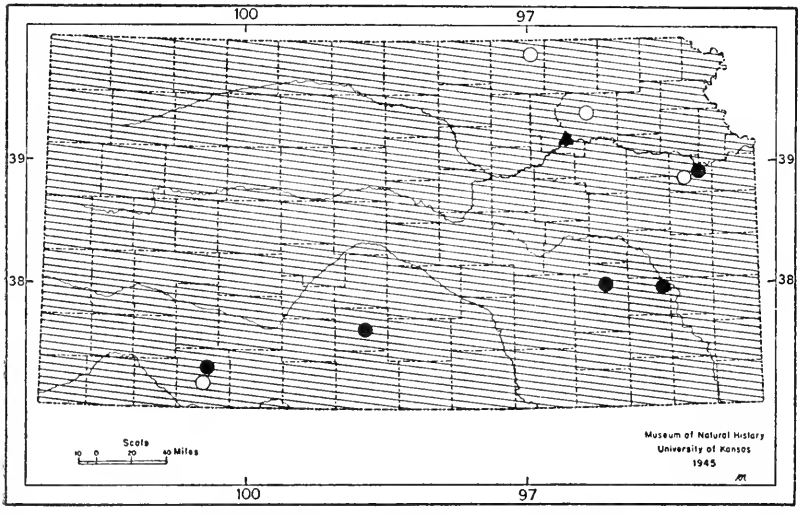

FIG. 16. Distribution of *Lasiurus cinereus cinereus* in Kansas. See figure 5 for explanation of symbols.

Lasiurus cinereus cinereus (Beauvois)

Vespertilio cinereus (misspelled *linereus*) Beauvois, Catal. Raisonne Mus. Peale, Philadelphia, p. 18, 1796, type from Pennsylvania, probably near Philadelphia.

Lasiurus cinereus cinereus, Dalquest, Univ. Kansas Publs., Mus. Nat. Hist., 2:168, 1948; Brumwell, Amer. Midland Nat., 45:209, 1951.

Lasiurus cinereus, Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Sprague, Jour. Mamm., 20:102, 1939; Hibbard, Trans. Kansas Acad. Sci., 47:65, 1944.

L[asiurus] cinereus, Knox, Trans. Kansas Acad. Sci., 4:20, 1875; Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905.

Alalapha cinerea, Cragin, Bull. Washburn College Lab. Nat. Hist., 1:45, 1885; H. Allen, Bull. U. S. Nat. Mus., 43:162, 1897.

Nycteris cinerea, Hall, Jour. Mamm., 4:192, 1923; Hibbard, Trans. Kansas Acad. Sci., 36:233, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 151, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):23, 1940.

Distribution.—Probably occurs throughout Kansas, wherever trees are present, in the summer months. It has not been taken in the extreme western and northwestern parts of the state. See map, figure 16.

Remarks.—External measurements of two adult females, from Lawrence, are: 150, 135; 65, 54; 13, 13; 14, 13.

Specimens examined.—Total, 45, distributed as follows: *Washington Co.* (?): Little Blue River, 1 (USNM). *Pottawatomie County:* Unspecified, 1 (OU). *Dickinson County:* Abilene, 1. *Douglas County:* Lawrence, 30; Unspecified, 5. *Woodson Co.:* Neosho Falls, 1 (USNM). *Pratt County:* State Fish Hatchery [= 1 mi. S, 2 mi. E Pratt], 2. *Greenwood County:* Hamilton, 1 (GCR). *Meade County:* Meade, 1 (USNM); Unspecified, 2.

Additional records.—Riley Co.: Manhattan (Cragin, 1885:45).

Lasiurus borealis

Red Bat

The bright red or rusty color of this bat distinguishes it from all other bats found in the state. The females are a dull buffy chestnut color, often frosted with white. The males are much brighter,

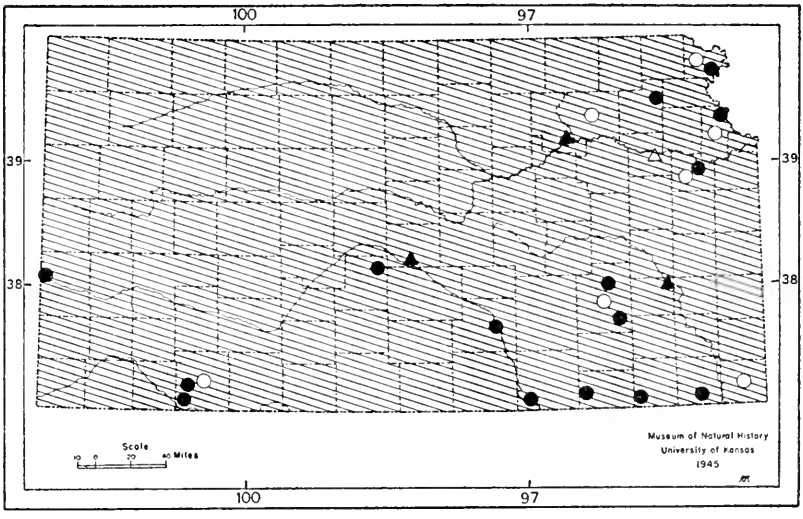

FIG. 17. Distribution of *Lasiurus borealis borealis* in Kansas. See figure 5 for explanation of symbols.

usually a bright orange-red. The red bat is perhaps the most common bat found in Kansas and, because it flies earlier in the evening than other bats, it is seen far more often than any other kind. It appears soon after sunset and long before dark, fluttering around trees, ponds, and even the street lights of the city. As many as three or four are often visible at one time around a single street light.

The red bat passes the day hanging in the branches of some shady tree, and, in autumn, migrates southward to spend the winter.

G. M. Allen (1939:256-259) summarized the evidence for migration. In brief, the evidence consists of: (1) observations of flights northward in the spring and southward in the fall at lighthouses as far as 15 miles from land; (2) the finding of animals at sea far from the nearest land . . . "as if they had wandered far or been blown to sea in the course of their passage south along the east coast" (Allen, 1939:256). It has been taken several times in Bermuda.

To date very little is known about the migration of this bat and, to my knowledge, no definite evidence, such as the recovery of an individual in the south that had been marked in the north, is available. Even less is known about their return from the south in the spring. In Kansas the earliest spring record is that of a female taken on April 26, 1950, in Lawrence. By mid-May female red bats are common, at least around Lawrence, and continue to be so until the middle of August. The latest recorded occurrence of a female is of one taken on September 19, 1924, 3 miles south of Lawrence.

The males do not arrive in Kansas in any great numbers until approximately the time when the young are born. The earliest spring record of an adult male is that of one taken on June 18, 1941, seven and one-half miles southwest of Lawrence. The last record of the season is that of a male bat taken on September 20, 1919, from an unspecified locality in Douglas County. This date is later by only one day than the latest record for a female.

In Douglas County June 15 is the earliest recorded date of birth of young and the latest record of embryos *in utero* is June 20. The number of young varies from two to four with three being the usual number. An examination of 16 pregnant females revealed one with two, nine with three, and six with four embryos, or an average of 3.31 per female. However, an examination of specimens in the collection of the University of Kansas Museum of Natural History, in which an adult female was associated with its young, reveals that in ten such cases, five were with two, four were with three, and one was with four young, or an average of 2.6 per female. This is significantly lower than the number of embryos—probably indicating that many of the young die before they reach maturity.

Lasiurus borealis borealis (Muller)

Vespertilio borealis Muller, Natursyst. Suppl., p. 20, 1776, type from New York.

Lasiurus borealis borealis, Johnson, Jour. Mamm., 13:132, 1932; Loewen, Trans. Kansas Acad. Sci., 37:258, 1934; Hibbard, Trans. Kansas Acad. Sci., 47:65, 1944; Brumwell, Amer. Midland Nat., 45:209, 1951.

Lasiurus borealis, Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:338, 1905.

Nycteris borealis borealis, Hall, Jour. Mamm., 4:192, 1923; Linsdale, Jour. Mamm., 9:141, 1928; Hibbard, Trans. Kansas Acad. Sci., 36: 233, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 150, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist., Surv., 20(5):22, 1940.

Lasiurus noveboracensis, Knox, Trans. Kansas Acad. Sci., 4:20, 1875; Baker, Trans. Kansas Acad. Sci., 11:57, 1889.

Atalapha noveboracensis, Cragin, Bull. Washburn College Lab. Nat. Hist., 1:45, 1885; H. Allen, Bull. U. S. Nat. Mus., 43:153, 1897.

Distribution.—Probably state wide but much more common in the eastern one-third of the state. See map, figure 17.

Remarks.—External measurements of two adult males and eleven adult females, taken in and near Lawrence are: ♂ 103, 110, ♀ 113.7 (109-124); 48, 47, 52.5 (50-60); 9, 9, 9.5 (9-10); 12, 12, 12.5 (12-13).

Hall (1923:193) reported observing this species: "at Atwood, Rawlins County, Kansas, where large numbers were inhabiting a cave." Hall now (1951) believes that this observation was in error (no specimens were taken) and that the bats observed were big brown bats, *Eptesicus fuscus*, or some species other than *Lasiurus borealis*.

Specimens examined.—Total, 155, distribubted as follows: *Doniphan County:* Doniphan Lake, 1; Unspecified, 2. *Pottawatomie County:* Unspecified, 1 (OU). *Jackson County:* 3½ mi. SW Muscotah, 4. *Leavenworth County:* Ft. Leavenworth, 3; Unspecified, 1. *Douglas County:* 3 mi. up Kansas R. (from Lawrence), 1; Lawrence, 27; K. U. Campus, 13; Haskell Institute, 3; 3 mi. SW Lawrence, 4; 3 mi. S Lawrence, 1; 7½ mi. SW Lawrence, 2; Unspecified, 21. *Hamilton County:* 1 mi. E Coolidge, 2. *Stafford County:* Little Salt Marsh, 2. *Greenwood County:* Hamilton, 33 (28, GCR); 8 mi. SW Toronto, 1; 8½ mi. SW Toronto, 15; Unspecified, 1. *Sedgwick County:* Wichita, 4. *Meade County:* 14 mi. SW Meade, 1; 17 mi. SW Meade, 1; Unspecified, 3. *Cowley County:* Arkansas City, 2. *Chautauqua Co.:* Cedar Vale, 1 (USBS). *Montgomery County:* 4 mi. N Caney, 2; 4 mi. NW Caney, 1. *Labette County:* 10 mi. SW Oswego, 1. *Cherokee County:* Unspecified, 1.

Additional records.—*Shawnee Co.:* Topeka, 2 (Cragin, 1885:45). *Riley Co.:* Manhattan, 1 (Cragin, 1885:45). *Rice County:* Sterling (Loewen, 1934:258). *Woodson Co.:* Neosho Falls (Cragin, 1885:45).

Genus **Corynorhinus** Allen

Long-eared Bat

The long-eared bat averages approximately a hundred millimeters in total length. The ears are long and are joined by a basal membrane. The dental formula is: i. $\frac{2}{3}$, c. $\frac{1}{1}$, p. $\frac{2}{3}$, m. $\frac{3}{3}$. From *Antrozous* this bat may be distinguished by: Darker color, especially on the venter; narrower ears; shorter forearm, which is less than 49 mm. (approximately 44 as opposed to 54 mm.); a lump on each side of the muzzle, as well as a larger number of teeth (36 as opposed to 28).

Corynorhinus rafinesquii

Long-eared Bat

Little is known of the habits of this bat in Kansas. To date it has been taken only in the gypsum caves of Barber and Comanche counties. Hibbard (1934C:237) reported that: "This long-eared bat showed little tendency to be gregarious in habit. Only females were found together. We succeeded in catching a male September 2, in Fallen Arch cave, three quarters of a mile south of the Natural Bridge on Bear Creek. Seven of these bats were observed in the caves of Barber County in September. They were always hanging by one foot and would fly at the slightest approach of our light,

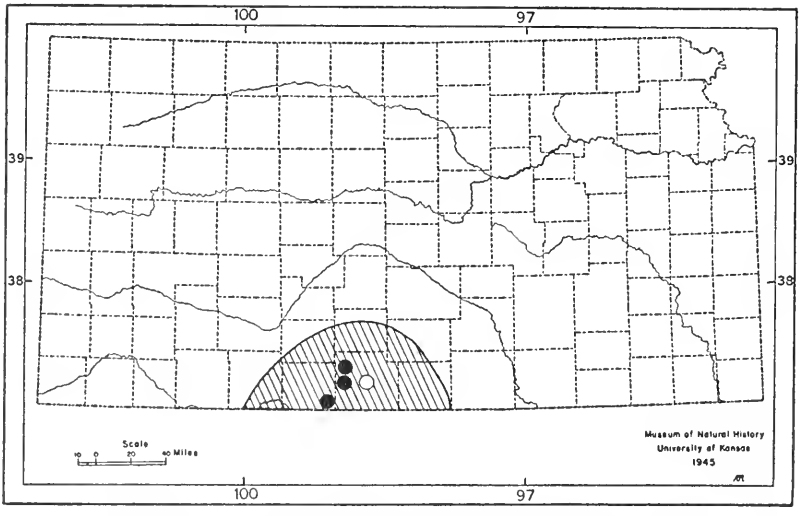

FIG. 18. Distribution of *Corynorhinus rafinesquii pallescens* in Kansas. See figure 5 for explanation of symbols.

darting in among the rocks or out of the many openings. . . . Two females were taken November 2 from a sinkhole in Barber County, one-eighth mile northeast of Dancer's cave. Three females were taken November 4 in Comanche County, from the Double Entrance S cave. All were found singly on the underside of large rocks very close to the stream bed."

Hall (1946:158) found that in Nevada: "The females are colonial when carrying embryos and when with young; at these times the females remain apart from the males. The number of adult females found together in Nevada always has been less than fifty—

usually about twenty-five. At the time of the year when the females are in colonies the males were found singly."

One is the usual number of young although Hall (*op. cit.*): reports "Of the ten females with embryos, nine had but one each and one had two embryos. All these data point to the last week of June as the time when young are born."

Corynorhinus rafinesquii pallescens Miller

Corynorhinus macrotis pallescens Miller, N. Amer. Fauna, 13:52, 1897, type from Keams Canyon, Navajo County, Arizona; Lantz, Trans. Kansas Acad. Sci., 20(2):215, 1907.

Corynorhinus rafinesquii pallescens, Miller, Bull. U. S. Nat. Mus., 128:82, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:233, 1933; Hibbard, Trans. Kansas Acad. Sci., 37:237, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 151, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):23, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:65, 1944.

Distribution.—Known only from the gypsum caves of Barber and Comanche counties. See map, figure 18.

Remarks.—External measurements of two males and five females from Barber County, are: ♂ 104, 102, ♀ 100.6 (98-103); 46, 48, 45.8 (40-50); 16, 11, 11.8 (11-14); 34, 30, 32.4 (29-35).

Specimens examined.—Total, 15, distribubted as follows: *Comanche County:* Swartz Canyon, 2; 6 mi. NW Aetna, "S" Cave, 3. *Barber County:* 4½ mi. SW Sun City, 1; 7 mi. S Sun City, 3; 18 mi. S Sun City, 2; 4 mi. S Aetna, 3; Unspecified, 1.

Genus Antrozous Allen

Pale Bats

This genus occurs only in North America, from western United States southward to Central Mexico. Kansas is at the eastern limit of the range of this genus. The dental formula is: i. $\frac{1}{2}$, c. $\frac{1}{1}$, p. $\frac{1}{2}$, m. $\frac{3}{3}$.

Antrozous bunkeri

Bunker Bat

This species was described by C. W. Hibbard from specimens taken in a tunnel at Natural Bridge, Barber County. Individuals of this species have been taken, with one exception, only between August 31st and September 9th in caves and sink holes within ten miles of the type locality. The one exception is a young female taken three miles north of Kenton, Cimmaron County, Oklahoma, on August 24, 1937 (Burt, 1945:309). This locality is more than 200 miles west of the type locality.

The large ear is the most obvious character of the Bunker bat. It has a smaller number of teeth than in the other long-eared bat in the state, *Corynorhinus*. Almost nothing is known about its habits; in fact, the bats have been found only in late August in Kansas and Oklahoma, and in Kansas in the first part of September. Hibbard, when he described this bat, had 25 specimens available, all taken on September 2, 1933. In writing of the cave bats of Kansas, he tells (1934:237) of the discovery of these bats: "The first place that we explored was a tunnel at the Natural Bridge, 7 miles south of Sun City, on the afternoon of September 2. The south entrance of the tunnel is about four feet high and three feet wide. Entering the tunnel from the south, we found a low ceiling for the first 130

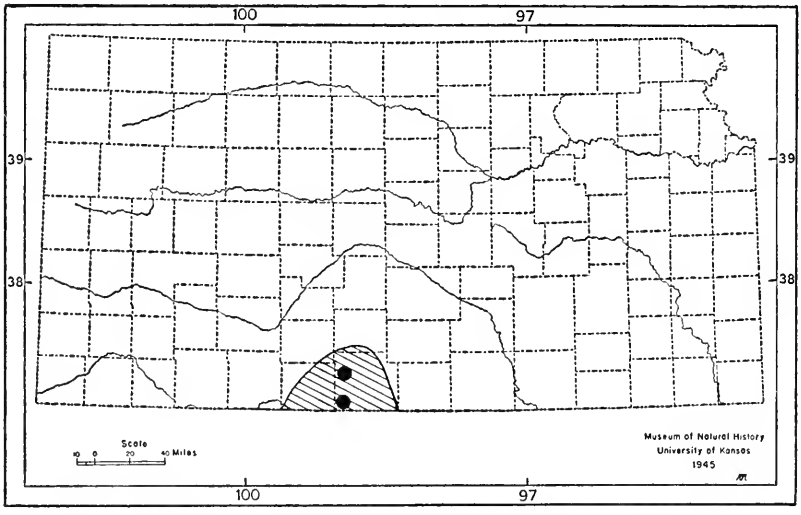

FIG. 19. Distribution of *Antrozous bunkeri* in Kansas. See figure 5 for explanation of symbols.

feet; at this point the ceiling became higher, ranging from 6 to 10 feet. A distance of 168 feet from the south entrance we came upon a group of *Antrozous bunkeri* hanging from the ceiling. As we came nearer to them two bats (*Myotis velifer incautus*) flew from the group into the north end of the tunnel. The bats paid no attention to us. They were closely packed, some hanging to others which were wedged in a crack. As we started collecting them from the ceiling, they attempted to crawl away over the surface, but made no effort to fly, neither did they attempt to bite as did the other bats collected. . . . Twenty-five specimens were collected, consisting of 12 adult females, 10 immature females and 3 immature

males. *Antrozous* was never found again on our collecting trips. The quantity of guano on the floor under the bats indicated that it was their first day in that part of the tunnel. About 20 feet from the north entrance was found a small area of freshly scattered guano belonging to *Antrozous*. It was apparently evident that the bats had only spent two days in this tunnel."

Antrozous bunkeri Hibbard

Antrozous bunkeri Hibbard, Jour. Mamm., 15:227, 1934, type from Natural Bridge, 5½ mi. S Sun City, Barber County, Kansas; Hibbard, Trans. Kansas Acad. Sci., 37:237, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 152, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):23, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:65, 1944.

Antrozous cf. *pacificus*, Hibbard, Trans. Kansas Acad. Sci., 36:234, 1933.

Distribution.—Known only from Barber County. See map, figure 19.

Remarks.—External measurements of 12 adult females from Barber County, are: 122 (115-130); 48 (40-52); 13.5 (12-15); 27.1 (26-28). These are the measurements given by Hibbard (1934:288) in the original description of *Antrozous bunkeri*. General comparisons indicate that *A. bunkeri* is at most subspecifically distinct from *Antrozous pallidus* (Le Conte). Because Bryan Glass is currently studying material from Oklahoma which bears on this point and because Dr. Robert T. Orr expects to make a systematic review of all members of the members of the genus *Antrozous*, I have not attempted at this time to settle the systematic status of *A. bunkeri*.

Specimens examined.—Total, 96, distributed as follows: *Barber County:* 7 mi. S Sun City, 24; 5½ mi. S Sun City, 70; 1 mi. SW Aetna, 2.

Family Molossidae

Free-tailed Bats

Members of this family are characterized by swift flight, short and satiny hair, and short, thick, leathery ears projecting forward over the face. The tail extends conspicuously beyond the interfemoral membrane. This family occurs in the warmer regions of both hemispheres. One genus, *Tadarida*, and two of its species occurs in Kansas.

Genus **Tadarida** Rafinesque

Free-tailed Bats

This genus occurs in the warmer parts of both the Old and New World. Generic characteristics according to Shamel (1931:1-2) include: deep vertical grooves or wrinkles on the upper lip; the

crown of the last upper molar has a definite Z-shape; and the premaxillae are separated between the upper incisors. The dental formula is: i. $\frac{1}{2}$, or $\frac{1}{3}$, c. $\frac{1}{1}$, p. $\frac{2}{2}$, m. $\frac{3}{3}$.

Tadarida mexicana

Mexican Free-tailed Bat

The first record of this species in the state seems to be that of a specimen obtained by C. P. Blachly, at Manhattan, and reported in 1885 by F. W. Cragin under the name "*Nyctinomys nasutus,* Spix., var. *fulginosus* Cooper?". D. E. Lantz (1907A:217) wrote of this specimen: "A proper determination of the specimen [collected at Manhattan by C. P. Blachly], which probably remains in the Washburn College Museum, will add another species to the Kansas list of mammals." Again, in 1908, Lantz (1908:336-337) wrote of this same specimen under the name *Nyctinomus mexicanus*: "The specimen of free-tailed bat collected at Manhattan by Dr. C. P. Beachey [= Blachly] and presented by him to the Washburn College Museum, was forwarded to the Biological Survey in February, 1907, and identified there as the Mexican species. It was submitted also to the judgment of Mr. Gerritt S. Miller, of the United States National Museum, who confirmed the identification."

In 1936, Hibbard (1936:167) apparently having only D. E. Lantz's 1907 report available, wrote: "A careful check was made at the Washburn College Museum in the spring of 1933, and it was found that this specimen [the one collected by C. P. Blachly] was missing."

M. C. Gardner, of the U. S. Fish and Wildlife Service, in reply to a query from me, wrote, in a letter dated May 5, 1948: "A thorough search of both collections here has failed to locate Doctor Blachly's *Tadarida* specimen. It is, however, listed in our identification card file. One mounted specimen from Manhattan, Kansas was identified for C. P. Blachly by Vernon Bailey on February 8, 1907 as *Tadarida mexicana.*"

Hibbard (1933:234) reported: ". . . these bats emerge by the thousands . . . [from Marihew Cave, ½ mile south of the Barber-Comanche Co. line, Woods County, Oklahoma, and swing] . . . northward to feed over the Salt Fork and Medicine rivers in Kansas. It is reported that they feed as far north as the Arkansas River, but I have no proof for this. On the evening of September 6, 1933, hundreds of these bats were observed in the early evening around Atena [= Aetna, Barber County] Kansas. I shot one just

north of the post office." This specimen is number 9315 in the collection of the Museum of Natural History, University of Kansas.

In 1936 Hibbard (1936:167-168) reported established colonies of *Tadarida* in Kansas. Those at Medicine Lodge are still the only colonies known in the state.

Another record worthy of note, is the specimen (no. 11597, UKMNH, skeleton only) taken on 5 September 1936, by Mr. C. D. Bunker, in Lawrence. This specimen was found dead on a street in Lawrence. From the appearance of the bones someone had stepped on the animal. However, in spite of the crushed bones

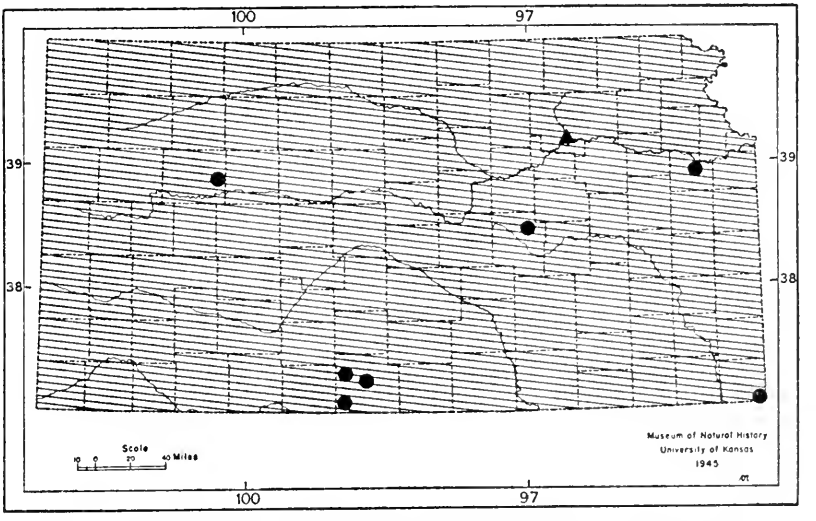

FIG. 20. Distribution of *Tadarida mexicana* in Kansas. See figure 5 for explanation of symbols.

and skull, sufficient diagnostic characters remain to identify the specimen as *Tadarida mexicana*. The teeth of this specimen are extremely worn, much more so than those of any other specimen of the same species in the collection of the University of Kansas.

The Mexican free-tailed bat, throughout most of its range, is colonial in habit and usually inhabits caves, although many smaller colonies have been found in attics and bell towers of buildings. One of the most famous colonies of this bat is the one living in the Carlsbad Cavern in New Mexico. The large number of individuals living here has impressed everyone who has seen the colony. Bailey (1931:378) reported that: "Late in August [1923] . . . they were said to leave the cave each evening in a black cloud visible 2

miles away at early dusk and to continue to pour out of the 50-foot throat of the cave for two hours. The numbers were estimated by millions, and such numbers would be necessary to account for the vast deposits of guano found in the cave."

Because of the concentration of large numbers of this species, many people have been interested in their food habits. Nelson (1926:6) reported that: "These bats are gluttonous feeders, and in some species twenty minutes after their appearance in the evening the stomachs have been found distended with food, the contents averaging one-quarter the weight of the animal. This would imply a capacity for at least half their weight in insects every night." Night-flying moths and beetles form the majority of their food and in one series of examinations conducted by the Division of Food Habits Research [see Storer 1926:86] moths comprised well over 90 percent of the total while: ". . . no mosquito remains whatever were found and indeed only a trace of a single insect of the whole order of Diptera." These results did not support the general belief that these bats destroy mosquitoes and indicated that, at least in the series examined, the Mexican free-tailed bat did not feed on mosquitoes.

Tadarida mexicana (Saussure)

Molossus Mexicanus Saussure, Revue et Magasin de Zoologie, Ser. 2, 12:283, 1860, type from Ameca, Jalisco, Mexico.

Tadarida mexicana, Miller, Bull. U. S. Nat. Mus., 128:86, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:234, 1933; Hibbard, Trans. Kansas Acad. Sci., 37:238, 1934; Black, Jour. Mamm., 16:147, 1935; Hibbard, Jour. Mamm., 17:167, 1936; Black, Kansas State Board Agric., 30th Biennial Rept., p. 152, 1937; Macy, Jour. Mamm., 20:382, 1939; P. B. Allen, State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):24, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:66, 1944.

Nyctinomus sp., Lantz, Trans. Kansas Acad. Sci., 20(2):216, 1907.

Nyctinomus nasutus var. *Fuliginosus*, Cragin, Bull. Washburn College Lab. Nat. Hist., 1:44, 1885.

Nyctinomus mexicanus, Lantz, Trans. Kansas Acad. Sci., 22:336, 1908.

Tadarida cynocephala, Macy and Macy, Jour. Mamm., 20:252, 1939.

Distribution.—Probably occurs rarely in most of the state. See map, figure 20.

Remarks.—External measurements of five males and 12 females, from Medicine Lodge, are: ♂ 94.2 (90-97), ♀ 98.4 (92-105); 35.2 (32-40), 35.1 (32-40); 9 (8-10), 9.2 (8-10); 17 (16-18), 16.5 (13-19).

Specimens examined.—Total, 24, distributed as follows: *Gove County:* Castle Rock, 1. *Douglas County:* Lawrence, 1. *Marion County:* Lincolnville, 1. *Barber County:* Medicine Lodge, 18; Aetna Post Office, 1; 4½ mi. SW Sun City, 2. *Cherokee County:* Galena, 1.

Additional records.—Riley County: Manhattan (see text).

Tadarida molossa

Big Free-tailed Bat

This species occurs in northern South America, on several islands in the Caribbean Sea, and in Western North America. Few individuals have been taken on the mainland of North America, and these from widely separated localities. It has been recorded from British Columbia, Iowa, Nevada, Utah, Colorado, California, Arizona, Texas, and Lower California and Federal District in Mexico.

Tadarida molossa (Pallas)

V[*espertilio*] *Molossus* Pallas, Miscellanea Zoologica, p. 49, 1767, type from "America," not improbably from Surinam.

Nyctinomus macrotis Gray, Am. Nat. Hist., 4:5, 1839, type from the interior of Cuba.

Tadarida macrotis, Miller, Bull. U. S. Nat. Mus., 128:86, 1924.

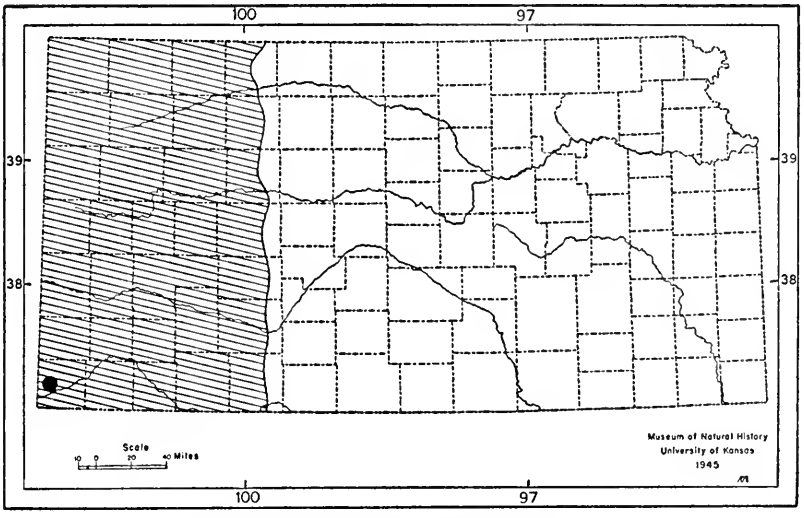

FIG. 21. Distribution of *Tadarida molossa* in Kansas. See figure 5 for explanation of symbols.

Distribution.—Known only from Morton County but may be expected to occur occasionally in any part of the state. See map, figure 21.

Remarks.—One specimen was taken in the fall of 1950, as it was hanging from the inside wall of a silo nine miles north of Elkhart. Eugene White, a high school student, found the bat and took it alive to his biology teacher, Mr. Jim Drake. Mr. Drake saved only the skull and noted: "wingspread 13 inches, length 6 inches."

Specimens examined.—Total, 1, from the following locality: *Morton County:* 9 mi. N Elkhart, 1.

TABLE 6.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF BATS.

Sex	Catalogue number or number averaged	Greatest length	Condylobasal length	Zygomatic breadth	Interorbital constriction	Breadth of braincase	Mandible	Maxillary tooth-row	Maxillary breadth at M3	Mandibular tooth-row
				Myotis lucifugus lucifugus, Douglas County						
♂	11887	14.4	13.9	....	4.2	7.8	....	4.3	5.8	6.6
♂	11886	14.5	13.8	8.9	4.0	7.8	10.6	4.3	5.7	6.8
♂	10282	14.4	13.8	8.8	4.2	7.8	10.3	4.3	5.6	6.5
♀	9183	....	....	9.2	4.3	....	10.9	4.6	5.7	6.8
♀	6498	14.7	14.0	8.9	4.1	7.8	10.7	4.5	5.9	6.8
♀	10927	14.6	13.9	9.1	4.1	7.8	10.6	4.6	5.6	6.8
				M. velifer incautus, Comanche County						
♂	9746	16.8	16.2	10.3	4.5	8.5	13.3	5.5	7.1	8.3
♂	9782	16.9	16.3	....	4.4	8.9	13.0	5.7	7.3	8.5
♂	9783	16.8	16.5	....	4.5	9.0	13.6	5.6	7.0	8.6
♀	9784	17.3	....	....	4.2	8.9	13.3	5.9	7.2	8.5
♀	9745	17.3	16.9	....	4.3	8.7	14.0	5.7	7.1	8.6
				M. subulatus subulatus, Logan County						
♂	5561	14.4	13.7	8.5	3.3	7.1	10.3	4.4	5.5	6.7
♂	5562	14.3	13.8	8.8	3.6	7.5	....	4.5	5.5	....
				Trego County						
♀	5559	14.7	14.2	....	3.4	7.5	10.4	4.5	5.5	6.6
				Lasionycteris noctivagans, Morton County						
?	38927	15.7	15.5	9.7	4.2	8.4	11.6	4.7	6.5	7.0
				Pipistrellus subflavus subflavus, Barber County						
♂	9748	12.3	11.6	7.8	3.6	6.8	9.2	3.6	5.1	5.5
♂	9758	12.9	12.0	....	3.8	6.9	9.3	3.6	5.1	5.6
♂	9312	12.9	12.4	8.0	3.8	7.2	9.6	3.8	5.6	6.0
♀	9749	13.0	12.4	7.9	3.7	7.1	9.7	3.7	5.3	5.9
♀	9314	13.0	12.3	7.9	3.5	7.3	....	3.9	5.4	....
				Eptesicus fuscus pallidus, Medicine Lodge, Barber County						
♂	9	19.6	18.5	12.9	4.5	8.8	13.8	7.3	8.2	7.9
	min.	19.1	18.3	12.6	4.2	8.6	13.5	7.1	7.9	7.6
	max.	20.1	18.8	13.4	4.7	9.4	14.1	7.7	8.5	8.4
♀	9	20.1	18.9	13.2	4.4	8.8	14.3	7.4	8.4	8.1
	min.	19.5	18.1	12.7	4.2	8.7	13.8	7.1	8.1	7.5
	max.	20.6	19.4	13.6	4.6	9.1	15.5	7.6	8.8	8.5
				E. fuscus fuscus, Fort Leavenworth, Leavenworth County						
♂	6	20.1	18.8	13.1	4.5	9.1	14.3	7.3	8.3	7.9
	min.	19.2	17.7	12.4	4.1	8.8	13.8	7.0	7.8	7.7
	max.	20.5	19.2	13.4	4.8	9.5	14.8	7.5	8.5	8.2
♀	13531	20.3	19.3	14.1	4.5	9.2	....	7.6	8.1	8.0
				Nyctecius humeralis humeralis, Douglas County						
♂	22143	14.6	14.0	....	4.1	7.9	10.8	3.9	....	6.5
				Clay County						
♀	12032	14.3	14.1	9.7	4.0	8.1	11.3	4.0	6.3	6.6
♀	12275	....	....	10.1	4.1	....	10.6	4.2	6.5	6.7
♀	12274	14.8	14.4	10.2	4.3	8.2	11.3	4.1	6.6	7.0
				Lasiurus cinereus cinereus, Douglas County						
♂	3174	17.0	17.0	11.9	5.3	9.8	13.0	4.5	8.6	7.9
♀	9218	18.3	18.3	13.0	5.0	10.6	13.7	5.5	8.9	8.4
♀	7344	18.1	18.1	12.8	5.2	10.6	13.8	5.2	8.6	8.0
♀	4471	18.2	18.2	12.9	5.0	10.2	13.1	5.3	8.9	7.9

TABLE 6.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF BATS.—*Concluded*

Sex	Catalogue number or number averaged	Greatest length	Condylobasal length	Zygomatic breadth	Interorbital constriction	Breadth of braincase	Mandible	Maxillary tooth-row	Maxillary breadth at M3	Mandibular tooth-row
				L. borealis borealis, Douglas County						
♂	22145	13.5	13.5	9.5	4.3	7.8	10.3	4.0	6.3	6.5
♂♂	8819	13.9	13.9	9.8	4.5	8.2	10.7	....	....	6.3
♀	4918	13.7	13.7	10.0	4.5	8.3	10.6	3.8	6.6	6.4
♀	4919	13.7	13.7	9.7	4.2	7.8	10.3	3.9	6.4	6.2
♀	4327	13.7	13.7	9.8	4.3	8.3	10.1	4.2	6.9	6.6
				Corynorhynus rafinesquii pallescens, Barber County						
♂	9309	16.0	14.8	8.5	3.6	8.9	10.0	4.1	6.0	6.5
♂	10052	15.9	15.3	8.9	3.7	9.0	10.3	4.5	5.9	6.6
♂	13218	16.7	15.5	....	3.8	9.0	10.9	4.4	5.7	6.2
♀	9694	16.4	15.6	9.2	3.9	9.4	10.5	4.6	6.3	6.9
♀	9699	16.9	15.6	9.1	3.8	9.2	10.9	4.4	6.2	6.7
♀	10050	16.3	15.5	9.0	3.8	9.2	10.7	4.4	6.0	6.8
				Antrozous bunkeri, Barber County*						
♀	12	21.3	19.7	13.5	4.2	9.4	....	7.6	....	....
	min.	20.5	19.0	13.0	4.0	9.0	....	7.2	....	....
	max.	22.0	20.6	14.0	4.5	10.0	....	8.0	....	....
				Tadarida mexicana, Barber County						
♂	9315	17.3	16.5	10.1	4.0	9.5	12.0	4.9	7.2	6.8
♂	11133	17.4	16.7	9.7	4.1	9.3	12.0	4.8	7.0	7.3
♂	11883	....	....	....	4.0	....	11.8	4.8	6.9	7.1
♀	11125	17.0	15.5	9.8	4.1	9.1	11.7	4.6	7.0	7.1
♀	11132	16.7	15.6	....	4.2	9.2	11.8	4.4	6.8	6.9
♀	11885	17.2	15.9	9.9	4.1	9.2	11.3	4.9	7.1	7.2
				T. molossa, Morton County						
?	38926	23.1	21.8	12.3	4.2	11.4	16.5	7.7	8.4	9.9

* Measurements from Hibbard (1934:228).

Order EDENTATA

Sloths, Anteaters and Armadillos

Recent members of this order occur in North and South America. They include the sloths, anteaters, and armadillos.

Genus **Dasypus** Linnaeus

Nine-banded Armadillos

This genus occurs in North and South America. Characteristics include: series of skin-covered bony plates forming hard shield on dorsum; few hairs; strong claws adapted for digging. Dental formula: i. $\frac{0}{0}$, c. $\frac{0}{0}$, p. and m. $\frac{8}{8}$. Teeth simple and peglike.

Dasypus novemcinctus

Nine-banded Armadillo

In the past several years the armadillo has been extending its range northward and eastward from its former northern limits in Texas. Tabor (1939:489-493) summarized the records available at that time and found that the armadillo occurred as far north, certainly, as the Arkansas River, Creek County, Oklahoma. Hamlett (1939:335) reported: "This species has an amazing distribution. It ranges south into northern Argentina . . . extends throughout central America and most of Mexico, and at the present time is spreading north and east in the United States. It has already invaded Oklahoma and Louisiana, at least one has been killed in Kansas. . . ."

The first two records for the armadillo, available for Kansas, are, in my opinion, probably of escapes. The earlier of the two is of an individual taken at an unspecified locality in Osage County on February 12, 1909, by Alexander Wetmore (KU no. 879). In 1910, according to Tabor (1939:490-1), the natural range of the armadillo did not extend much east of the Brazos River in Texas, nor north of Stephens County, Texas.

The second record of the armadillo in Kansas is one reported by Hibbard (1944:87), as follows: "A few years ago an Armadillo was found living in a den in Chase County near Strong, Kansas." I do not know in what year this animal was found, but presumably it was not later than 1939, at which time Tabor (*loc. cit.*) indicated that the armadillo occurred as far north as Creek County, Oklahoma.

There are four more recent records of the occurrence of the armadillo in Kansas: One individual taken four and one-half miles northwest of Caldwell on September 9, 1942 (KU no. 14354), and three reported in 1950, one each from Pratt, Stevens, and Chautauqua counties. Of the specimen taken in Pratt County, Lutz (1950A) wrote: ". . . George Lance, of Iuka brought to the state fish hatchery an armadillo, which he had killed at his farm, 10 miles north of Pratt. . . . This [armadillo] was taken to a taxidermist at Great Bend and when mounted, it will be added to the museum in the fish and game commission's headquarters at Pratt." This animal was killed probably in the first week of August, 1950. Lutz (1950B) also reported the armadillo in Stevens County: "A second armadillo has been reported found in Kansas. The Hugoton *Hermes* reported last week [August 13-19, 1950] that Lloyd Fellers, a farmer living northwest of Hugoton, caught one at his farm." On Decem-

ber 10, 1950, Lew Green, while hunting raccoons at night, shot an armadillo four miles east and three miles north of Sedan.

No observations have been made on the life history and habits of the armadillo in Kansas. Baker's (1943:379-380) study and Kalmbach's study (1943:23-58) of its food habits in Texas, each reveals that insects made up approximately three-fourths of the volume of

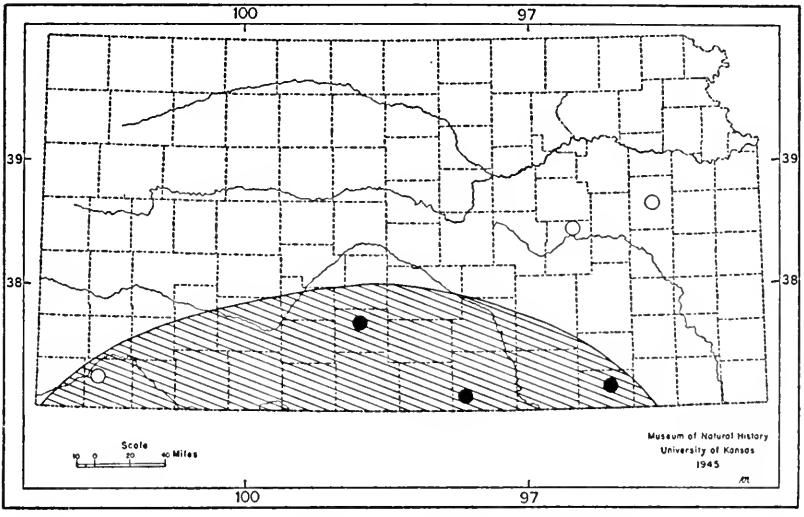

FIG. 22. Distribution of *Dasypus novemcinctus mexicanus* in Kansas. See figure 5 for explanation of symbols.

its food and that other arthropods, earthworms, amphibians, reptiles, and blackberries made up the remainder.

Dasypus novemcinctus mexicanus Peters

Dasypus novemcinctus var. *mexicanus* Peters, Monatsber. k. preuss. Akad. Wissensch. Berlin, p. 180, 1864, type from Matamoros, Tamaulipas, Mexico (see Hollister, 1925:60).

Tatu novemcinctum texanum Bailey, N. Amer. Fauna, 25:52, 1905, type from Brownsville, Cameron County, Texas.

Dasypus novemcinctus texanus, Miller, N. Amer. Land Mamm., 1911, p. 378, 1912; Hibbard, Trans. Kansas Acad. Sci., 47:87, 1944.

Dasypus novemcinctus, Hamlett, Jour. Mamm., 20:335, 1939.

Distribution.—Rare in the southern part of the state. See map, figure 22.

Remarks.—External measurements of a male taken four miles north and three miles east of Sedan are: 693, 254, 107, 40. The weight was 12¼ pounds.

Specimens examined.—Total, 3, distributed as follows: *Osage County:* Unspecified, 1. *Sumner County:* 4½ mi. NW Caldwell, 1. *Chautauqua County:* 4 mi. E, 3 mi. N Sedan, 1.

Additional records.—Chase County: "near Strong", 1 (Hibbard, 1944:87). *Pratt Co.:* Iuka, 10 mi. N Pratt, 1 (Lutz, 1950A). *Stevens Co.:* "NW of Hugoton", 1 (Lutz, 1950B).

Order LAGOMORPHA

Hares, Rabbits, and Pikas

The Lagomorphs, including the hares, rabbits, and pikas, are nearly worldwide in distribution. One of the diagnostic characteristics of this order is the unique arrangement of the upper incisors, of which there are four. The first pair is large; the second pair is small, without cutting edge and nearly circular in outline. Only one (Leporidae) of the two currently recognized living families is found in Kansas. The dental formula of the North American members of this family is: i. $\frac{2}{1}$, c. $\frac{0}{0}$, p. $\frac{3}{2}$, m. $\frac{3}{3}$. The following key will aid in the separation of the species in this family.

1. Hind foot more than 105 mm.; ears more than 90 mm.; interparietals fused with parietals.....2
1′. Hind foot less than 105 mm.; ears less than 90 mm.; interparietals not fused with parietals.....3
2.(1) Top of tail white; postorbital projection of supraorbital process not touching skull; occlusal face of first upper incisor showing a complex infolding from groove on anterior face of tooth, *Lepus townsendii*, p. 97
2′. Top of tail black; postorbital projection of supraorbital process touching skull, leaving an aperature; occlusal face of first upper incisor showing a simple groove on anterior face of tooth, *Lepus californicus*, p. 99
3.(1′) Total length more than 470 mm.; basilar length of skull more than 60 mm.; 5% or all of postorbital projection of the supraorbital process fused to skull, leaving no aperature or at most a small foramen, *Sylvilagus aquaticus*, p. 107
3′. Total length less than 470 mm.; basilar length of skull less than 60 mm.; less than 5% of postorbital projection of the supraorbital process fused to skull, leaving an aperature.....4
4.(3′). Length of ear usually more than 60 mm.; diameter of the auditory meatus more than 37 per cent of the alveolar length of the upper cheek teeth .....*Sylvilagus auduboni*, p. 105
4′. Length of ear usually less than 60 mm.; diameter of the auditory meatus less than 37 per cent of the alveolar length of the upper cheek teeth .....*Sylvilagus floridanus*, p. 101

Rabbits are well known for their ability to reproduce rapidly under favorable environmental conditions. Normally, however, their natural enemies, such as hawks, owls, wolves, coyotes, foxes, wildcats, and human hunters exert a checking effect on the numbers of rabbits. Rabbits in this latitude are subject to multiannual

fluctuations in population levels, regardless of predaceous animals. As rabbit populations approach their peak in numbers, epidemic diseases may check their increase and eventually, often rapidly, severely reduce population levels.

The attitude of the people of Kansas and of their Forestry, Fish and Game Commission toward rabbits has changed much. At one time rabbits were considered to be pests and on March 6, 1877, the Legislature of Kansas passed a law providing for a bounty of five cents for each rabbit scalp presented to the county commissioner. Twenty-five counties, mainly in the eastern part of the state, offered bounties for various periods of time, ranging from 12 days in Douglas County to 404 days in Marion County. The kinds of rabbits on which bounties were paid were not indicated. Table 7 gives a summary of the number and amount of bounties paid and the period in which they were paid. This table is based on information found in the First Biennial Report of the State Board of Agriculture to the Legislature of the State of Kansas for the years 1877-8 (pp. 584-589).

A glance at Table 7 (page 92) provides strong evidence of one of the main evils ascribed to the bounty system as a means of controlling unwanted animals, namely, that animals are presented from nearby areas where the bounty is not provided. Doniphan, Linn, Crawford, and Cherokee counties each paid bounties on 50,000 to 71,064 rabbits in less than one year or on a numerical average of 241.8 rabbits per day in each of the four counties. Doniphan County, in the four months that it paid bounties, paid a total of $1,300.00 on 65,000 rabbits, a numerical average of 537.2 rabbits per day. An examination of the map reveals that each of these counties is on the border of the state. In spite of the law which stated: "No person shall be entitled to receive any bounty . . . without first making it appear by positive proof, by affidavit in writing . . . that the . . . rabbit . . . was killed within the limits of the county in which application is made," it is quite likely that these counties paid bounties on many rabbits which were actually killed in another area; otherwise, for example, Jackson County would be expected to have paid as many bounties as Doniphan. Actually, Jackson County, which is not on the border of the state, paid on only one twelfth as many rabbits per day.

Again in 1885 and 1889 laws were passed authorizing the payment of bounties on rabbits—still at the rate of five cents each. Only 16 counties ordered the payment of bounties. The records of

TABLE 7.—NUMBER AND AMOUNTS OF BOUNTIES PAID ON RABBITS IN VARIOUS COUNTIES IN 1877-8.

COUNTY	Days	Rabbits	Cost	Average number per day
Butler	391	23,539	$1,176.45	60.2
Chautauqua	209	8,700	435.00	41.6
Chase	325	7,102	355.10	21.8
Cherokee	324	70,000	3,500.00	216.0
Crawford	348	50,000	2,500.00	143.7
Doniphan	121	65,000	1,300.00	537.2
Douglas	12	2,850	142.50	237.5
Ellsworth	365	3,535	176.75	9.7
Harvey	335	7,560	378.00	22.5
Jackson	312	13,291	664.55	42.5
Johnson	183	9,432	471.60	51.5
Labette	386	27,896	1,394.80	72.3
Linn	308	71,064	3,553.20	230.7
Lyon	273	17,362	868.10	63.6
Marion	404	2,564	128.20	6.3
McPherson	433	1,926	96.30	4.4
Mitchell	182	5,320	266.00	29.2
Morris	237	5,437	271.85	23.0
Neosho	?	14,000*	700.00	?
Osage	365	6,299	314.95	17.2
Pawnee	104	1,918	95.90	18.4
Riley	273	9,710	485.50	35.5
Wabaunsee	273	14,280	714.00	52.3
Wilson	365	20,470	1,023.50	56.0
Woodson	302	9,133	456.65	30.2
Totals	.....	429,378	$21,468.90	.....

* Estimate.

bounties paid in 1885-89 are incomplete, but Palmer (1897:42) listed the counties that paid bounties on rabbits. Unfortunately, in most counties, no break down as to the amount paid as bounties on each kind of animal was available, to Palmer in 1897 (*op. cit.*) or to me in 1950. In most counties, the bounties paid include payments made on coyotes and animals other than rabbits. Table 8 lists the counties that were reported upon by Palmer, with the dates, and the amounts paid for bounties. One of the most striking facts available from this table is that of the 25 counties that paid bounties on rabbits in 1877-78, only three made any later payments.

Sometime in the last part of the nineteenth century, farmers and hunters began to hunt rabbits for the market. Untold thousands were shipped to markets in the larger cities all over the United States. Unfortunately, no records are available as to the exact numbers that have been shipped from the state. Palmer (1897:

73-4) summarized the market hunting of jackrabbits at that time. "Many jackrabbits are shipped to market from Kansas. Norton, Winona, and other places in the western part of the State send the game to Denver, while from points in central and southern Kansas a good deal is shipped direct to New York and other Eastern cities. A commission merchant in Great Bend, Kans., states that he shipped about 4,200 jackrabbits (350 dozen) during the winter of 1893-94 and about 6,000 (500 dozen) during the winter of 1894-95. . . . A commission merchant writes that his ship-

TABLE 8.—NUMBER AND AMOUNTS OF BOUNTIES PAID ON RABBITS IN VARIOUS COUNTIES IN 1879-1895.

COUNTY	Dates	No. of rabbits	Cost
Barber	1891–1894	?	?
Chase*	1879–1895	72,898	$3,644.90a
Decatur	1890	?	4,024.00
Ford	1891–1893	?	4,472.40
Graham	1894–1895	?	2,807.05
Hamilton	1890–1895	?	1,740.95
Hodgeman	1890–1896	?	4,937.45
Kingman	June-August, 1896	8,000	320.00b
Lane	1893–1894	?	1,552.45
Logan	1890–1891	?	?
Pawnee*	1895	14,333	429.99a
Scott	1890–1895?	?	?
Thomas	1890–1895	?	8,161.25
Trego	1888–1895	148,000	7,400.00c
Wabaunsee*	1880?	?	?
Wichita	1889–1895	36,000	1,800.00c

* Counties that also paid rabbit bounties reported in 1878.
a. Rabbits only, reported here.
b. Rabbits only, bounties paid at rate of four cents each.
c. Rabbits only, the amount of bounties paid is only approximate.

ments from Independence have been increasing gradually during the last few years at the rate of 200 to 300 per year. In the winter of 1894-95 he shipped about 1,600 jack rabbits direct to New York. McPherson County is one of the main shipping centers in the state, and a dealer in Marquette writes that he handled 2,646 jack rabbits last season. . . . Last season the McPherson Produce Company handled 7,927 jack rabbits, and the total shipments from that place average about five carloads, or 20,000 rabbits a season.

"In Kansas large numbers of jack rabbits are killed after heavy snowfalls, and in Chautauqua and Montgomery counties it is said that farmers sometimes bring them in by the wagon load; the hunters usually receive about 10 cents apiece for them. Near McPherson one method of hunting is to stretch a wire between

two wagons about 200 yards apart, and allow it to drag in the grass or stubble as they proceed. As the rabbits are started they are shot from the wagons or by two hunters who follow behind. In this vicinity the prices vary from 15 cents apiece in October, down to 5 cents in January."

Mearns (1890:298) purchased a black-tailed jackrabbit on the market in New York. He found that it was a new kind of jackrabbit and described it as a new species. Of this specimen he wrote (*loc. cit.*): "This is a market specimen, invoiced with several hundred pairs from the above locality [Independence, Kansas], most of which I examined, and which I am informed were doubtless killed on the northern border of Indian Territory. They command a ready sale, in the New York markets, at $1.50 per pair."

In addition to the rabbits that have been sold for food, thousands of live cottontails have been shipped from Kansas to furnish stock for eastern states. Dice (1927:90-96) reported that cottontails from Kansas were introduced into the following states: Connecticut (1925 and 1926), Massachusetts (240 in 1924 and 408 in 1925), Ohio (in 1926), and Pennsylvania (58,404 from Kansas and Missouri in 1924-1925). Such introductions of game animals are often dangerous to the native wildlife; diseases and parasites are often introduced along with the game animals, and may become established in the native wildlife. Chaddock (1938:49-52) reported that an autopsy of 14 specimens of cottontails from Kansas, imported into Wisconsin for restocking purposes, revealed infections of coccidia, tapeworms, flukes, nematodes, and tularemia bacilli. He emphasized the danger of introducing rabbits from other areas into Wisconsin.

The market hunting continued until, as Lunn (1940:78) pointed out: "Because of the fear of tularemia the market for rabbits in the East was seriously injured. Over-supply of the market sent the prices down. In 1927 the commission was authorized to regulate and control the rabbit industry and the rabbit dealers were required to take out a license from the Commission. . . . There was no immediate danger of depletion of the supply of rabbits but the Commission was given the power to regulate in order to prevent the exploitation of the supply. Confidential reports of shipments in 1927 indicate 58,967 cottontails and in 1928 62,791." As recently as 1942, as reported in the Ninth Biennial Report of the Forestry, Fish and Game Commission (1942:17), one Kansas firm shipped nearly 70,000 cottontails to the eastern market. These were live rabbits, being used to restock eastern states.

Last summer (1950) ranchers in Morton and Stanton counties told me of the activities of one group of market hunters who operated in those counties in 1949. These hunters had a small truck, filled with cages and equipped with a platform on the top. One man stood on the platform as the truck moved across the short-grass prairies, and when he spotted a rabbit, he threw a large metal hoop around the rabbit. This hoop had a net attached, thus trapping the rabbit.

The Audubon cottontail, *Sylvilagus audubonii,* is the common cottontail in the southwestern part of the state. Probably it has been introduced into many eastern states, far beyond its native short-grass plains habitat, but, if so, this seems not to have been reported.

No reliable estimates are available as to the numbers of rabbits that are killed each year by the hunters of the state, but several thousand rabbits are killed each year for their fur. The Seventh Biennial Report of the Forestry, Fish and Game Commission (June 30, 1938) indicated that 49,319 rabbits had been sold in the state in one year (1937?) for their fur—the kind of rabbit was not specified.

In recent years the advent of highways and automobiles has resulted in an additional hazard to the rabbits of the state. Robert W. Hankins (unpublished notes) kept a daily record for four months (Sept. 14, 1948, to Jan. 14, 1949) of the animals found dead along state highway no. 10, between Sunflower, Johnson County, and Lawrence, Douglas County, a distance of 14 miles. He saw a total of 133 cottontails and 1 jackrabbit dead on the road. When this figure is multiplied by the many thousands of miles of highways in the state for a year, instead of only 4 months, the factor of highway mortality begins to assume a new significance.

Sprague (1939:110-111) made counts on the number of black-tailed jackrabbits seen dead along U. S. highway 83 from 40 miles south of Garden City to Garden City, Kansas. He counted a total of 175 jackrabbits in the first 33 miles, an average of 5.3 per mile, and a total of 5 jackrabbits in the last 7 miles, an average of .7 per mile. The first 33 miles was through a cultivated area, and the last 7 miles was through a natural, uncultivated area. Sprague (*op. cit.*: 110) thought that: "The rabbits living in the cultivated area were forced, because of the lack of food in the stubble, to resort to the roadside ditches to feed on the vegetation growing there."

Rabbit drives have been held in the state at various times. Some of these drives took a heavy toll of the rabbit population.

Perhaps the most important single factor in the reduction of the rabbit populations in the state is that of land use. In the last seventy years large areas of the prairie lands have been plowed, mainly for wheat. This destruction of the original prairie grasslands has effectively reduced the jackrabbit population, and to a somewhat lesser extent, the cottontail population.

The Biennial reports of the Forestry, Fish and Game Commission for 1938 through 1948 each recommended that the rabbit be considered as a game animal and that a closed season be established and a reasonable bag limit be set. Each of these reports, except the one for the biennium ending 30 June 1942, indicated that the numbers of the rabbits were being greatly reduced and that in many areas there were practically no cottontails.

The Twelfth Biennial Report of the Forestry, Fish and Game Commission issued June 30, 1948, stated that: "What this state needs is a good strong law affording a greater measure of protection to the rabbits and hares, now all but gone from the prairies of Kansas. The decrease in this valuable wildlife resource was the result of several contributing factors, namely, no protecting law, destruction of cover, waste, disease, processing and exporting. The commission could control many of these destructive influences, providing there was a law enacted designating the rabbit and hare as game animals and subject to the rules and regulations of the commission. A bill with that end in view will be presented to the 1949 legislature for your study and consideration."

Under the revised laws of 1949, for the first time, rabbits and hares were declared to be wild game animals. The open season was declared to be December 15 to October 15 inclusive and during the open season of the upland game birds. In effect, this outlawed rabbit hunting in the open season on upland game birds, except on those particular days when game birds could be legally shot.

Genus **Lepus** Linnaeus

Hares

This genus is separated from that of the cottontails, *Sylvilagus*, by larger size, longer ears and hind feet, and by having the interparietal fused with the parietals. It is almost world-wide in occurrence and is represented in Kansas by two species, the white-tailed jackrabbit and the black-tailed jackrabbit.

Within historic times several changes in the distribution of American hares and rabbits have been noted. As early as 1909, Nelson

(1909:20) pointed out that: "The main and most permanent changes in distribution are caused by man. The extension of the farming area in the United States and Canada, deforestation of the country, and destruction of the natural enemies of cottontails, such as birds and beasts of prey, has resulted in considerable permanent extensions of the ranges of several species." An examination of the available records shows that a marked shift has occurred in the range and relative numbers of the two species of jackrabbits in Kansas. In brief, the white-tailed jackrabbit has decreased in range, at present being confined to the northwestern counties of the state, while the black-tailed jackrabbit has become more abundant in the northwestern part of the state. A discussion of these shifts will be found in the account of these two species.

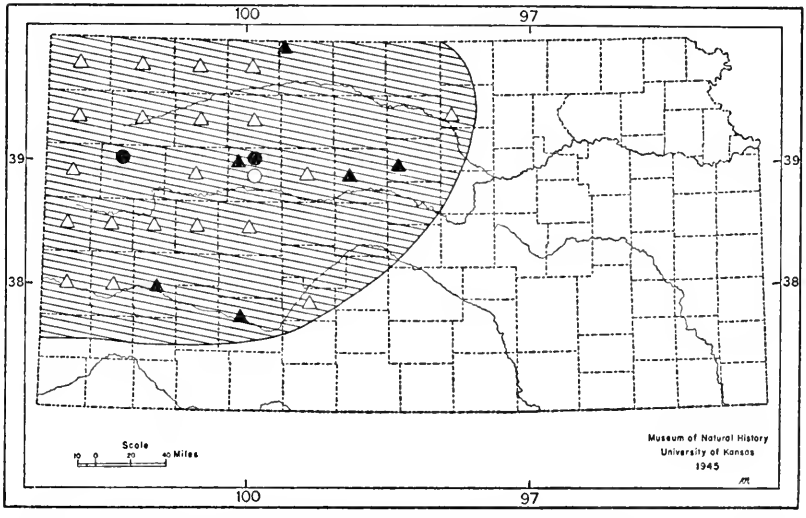

FIG. 23. Distribution of *Lepus townsendii campanius* in Kansas. See figure 5 for explanation of symbols.

Lepus townsendii

White-tailed Jackrabbit

As its common name indicates, the top of the tail is white, in contrast to the black color characterizing the top of the tail of the other species of this genus found in the state. In the mountains and in the northern part of its range this species becomes pure white in winter but in Kansas, as well as other places near the southern part of its range, its coat color is approximately the same throughout the year.

The first record known to me of this species in the state is Baird's

(1858:589) report of a white-tailed jackrabbit from 60 miles northwest of Fort Riley, Kansas Territory. The specimen (U. S. Nat. Mus. no. 1900/2598, original number 47) was taken on June 29, 1856, by W. S. Wood. The white-tailed jackrabbibt was formerly found in a larger part of the state than at present. Palmer (1897: 15) stated that: ". . . on the south it is not found on the plains much below central Kansas and southern Colorado—Fort Riley and Pendennis, Kans. . . . being near its southern limits." Brown summarized several records of occurrence of this species in the state and recorded several observations on its past distribution. He pointed out (1940:385) that: "Evidence shows that there has been a change in the distribution of the white-tailed jackrabbit in Kansas. They were once common, at least in western Kansas, but are now scarce everywhere in the state." Many of the reports cited by Brown are those made by the early settlers of western Kansas, all of which indicate that (1) the white-tailed jackrabbit was formerly found at localities farther south and east than at present and (2) it was formerly more abundant in the northwestern part of the state where it is found in small numbers today and where the black-tailed jackrabbit, formerly rarely seen, is now common.

Brown later pointed out (1947:456) that: "The change in distribution of the two species of jackrabbits in Kansas was gradual. The changes in environmental conditions when man began to break up the prairie and plant crops, especially wheat, seems to be the most reasonable explanation for the decrease in numbers of the white-tailed jackrabbit. The changing of the open prairie to cultivated land seemed to make conditions more favorable for the black-tailed jackrabbit to adapt itself to the new agricultural environment."

According to Asdell (1946:207) the white-tailed jackrabbit breeds in April, and three to six young, usually four, are born in June or early July.

Lepus townsendii campanius Hollister

Lepus townsendii campanius Hollister, Proc. Biol. Soc. Washington, 28:70, 1915, type from Plains of the Saskatchewan, Canada; Dice, Jour. Mamm., 4:111, 1923; Dice, Ecology, 4:51, 1923; Wooster, Trans. Kansas Acad. Sci., 24:112, 1931; Hibbard, Trans. Kansas Sci., 36:246, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 208, 1937; Carter, Trans. Kansas Acad. Sci., 42:431, 1939; Brown, Trans. Kansas Acad. Sci., 43:385, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:84, 1944; Brown, Trans. Kansas Acad. Sci., 49:455, 1947.

Lepus campestris, Baird, Mamm. N. Amer., p. 589, 1858; J. A. Allen, Bull. Essex Inst., 6:52, 1874; Coues, Monograph N. Amer. Rodentia, p. 301, 1877; Baker, Trans. Kansas Acad. Sci., 11:58, 1889; J. A.

Allen, Bull. Amer. Mus. Nat. Hist., 7:264, 1895; Palmer, U. S. Dept. Agric., Div. Biol. Surv. Bull., 8 (revised): 14, 1897; Merriam, Proc. Biol. Soc. Washington, 17:131, 1904; Lantz, Trans. Kansas Acad. Sci., 19:176, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905; Elliott, Field Columbian Museum, Publ. 115, Zool. Series, 8:385, 1907; Lantz, Trans. Kansas Acad. Sci., 22:336, 1908; Nelson, N. Amer. Fauna, 29:78, 1909.

L[epus] campestris, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Distribution.—At present occurs only rarely in the northwestern part of the state; formerly ranged over most of the grasslands of western Kansas east at least to Cloud County and south into Ford County. See map, figure 23.

Remarks.—No reliable external measurements are available for specimens taken in Kansas in the collection of the University of Kansas Museum of Natural History.

Nelson (1909:74) listed two specimens from Lawrence, Douglas County, which he referred to this species, and indicated that these specimens were in the United States National Museum. At my request Henry W. Setzer, Associate Curator of Mammals at the United States National Museum, checked the identification of these two specimens (skulls only) and discovered that they are actually *Lepus californicus.*

Specimens examined.—Total, 7, distributed as follows: *Logan County:* Winona, 5. *Trego County:* Wakeeney, 1; Unspecified, 1.

Additional records.—Cheyenne County: Unspecified (Brown, 1940:389). *Rawlins County:* Unspecified (Brown, 1940:389). *Decatur County:* Unspecified (Brown, 1940:389). *Norton County:* Unspecified (Brown, 1940: 389). *Phillips Co.:* Long Island (Nelson, 1909:78). *Sherman County:* Unspecified (Brown, 1940:389). *Thomas County:* Unspecified (Brown, 1940:389). *Sheridan County:* Unspecified (Brown, 1940:389). *Graham County:* Unspecified (Brown, 1940:389). *Cloud Co.?:* 60 miles northwest Fort Riley (Baird, 1858:589); Republican Fork, 60 mi. W [northwest?] Fort Riley (Coues, 1877:302); Red Fork, 60 mi. W [northwest?] Fort Riley (Nelson, 1909:78). *Wallace County:* Unspecified (Brown, 1940:389). *Gove County:* Unspecified (Brown, 1940:389). *Trego Co.:* Coyote Station (Coues, 1877: 303). *Ellis County:* Unspecified (Wooster, 1931:112). *Russell County:* Russell (Brown, 1940:386). *Lincoln County:* Sylvan Grove (Brown, 1940: 388). *Greeley County:* Unspecified (Brown, 1940:389). *Wichita County:* Unspecified (Brown, 1940:389). *Scott County:* Unspecified (Brown, 1940: 389). *Lane County:* Unspecified (Brown, 1940:389). *Ness County:* Unspecified (Brown, 1940:389). *Hamilton County:* Unspecified (Brown, 1940:389). *Kearny County:* Unspecified (Brown, 1940:389). *Finney Co.:* Garden City (Nelson, 1909:78). *Ford County:* Dodge City (Brown, 1940: 386). *Edwards County:* Unspecified (Brown, 1940:389).

Lepus californicus

Black-tailed Jackrabbit

Only one subspecies of the black-tailed jackrabbit occurs in Kansas; it is probably state wide in distribution. As indicated by the common name, the dorsal surface of the tail is covered by black hairs. This one characteristic separates the two kinds of

jackrabbits occurring in Kansas. The total length of the black-tailed jackrabbit is approximately two feet; the tail comprises approximately three inches of this total.

According to Asdell (1946:207) this species may have several litters per year; these are born between April and August. One to seven young are born in each litter, the numerical average being 4.1. Palmer (1897:28) reported that young were born in March,

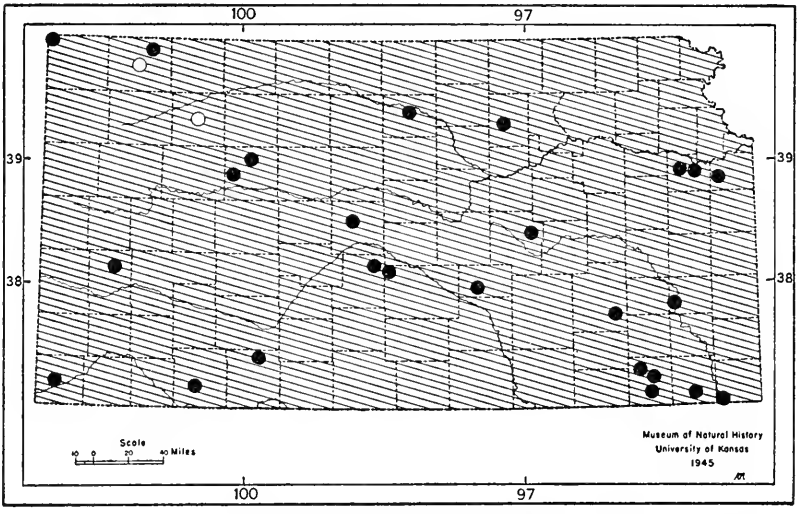

FIG. 24. Distribution of *Lepus californicus melanotis* in Kansas. See figure 5 for explanation of symbols.

July, and September at three different localities in Kansas. Michael Justice reports (personal communication) that he has taken rabbits of this species in February in Cowley County which contained almost full term embryos.

Lepus californicus melanotis Mearns

Lepus melanotis Mearns, Bull. Amer. Mus. Nat. Hist., 2:297, 1890, type from Independence, Montgomery County, Kansas; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:264, 1895; Palmer, U. S. Dept. Agric., Div. Biol. Surv. Bull., 8 (revised):14, 1897; Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:182, 1901; Lantz, Trans. Kansas Acad. Sci., 19:176, 1905; Elliot, Field Columbian Mus., Publ. 115, Zool. Series, 8:380, 1907; Lantz, Trans. Kansas Acad. Sci., 22:336, 1908.

Lepus californicus melanotis, Nelson, N. Amer. Fauna, 29:148, 1909; Dice, Ecology, 4:51, 1923; Dice, Jour. Mamm., 4:112, 1923; Linsdale, Jour. Mamm., 9:146, 1928; Wooster, Trans. Kansas Acad. Sci., 34:112, 1931; Hibbard, Trans. Kansas Acad. Sci., 36:246, 1933; Wooster, Trans. Kansas Acad. Sci., 38:351, 1935; Black, Kansas State Board Agric., 30th Biennial Rept., p. 209, 1937; Sprague, Jour. Mamm., 20:110, 1939; Carter, Trans. Kansas Acad.

Sci., 42:431, 1939; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:508, 1939; Wooster, Trans. Kansas Acad. Sci., 42:515, 1939; Wooster, Trans. Kansas Acad. Sci., 43:302, 1940; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; Riegel, Trans. Kansas Acad. Sci., 44:96, 1941; Riegel, Trans. Kansas Acad. Sci., 45:369, 1942; Hibbard, Trans. Kansas Acad. Sci., 47:85, 1944; Brown, Trans. Kansas Acad. Sci., 50:28, 1947; Brumwell, Amer. Midland Nat., 45:214, 1951.

L[epus] melanotis, Lantz, Kansas State College Exp. Sta. Bull., 129: 336, 1905.

Lepus callotis, J. A. Allen, Bull. Essex Inst., 6:52, 1874.

L[epus] callotis, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Lepus callotis texianus, Baker, Trans. Kansas Acad. Sci., 11:58, 1889.

L[epus] texianus, Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Distribution.—State-wide, see map, figure 24.

Remarks.—Measurements of one adult male and one adult female, respectively, from Montgomery County are: 567, 510; 68, 60; 130, 125; 109, 150.

Specimens examined.—Total, 58, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 2. *Rawlins County:* 2 mi. NE Ludell, 2; Unspecified, 1. *Sheridan County:* Unspecified, 1. *Mitchell County:* 5 mi. W, ½ mi. S Beloit, 1. *Clay County:* 6 mi. SW Clay Center, 5. *Trego County:* Wakeeney, 4; Banner, 2; Perrington Ranch, 1. *Douglas County:* Lawrence, 2; 2 mi. SW Lawrence, 1; 3 mi. SW Lawrence, 1; 2½ mi. S Lawrence, 1; Clinton, 1. *Johnson County:* Prairie Center, 1. *Barton County:* 3 mi N, 2 mi. W Hoisington, 2. *Marion County:* 4 mi. SE Lincolnville, 2. *Kearney County:* 15 mi. N, 1 mi. E Lakin, 1. *Stafford County:* Little Salt Marsh, 6. *Reno County:* 5 mi. NE Little Salt Marsh, 1. *Harvey County:* Halstead, 2. *Greenwood County:* 8 mi. SW Toronto, 2. *Allen County:* 2 mi. N, ½ mi. W Neosho R. bridge, Humboldt, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 6. *Meade County:* Rexroad Ranch, 1. *Clark County:* 7 mi. S Kingsdown, 1. *Montgomery County:* 6 mi. NW Independence, 1; Independence, 3; 5 mi. S Independence, 1. *Labette County:* 10 mi. SW Oswego, 1. *Cherokee County:* 18 mi. SW Columbus, 1.

Genus Sylvilagus Gray

Cottontails and Allies

This genus differs from *Lepus,* in smaller size, shorter ears and hind feet, and interparietal not fused, instead of fused, with the parietals. In Kansas there are three species of *Sylvilagus,* the swamp rabbit, the Florida cottontail, and the Audubon cottontail.

Sylvilagus floridanus

Florida Cottontail

Four subspecies of the Florida cottontail occur in Kansas. According to Asdell (1946:205) this rabbit breeds from mid-January into August, in which time they produce a number of litters. The gestation period is 26.5 to 30 days and the average litter size is 4.5 with a range from 2 to 7.

The cottontail is subject to great fluctuations in population level which varies from year to year, and at any one time from area to area. Such fluctuations are influenced in part by food and cover and in part by a long-term cyclic pattern of population levels.

The average length of life of a cottontail in nature is unknown. Specimen No. 4309 in the University of Kansas Museum of Natural History was captured as a young rabbit in June, 1914, and held captive until its death on January 17, 1924, almost ten years later.

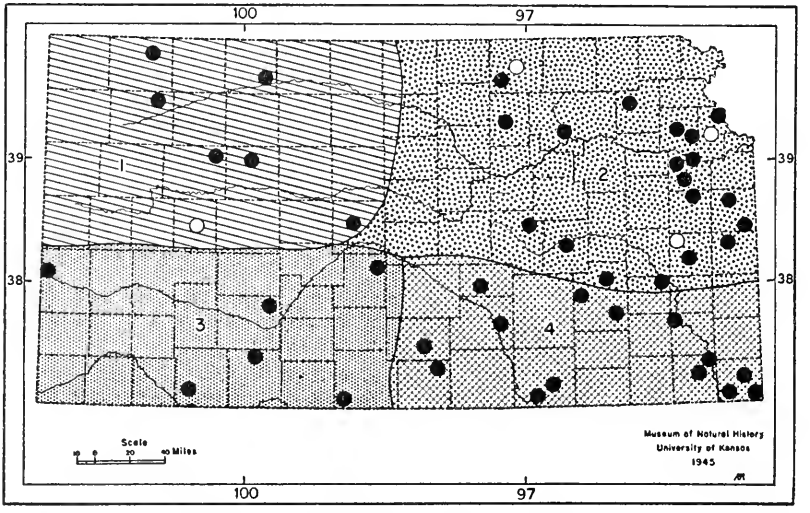

FIG. 25. Distribution of *Sylvilagus floridanus* in Kansas. 1. *S. f. similis.* 2. *S. f. mearnsii.* 3. *S. f. llanensis.* 4. *S. f. alacer.* See figure 5 for explanation of symbols.

The cottontail is a favorite game animal in most eastern states. Its life history has been extensively investigated (see Hendrickson, 1938, 1939, 1940, 1943, 1943B, and others), especially from the standpoint of increasing populations to withstand the increased hunting pressure in recent years. Until recently, Kansas has not been confronted with this problem. With increased hunting pressure in the future and further land utilization for crops, information on how to maintain the population level will become necessary in Kansas.

Sylvilagus floridanus similis Nelson

Sylvilagus floridanus similis Nelson, Proc. Biol. Soc. Washington, 20:82, 1907, type from Valentine, Cherry County, Nebraska; Lantz, Trans. Kansas Acad. Sci., 22:336, 1908; Nelson, N. Amer. Fauna, 29:174, 1909; Hibbard, Trans. Kansas Acad. Sci., 36:246, 1933; Black, Kansas State Board of Agric., 30th Biennial Rept., p. 212, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:85, 1944.

Sylvilagus floridanus mearnsi, Wooster, Trans. Kansas Acad. Sci., 42:515, 1939; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; Brown, Trans. Kansas Acad. Sci., 50:28, 1947.

Lepus floridanus alacer, Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:370, 1907.

Lepus sylvaticus bachmani, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:264, 1895.

Sylvilagus floridanus, Wooster, Trans. Kansas Acad. Sci., 43:302, 1940.

Distribution.—Northwestern part of the state, east certainly to Norton and Barton counties and south certainly to Lane County. See map, figure 25.

Remarks.—External measurements of five males and one female, respectively, from Norton County are: 393.8 (376-410), 425; 48.0 (42-55), 54; 96.2 (95-98), 98; 59.8 (57-65), 62; ear, crown 68.6 (65-73), 70.

Specimens examined.—Total, 16, distributed as follows: *Rawlins County:* 2 mi. NE Ludell, 2. *Norton County:* 5 mi. W, 1 mi. N Logan. *Thomas County:* 10 mi. N, 6 mi. E Colby, 1. *Gove County:* 5 mi. E Quinter, 1 (GCR). *Trego County:* Wakeeney, 4. *Lane County:* Unspecified, 1. *Barton County:* 3 mi. N, 2 mi. W Hoisington, 1.

Sylvilagus floridanus mearnsii (J. A. Allen)

Lepus sylvaticus mearnsii J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:171, 1894, type from Fort Snelling, Hennepin County, Minnesota.

Sylvilagus floridanus mearnsi, Lyon, Smiths. Misc. Coll., 45:336, 1904; Lantz, Trans. Kansas Acad. Sci., 22:336, 1908; Nelson, N. Amer. Fauna, 29:172, 1909.

Sylvilagus floridanus mearnsii, Dice, Ecology, 4:45, 1923; Dice, Jour. Mamm., 4:112, 1923; Linsdale, Jour. Mamm., 9:146, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:246, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 210, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:85, 1944; Brumwell, Amer. Midland Nat., 45:214, 1951.

Lepus floridanus mallurus, Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:368, 1907.

Lepus sylvaticus, Allen, Bull. Essex Inst., 6:52, 1874; Knox, Trans. Kansas Acad. Sci., 4:22, 1875; Coues, Monograph N. Amer. Rodentia, p. 333, 1877; Baker, Trans. Kansas Acad. Sci., 11:58, 1889.

Lepus floridanus mearnsi, Lantz, Trans. Kansas Acad. Sci., 19:176, 1905.

L[epus] floridanus mearnsi, Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Distribution.—Northeastern part of the state, west certainly to Washington County, south certainly to Marion and Woodson counties and east to Linn County. See map, figure 25.

Remarks.—External measurements of 15 males and seven females from Douglas County are: ♂ 406.3 (375-445), ♀ 430.3 (388-460); 60.3 (39-72), 60.0 (50-75); 96.0 (85-105), 96.1 (90-108); 55.2 (52-58), 61.0 (60-63).

Specimens from Hamilton and Neosho Falls are intermediate between *S. f. mearnsi* and *S. f. alacer,* but tend slightly toward the former.

Specimens examined.—Total, 122, distributed as follows: *Washington County:* Strawberry, 1; Unspecified, 1. *Clay County:* 4 mi. SW Clay Center, 3; 6 mi. SW Clay Center, 3. *Riley County:* Manhattan, 1. *Jackson County:* 2 mi. S, 10 mi. W Holton, 1. *Jefferson County:* 2⅓ mi. E Ozawkie, 1; 16 mi. N Lawrence, 1. *Leavenworth County:* Ft. Leavenworth, 3; Unspecified, 2. *Douglas County:* 5 mi. NE Lawrence, 1; 4 mi. NE Lawrence, 1; 1 mi. W Lawrence, 2; Lawrence, 14; 3 mi. S Lawrence, 1; 7 mi. SW Lawrence, 1; 7½ mi. SW Lawrence, 12; 11 mi. SW Lawrence, 3; Clinton, 1; Unspecified, 14. *Marion County:* 1 mi. N, ½ mi. E Lincolnville, 1. *Chase County:* 3 mi. E, 4 mi. S Cottonwood Falls, 1. *Franklin County:* 2 mi. S LeLoup, 4. *Anderson County:* Harris, 1; 6 mi. SW Garnett, 1; 4 mi. W, ½ mi. S Welda, 11. *Miami County:* 6 mi. N Paola, 24; 5 mi. SE Fontana, 2; 7 mi. SW Springhill, 1. *Linn County:* 6 mi. SW Fontana, 1. *Greenwood County:* Hamilton, 3 (GCR); 3½ mi. SE Hamilton, 1 (GCR). *Woodson County:* Neosho Falls, 4.

Sylvilagus floridanus llanensis Blair

Sylvilagus floridanus llanensis Blair, Occas. Papers Mus. Zool. Univ. of Michigan, 380:1, 1938, type from Old "F" Ranch Headquarters, Quitaque, Briscoe County, Texas; Hibbard, Trans. Kansas Acad. Sci., 47:85, 1944.

Sylvilagus floridanus alacer, Nelson, N. Amer. Fauna, 29:176, 1909 (part, that part from Garden Plain); Tihen and Sprague, Trans. Kansas Acad. Sci., 42:509, 1939.

Distribution.—Southwestern part of the state, north certainly to Hamilton County and east certainly to Stafford and Barber counties. See map, figure 25.

Remarks.—External measurements of two males from Clark County and one female from Meade County are: ♂, 385, 405, ♀ 430; 50, 50, – –; 95, 95, 101; 53, 60, 58.

Specimen no. 10067 in the University of Kansas Museum of Natural History from one mile south of Aetna shows characters intermediate between *S. f. llanensis* and *S. f. alacer*, but is referable to the former. Of three specimens from Stafford County, one (KU no. 4489) shows characters of *S. f. llanensis*, a second (KU no. 5619) is intermediate and the third (KU no. 5547) shows characteristics of *S. f. alacer* except in the color of the sides, which is as in *S. f. llanensis*. One specimen (KU no. 12968) from Hamilton County shows characteristics of *S. f. similis* in the color of the nape of the neck. Two other specimens from the same county show little evidence of intergradation with *S. f. similis* but are referable to *S. f. llanensis*.

Specimens examined.—Total, 25, distributed as follows: *Hamilton County:* Coolidge, 3; 1 mi. E Coolidge, 2. *Stafford County:* Little Salt Marsh, 9. *Ford County:* 2 mi. N Bellefont, 2. *Meade County:* 13 mi. SW Meade, 2; State Park, 14 mi. SW Meade, 1 (GCR). *Clark County:* 7 mi. S Kingsdown, 3; 7 mi. SW Kingsdown, 1. *Barber County:* 1 mi. S Aetna, 1; 1 mi. NE Aetna, 1.

Sylvilagus floridanus alacer (Bangs)

Lepus sylvaticus alacer Bangs, Proc. Biol. Soc. Washington, 10:136, 1896, type from Stilwell, Boston Mountains, Adair County, Oklahoma; Lantz, Trans. Kansas Acad. Sci., 19:176, 1905.

Sylvilagus floridanus alacer, Lyon, Smiths. Misc. Coll., 45:336, 1904; Nelson, N. Amer. Fauna, 29:176, 1909; Hibbard, Trans. Kansas Acad. Sci., 36:246, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 212, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:85, 1944.

L[epus] floridanus alacer, Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Distribution.—Southeastern part of the state, north certainly to southern Greenwood County and Harvey County and west certainly to Kingman and Harper counties. See map, figure 25.

Remarks.—External measurements of three males and one female from Labette County are: ♂ 390 (374-400), ♀ 395; 55.6 (52-60), 56; 91.3 (89-93), 84; 56.6 (51-63), 56.

Specimens from Kingman County show some characteristics of *S. f. llanensis* but are referable to *S. f. alacer.*

Specimens examined.—Total, 63, distributed as follows: *Harvey County:* Halstead, 6; 1 mi. S, ½ mi. E Halstead, 2; Unspecified, 10. *Greenwood County:* 4 mi. S, 14 mi. W Hamilton, 1; Vinegar Hill, 1; 8 mi. SW Toronto, 3; 8½ mi. SW Toronto, 5. *Neosho County:* 3 mi. N Chanute, 2. *Kingman County:* Rago, 14. *Sedgwick County:* Wichita, 2. *Harper County:* 8 mi. NE Harper, 1. *Cowley County:* 5 mi. N, 11 mi. E Arkansas City, 1; 3 mi. SE Arkansas City, 1. *Labette County:* 10 mi. E, 1½ mi. N Parsons, 4; 6¾ mi. SE Parsons, 600 ft., 1. *Cherokee County:* 4 mi. SE Columbus, 2; 8 mi. SW Columbus, 2; 18 mi. SW Columbus, 1; 1 mi. S, 4¾ mi. E Baxter Springs, 2; Unspecified, 2.

Sylvilagus audubonii

Audubon Cottontail

Two subspecies of the Audubon cottontail occur in Kansas. Both are found only in the western part of the state. This species is found throughout western United States and south into Mexico. It differs from *Sylvilagus floridanus* in that the auditory bullae are more inflated, the diameter of the external auditory meatus is greater, the lower incisors are more procumbent, and the walls of the posterior nasal foramen are constricted. Externally *S. audubonii* and *S. floridanus* are similar.

According to Asdell (1946:208) this species may breed all year but does so mostly between June and October. Two young are born after a gestation period of 28 to 30 days.

One specimen in the collection of the University of Kansas Mu-

seum of Natural History, taken on July 14, 1938, at a point 13 miles southwest of Meade, contained three embryos.

Sylvilagus audubonii baileyi (Merriam)

Lepus baileyi Merriam, Proc. Biol. Soc. Washington, 11:148, 1897, type from Spring Creek, east side of Bighorn Basin, Bighorn County, Wyoming.

Sylvilagus audubonii baileyi, Miller, U. S. Nat. Mus. Bull., 128:473, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:246, 1933; Hibbard, Trans. Kansas Acad. Sci., 47:85, 1944.

Sylvilagus auduboni baileyi, Lantz, Trans. Kansas Acad. Sci., 22:336, 1908; Nelson, N. Amer. Fauna, 29:232, 1909; Black, Kansas State Board Agric., 30th Biennial Rept., p. 213, 1937.

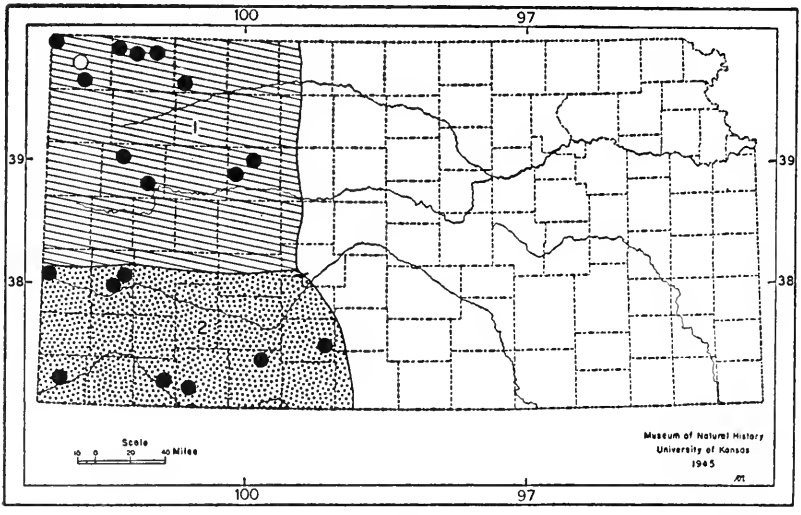

FIG. 26. Distribution of *Sylvilagus audubonii* in Kansas. 1. *S. a. baileyi.* 2. *S. a. neomexicanus.* See figure 5 for explanation of symbols.

Distribution.—Northwestern part of the state, as far south as Logan County and east as far as Decatur and Trego counties. See map, figure 26.

Remarks.—External measurements of two males and three females, from five miles west of Elkader, are: ♂ 382 (365-399), ♀ 363 (359-370); 55.5 (54-57), 49 (44-57); 90 (88-92), 87.6 (85-90); 67 (66-68), 64 (59-69).

Specimens examined.—Total, 25, distributed as follows: *Cheyenne County.* 19 mi. N Goodland, 1; 23 mi. NW St. Francis, 2; Unspecified, 1. *Rawlins County:* 7 mi. NW Atwood, 1; 27 mi. W Atwood [= 7 mi. N, 16½ mi. W Atwood], 2; 2 mi. NE Ludell, 3. *Decatur County:* 12½ mi. S, 4 mi. W Oberlin, 1. *Logan County:* Winona, 1; 5 mi. W Elkader, 8. *Trego County:* Wakeeney, 2; Banner, 1; Castle Rock, 2.

Sylvilagus audubonii neomexicanus Nelson

Sylvilagus auduboni neomexicanus Nelson, Proc. Biol. Soc. Washington, 20:83, 1907, type from Fort Sumner, Guadalupe County, New Mexico; Lantz, Trans. Kansas Acad. Sci., 22:336, 1908; Nelson, N. Amer. Fauna, 29:236, 1909; Black, Kansas State Board Agric., 30th Biennial Rept., p. 213, 1937.

Sylvilagus audubonii neomexicanus, Miller, Bull. U. S. Nat. Mus., 128:473, 1924; Dice, Jour. Mamm., 10:227, 1929; Hibbard, Trans. Kansas Acad. Sci., 36:246, 1933; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:508, 1939; Hibbard, Trans. Kansas Acad. Sci., 47:86, 1944.

Lepus arizonae minor, Lantz, Trans. Kansas Acad. Sci., 19:176, 1905.

L[epus] arizonae minor, Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Distribution.—Southwestern part of the state, north certainly to Hamilton County and east to Kiowa County. See map, figure 26.

Remarks.—External measurements of two males and four females from Meade County, are: ♂ 402.5 (400-405), ♀ 389 (370-401); 49.5 (48-51), 52.7 (48-61); 90.5 (90-91), 88.2 (82-93); 62 (59-65), 64.7 (63-66).

Specimens examined.—Total, 23, distributed as follows: *Hamilton County:* 2 mi. E, 1 mi. N Coolidge, 1; 1 mi. E, ½ mi. S Coolidge, 1; 1 mi. E Coolidge, 1. *Kearny County:* 2½ mi. S, 2½ mi. W Larkin, 1; 13 mi. N, 2 mi. E Larkin, 1. *Kiowa County:* Rezeau Ranch, 5 mi. N Belvidere, 2. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 5. *Seward County:* 1 mi. E Arkalon, 2. *Meade County:* 13 mi. SW Meade, 4; Meade Co. State Park, 4. *Clark County:* 7 mi. S Kingsdown, 1.

Sylvilagus aquaticus

Swamp Rabbit

The swamp rabbit lives in the wet bottomlands along the Neosho River and tributaries in the southeastern part of the state. It is readily distinguished from the cottontail by its larger size, its short, sleek fur, and its thin-haired tail. Little is known of the habits of this rabbit in the state, where local hunters refer to it as the "market rabbit" and are well aware of its larger size. The swamp rabbit is approximately twenty-two inches in total length of which the tail makes up approximately two and one-half inches.

The presence of swamp rabbits in an area is revealed by the presence of piles of fecal pellets on suitable logs. During times of high water in overflow areas, swamp rabbits spend a good part of their time on such logs, and, according to hunters' reports, are never found more than a mile from the nearest swamp. When startled they run directly toward the swamp to escape enemies. I have personally seen this rabbit take readily to water while attempting to escape an enemy, although it usually retreats into a thick briar patch adjacent to the swampy area.

According to Asdell (1946:207) this species has two litters a year, each with one to six young.

Sylvilagus aquaticus aquaticus (Bachman)

Lepus aquaticus Bachman, Jour. Acad. Nat. Sci. Philadelphia, 7:319, 1837, type from western Alabama.

Sylvilagus aquaticus aquaticus, Miller, Bull. U. S. Nat. Mus., 128:479, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:246, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 214, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):52, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:86, 1944.

Distribution.—Known only from the bottomlands of the Neosho River and its tributaries in the southeastern part of the state. See map, figure 27.

Remarks.—External measurements of four males and two females from Labette County are: ♂ 506 (490-539), ♀ 514, 528; 59 (54-64), 67, 68; 109.2 (108-110), 108, 108; 74.2 (70-77), 77, 76; ear, crown, 83.5 (80-88), 84, 87.

Specimens examined.—Total, 22, distributed as follows: *Crawford County:* Unspecified, 4. *Labette County:* 10 mi. E, 1½ mi. N Parsons, 6. *Cherokee County:* 18 mi. SW Columbus, 11; ½ mi. NE Baxter Springs, 800 ft., 1.

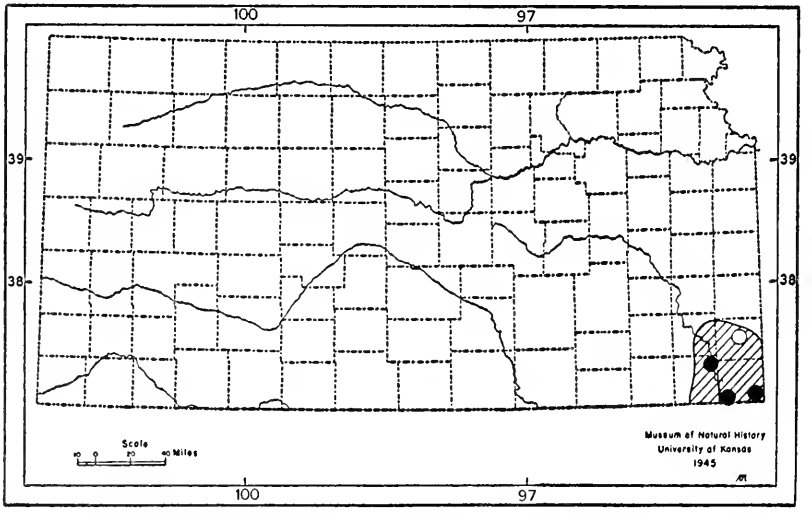

FIG. 27. Distribution of *Sylvilagus aquaticus aquaticus* in Kansas. See figure 5 for explanation of symbols.

TABLE 9.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF LEPORIDS.

Sex	Catalogue number	Basilar length	Zygomatic breadth	Postorbital constriction	Length of nasals	Width of nasals	Length of upper molar series	Diameter of auditory meatus	Breadth of braincase	Length palatal bridge
				Lepus townsendii campanius, Winona, Logan County						
♂	1163	73.3	42.6	12.9	39.7	18.8	16.9	6.0	30.7	5.8
♂	1164	71.3	44.1	12.4	39.7	18.7	17.5	5.8	32.2	5.4
♀	1165	68.5	45.4	15.5	38.1	19.0	16.8	5.5	32.6	6.2
♀	1161	70.0	44.3	14.6	37.8	20.4	17.3	5.8	32.2	5.1
				Lepus californicus melanotis, Little Salt Marsh, Stafford County						
♂	5551	74.2	44.7	11.4	41.1	20.9	17.8	6.2	31.9	6.5
♂	4497	74.3	41.8	11.7	40.4	19.5	18.3	6.4	30.1	6.9
♀	4494	74.7	42.0	10.9	38.0	17.8	16.8	6.2	29.9	5.4
♀	5498	71.5	42.5	11.9	....	....	15.7	6.1	30.5	6.9
				Sylvilagus floridanus similis, Norton County						
♂	5	52.6[3]	34.8[4]	11.8	29.5	13.0	14.0	4.7	26.5[4]	6.5
	max.	54.7	35.8	12.6	31.2	15.1	15.3	5.0	27.5	7.2
	min.	49.3	33.3	10.9	28.5	12.3	12.5	4.3	25.4	5.8
♀	18863	54.6	35.1	11.3	31.7	13.8	13.8	....	27.6	6.4
				Sylvilagus f. mearnsi, Douglas County						
♂	15	56.03	35.8	12.2	32.2	14.6	14.4	4.5	26.7	6.6
	max.	58.9	37.5	13.8	33.6	17.2	14.9	5.0	28.2	7.7
	min.	51.4	33.8	11.0	28.4	12.5	13.4	4.3	25.2	5.4
♀	4	54.8	35.4	11.5	29.9	14.4	13.8	4.6	26.2	6.4
	max.	57.0	35.8	12.3	25.8	15.8	15.1	5.3	26.8	6.8
	min.	52.4	35.1	11.1	31.8	13.3	11.9	4.3	25.2	6.0
				Sylvilagus f. llanensis, Clark County						
♂	4	53.9[3]	34.8	12.4	30.9	14.5	14.0	4.4	26.2[3]	6.3
	max.	54.6	35.2	13.9	31.9	15.1	14.4	4.7	26.7	6.9
	min.	53.3	34.5	11.2	30.2	14.0	13.5	4.1	25.9	6.0
				13 mi. SW Meade, Meade County						
♀	13207	55.4	38.3	13.8	30.8	15.8	15.3	4.5	27.3	6.1
♀	12962	57.6	37.2	12.3	32.8	15.8	15.5	4.6	27.8	6.8
				Sylvilagus f. alacer, 10 mi. E, 1½ mi. N Parsons, Labette County						
♂	18896	54.1	35.5	12.8	31.1	14.4	13.8	4.8	27.0	6.9
♂	18897	52.6	33.7	11.7	30.0	14.3	14.5	4.3	24.7	6.5
♀	18899	54.1	36.8	16.0	24.7	12.6	13.6	4.6	27.3	8.5
				Sylvilagus auduboni baileyi, Cheyenne County						
♂	10975	56.1	35.2	11.5	28.3	15.4	13.5	5.5	26.3	6.3
♂	10974	51.7	35.0	11.3	27.0	12.7	12.7	5.4	26.3	5.0
♀	12401	53.9	34.3	11.7	30.0	13.5	12.0	5.7	25.2	5.7
				Sylvilagus auduboni neomexicanus, Morton County						
♂	5517	52.3	34.9	11.8	29.8	14.3	13.6	5.1	26.4	5.9
♀	5621	52.6	35.1	11.7	29.1	14.2	13.2	5.3	25.8	5.5
♀	5437	54.8	36.1	11.1	28.8	13.0	13.0	5.0	26.3	6.1
				Sylvilagus aquaticus aquaticus, Crawford County						
♂	9127	66.5	....	....	33.3	14.7	16.8	4.5	28.8	9.5
♀	8826	69.5	41.2	16.4	37.5	15.9	17.5	4.8	28.7	8.9

Superscript numbers indicate number actually averaged.

Order RODENTIA

Rodents

The rodents, or "gnawers," are by far the largest group of mammals, both in numbers of kinds and in numbers of individuals. Their teeth are functionally adapted for gnawing: the incisors are reduced to one on each side, both above and below, and are chisel-like, and grow continuously throughout life; the canines and at least the anterior premolars are absent, resulting in a wide space (diastema) between the incisors (gnawing teeth) and the cheek teeth (grinding teeth).

The rodents are world wide in distribution, being found on all continents and on most islands, from sea level to mountain tops, in cities, country, forests, plains, and deserts. They range in size from four feet long (South American capybara) to only two inches long (mice). The smaller species are often extremely abundant, sometimes, under unusual conditions, reaching population levels of several hundred individuals of one species per acre. There are approximately 6,300 species of rodents living in the world today.

The following key will aid in the separation of the eight families of rodents found in Kansas.

1. Body and tail without quills; facial opening of infraorbital canal smaller than foramen magnum.....2
1'. Body and tail with quills; facial opening of infraorbital canal larger than foramen magnum.....ERETHIZONTIDAE, p. 216
2.(1) Hair on middle of tail longer than the diameter of fleshy part of the tail at that point; skull with well developed postorbital processes on frontal bones.....SCIURIDAE, p. 111
2'. Hair on middle of tail shorter than the diameter of fleshy part of the tail at that point; skull without postorbital processes on frontal bones 3
3.(2') External, fur-lined cheek pouches present; auditory bulla longer than crown surface of upper cheek teeth and longer than incisive foramina 4
3'. External, fur-lined cheek pouches absent; auditory bulla shorter than crown surface of upper cheek teeth or shorter than incisive foramina and usually shorter than each.....5
4.(3) Tail more than ¾ length of head and body; claws on forefeet less than 1¾ as long as those on corresponding toes on hind feet; nasals projecting much beyond incisors; auditory bulla exposed on parietal face of skull.....HETEROMYIDAE, p. 144
4'. Tail less than ¾ length of head and body; claws on forefeet more than 1¾ as long as those on corresponding toes of hind feet; nasals even with or projecting barely beyond incisors; auditory bulla not exposed on parietal face of skull.....GEOMYIDAE, p. 136

5.(3′) Tail flattened dorsoventrally; incisive foramen shorter than first two upper cheek teeth.....CASTORIDAE, p. 154
5′. Tail not flattened dorsoventrally; incisive foramen longer than first two upper cheek teeth.....6
6.(5′) Tail equal to or less than the length of head and body; cheek teeth ⅔.....7
6′. Tail longer (by ⅕) than head and body; cheek teeth ⅓ (in Kansas).....ZAPODIDAE, p. 213
7.(6) Annulations on tail nearly or completely concealed by hair; cheek teeth with cusps (or prisms that remain when cusps are worn down) in two longitudinal rows.....CRICETIDAE, p. 158
7′. Annulations on tail revealed by sparce hairiness; cheek teeth with cusps in three longitudinal rows.....MURIDAE, p. 207

Family Sciuridae

Squirrels

Most members of this family are diurnal and feed chiefly on seeds and nuts. The woodchucks, ground squirrels, chipmunks, tree squirrels, flying squirrels, and prairie dogs are examples. The following key will aid in the separation of the genera and species, of this family, which are found in Kansas.

1. Hind foot more than 75 mm.; postorbital process at right angle to long axis of skull.....*Marmota monax*, p. 117
1′. Hind foot less than 75 mm.; postorbital process projecting downward and backward.....2
2.(1′) Fold of skin on side between fore- and hind-leg; diameter of external auditory meatus amounting to length of the occlusal surfaces of 2½ or more upper molars.....*Glaucomys volans*, p. 132
2′. No loose fold of skin on side between fore- and hind-leg; diameter of external auditory meatus amounting to less than the length of the occlusal surfaces of 2½ upper molars.....3
3.(2′) Hind foot more than 61 mm.; crown of second upper molar as long as wide.....4
3′. Hind foot less than 61 mm.; crown of second upper molar wider than long.....5
4.(3) Lateral hairs on tail tipped with white; upper P3 usually present, *Sciurus carolinensis*, p. 112
4′. Lateral hairs on tail not tipped with white; upper P3 absent, *Sciurus niger*, p. 114
5.(3′) Under parts white; always striped above; upper P3 absent, *Tamias striatus*, p. 130
5′. Under parts grayish red; striped or mottled or plain above; upper P3 present.....6
6.(5′) Tail less than 25 per cent of total length; upper molar rows strongly convergent posteriorly; upper P3 enlarged, complex, with 4 ridges, *Cynomys ludovicianus*, p. 119
6′. Tail more than 25 per cent of total length; upper molar rows not strongly convergent posteriorly; upper P3 simple, peglike.....7

7.(6′) Total length more than 325 mm.; upper molariform tooth-row more than 8.5 mm. ..... *Citellus franklinii*, p. 128
7′. Total length less than 325 mm.; upper molariform tooth-row less than 8.5 mm. 8
8.(7′) Upper parts striped; postorbital constriction less than 12 mm., *Citellus tridecemlineatus*, p. 122
8′. Upper parts with indistinct spots; postorbital constriction more than 12 mm. ..... *Citellus spilosoma*, p. 126

Genus Sciurus Linnaeus

Tree Squirrels

This genus occurs in Europe, Asia, and North and South America. In North America, tree squirrels of this genus occur from the northern United States south through Mexico into Central America. Two species occur in Kansas.

Sciurus carolinensis

Gray Squirrel

This large tree squirrel has a local distribution in the eastern part of the state. It is generally grayish, tinged with pale rusty brown on the middle of the back. The hairs of the tail are tawny brown

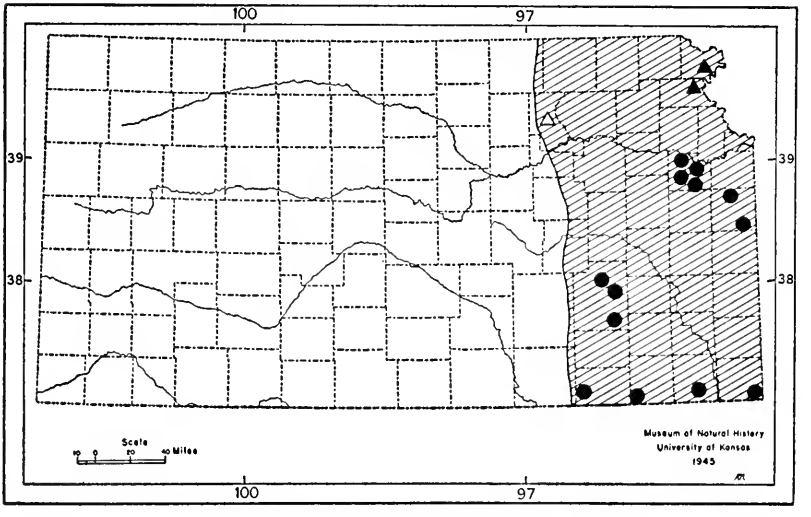

FIG. 28. Distribution of *Sciurus carolinensis carolinensis* in Kansas. See figure 5 for explanation of symbols.

at the base, banded with black and broadly tipped with white. The dental formula is: i. $\frac{1}{2}$, c. $\frac{0}{0}$, p. $\frac{2}{1}$, m. $\frac{3}{3}$. The first premolar is not always present and when present is very small and peglike.

Gray squirrels spend most of their time in trees, coming to the

ground only to collect and bury nuts. In eastern Kansas they are found in the few remaining stands of oak-hickory woods, rarely venturing into the open. As pointed out by Hamilton (1943:229-30) their distribution: ". . . coincides strikingly with that of the oak, chestnut and hickory forests. It is evident that their mainstay is the mast of these nut trees. In addition, the gray squirrel feeds on a multitude of swelling buds, various fruits and berries, an occasional insect and perhaps now and then a young bird."

The gray squirrels mate in mid-winter. After a gestation period of approximately 44 days, the young are born in hollow trees or in a nest of leaves high in the tree. A second litter is usually produced in the late summer. From three to six young are born in a litter. Three young, two females and one male, were collected on April 28, 1898, at Lawrence and are in the collection of the University of Kansas Museum of Natural History.

Sciurus carolinensis carolinensis Gmelin

[Sciurus] carolinensis Gmelin, Syst. Nat., 1:148, 1788, type from "Carolina".

Sciurus carolinensis carolinensis, True, Proc. U. S. Nat. Mus., 7 (1884):595, 1885; Dice, Jour. Mamm., 4:111, 1923; Linsdale, Jour. Mamm., 9:143, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:239, 1933; Black, Kansas State Board Agric., 30th Biennnal Rept., p. 179, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):34, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:74, 1944; Brumwell, Amer. Midland Nat., 45:211, 1951.

Sciurus carolinensis, Baird, Mamm. N. Amer., p. 262, 1858; Lantz, Trans. Kansas Acad. Sci., 19:173, 1905.

S[ciurus] carolinensis, Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905.

S[ciurus] Carolinensis, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Disribution.—Eastern part of the state, west certainly to Riley County. See map, figure 28.

Remarks.—External measurements of five males from Douglas County, are: 450.8 (425-464), 198.0 (184-212), 63.2 (61-66), 32.0 (28-33).

Specimens examined.—Total, 39, distributed as follows: *Douglas County:* Lecompton, 3 (USBS); Lawrence, 6; 7 mi. SW Lawrence, 1; 7½ mi. SW Lawrence, 6; 12½ mi. S, 1½ mi. W Lawrence, 1; Unspecified, 5. *Miami County:* 9 mi. N Paola, 1; 7 mi. SW Springhill, 1; 5½ mi. SE Fontana, 1. *Greenwood County:* 4 mi. NE Hamilton, 1 (GCR); 1 mi. SW Hamilton, 1 (GCR); 1 mi. SE Hamilton, 1 (GCR); 9 mi. SE Hamilton, 2 (GCR); West Creek, 10 mi. SE Hamilton, 4 (GCR); 5 mi. NW Fall River, 1. *Chautauqua County:* Cedar Vale, 1 (USBS). *Montgomery County:* 4 mi. N Caney, 1. *Labette County:* 10 mi. SW Oswego, 1. *Cherokee County:* Baxter Springs, 1.

Additional records.—Doniphan County: Geary, (Linsdale, 1928:143). *Riley County:* Unspecified, (Dice, 1923:111). *Leavenworth Co.:* Fort Leavenworth (Baird, 1858:262).

Sciurus niger

Fox Squirrel

This is the common tree squirrel of Kansas. With the possible exception of some of the western counties, it now (1951) is state wide in distribution. The general reddish or fulvous color, which is mixed with grizzled grayish on the backs and sides, serves to distinguish the fox squirrel from the gray squirrel. The broad tips on the tail hairs and the tufts behind the ears are fulvous, not whitish as they are in the gray squirrel. The dental formula, i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$, serves as a further aid in distinguishing between this and the gray squirrel; the gray squirrel usually has two upper premolars.

The fox squirrel spends much of its time on the ground where it searches for food. The list of foods taken by the fox squirrel is

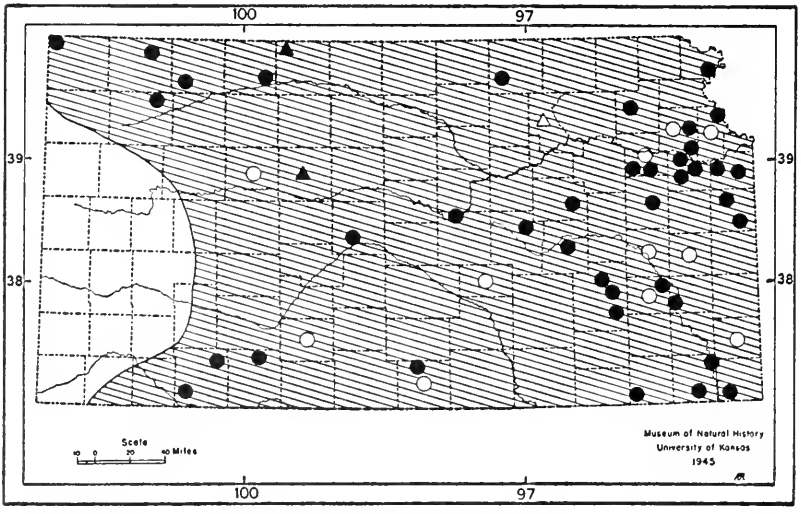

FIG. 29. Distribution of *Sciurus niger rufiventer* in Kansas. See figure 5 for explanation of symbols.

extensive and naturally varies with the habitat of the individual. Nuts, seeds, buds, mushrooms, bird's eggs, young birds, fruits, and corn are but a few of the items taken. Whitaker (1939:117) recorded the use of the seeds of Osage orange (*Maclura pomifera*) in eastern and central Kansas. Bugbee and Riegel (1945:199-203) studied the seasonal food choices of the fox squirrel at Hays, Ellis County. They found that in the late summer and fall the food included: hackberry nipplegalls, cedar berries, pods of the honey locust, walnuts, bark of Russian olive tree, and seeds of the wild

gourd. In the summer, petiole galls on cottonwood and hackberry seeds were taken whereas in the winter and spring, elm seeds and buds and fruits of the Russian olive were eaten. The authors concluded with the statement that: "This short list is enough to show that the fox squirrel is able to utilize a variety of materials for food in an area where oaks are absent and nut-bearing trees in general are scarce or non-existent. It is able to thrive on a somewhat different diet than is found farther east."

The summer home of the fox squirrel is a loosely built shelter of leaves but in the fall they move to a cavity in a tree or construct a substantial nest of leaves, twigs, and branches. These winter nests are often used for many years.

Mating usually occurs in January and two to four young are born in late February or early March.

Sciurus niger rufiventer Geoffroy

Sciurus rufiventer Geoffroy, Catal. Mamm. Mus. Nat. Hist., Paris, p. 176, 1803, type from Mississippi Valley; Lantz, Trans. Kansas Acad Sci., 19:176, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Elliot, Field Columbian Mus., Publ. 115, Zool. Ser. 8:124, 1907.

Sciurus niger rufiventer, Osgood, Proc. Biol. Soc. Washington, 20:44, 1907; Dice, Ecology, 4:45, 1923; Linsdale, Jour. Mamm., 9:143, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:239, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 179, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:507, 1939; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):35, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:74, 1944; Bugbee and Riegel, Trans. Kansas Acad. Sci., 48:199, 1945; Brumwell, Amer. Midland Nat., 45:211, 1951.

Sciurus niger, Bryant, Amer. Midland Nat., 33:264, 1945.

Sciurus ludovicianus, Baird, Mamm. N. Amer., p. 253, 1858; Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Sciurus niger ludovicianus, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:270, 1895.

Sciurus cinereus var. *Ludovicanus*, J. A. Allen, Bull. Essex Inst., 6:49, 1874.

Sciurus macroura Say, Long's Exped. to Rocky Mts., 1:115, 1823, type from northeastern Kansas (see Lowery and Davis, 1942:162).

Distribution.—Probably occurs in suitable habitats in most of the state. See map, figure 29.

Remarks.—External measurements of four males and three females from Douglas County are: ♂ 507.0 (460-564), ♀ 516, 506, 545; 222.7 (180-240), 245, 239, 251; 69.2 (64-73), 65, 66, 75; 27.7 (24-30), 28, 26, 30.

Specimens examined.—Total, 157, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 2. *Rawlins County:* 2 mi. NE Ludell, 2. *Decatur County:* 6 mi. S, 6 mi. W Oberlin, 1; 8 mi. S, 5 mi. W Oberlin, 2. *Norton County:* 5 mi. W, 1 mi. N Logan, 3; 4 mi. W, 1 mi. S Logan, 1. *Wash-*

ington County: Strawberry, 1. *Doniphan County:* Geary, 2. *Thomas County:* 10 mi. N, 6 mi. E Colby, 2. *Jackson County:* 10½ mi. WSW Holton, 3. *Jefferson County:* 16 mi. N Lawrence, 1; 8 mi. N Lawrence, 1; Unspecified, 1. *Leavenworth County:* Ft. Leavenworth, 2; Unspecified, 8. *Trego County:* Unspecified, 1. *Morris County:* Council Grove, 1. *Shawnee County:* Auburn, 7; Wakarusa, 5; Unspecified, 3. *Osage County:* 3.5 mi. S, ½ mi. W Linden, 1. *Douglas County:* Lakeview, 2, ½ mi. W Lawrence, 1; ¼ mi. W Lawrence, 1; Lawrence, 16; 3 mi. E Lawrence, 1; 9 mi. E Lawrence [by road?], 1; 7 mi. SW Lawrence, 1; 7½ mi. SW Lawrence, 7; Washington Creek, 5; 9 mi. S KU Campus, 1; Unspecified, 17. *Johnson County:* 1 mi. W De Soto, 1; Olathe, 1; Unspecified, 1. *Barton County:* 5½ mi. N, 1½ mi. W Great Bend, 1. *McPherson County:* Smoky Hill River, 1 mi. S, ½ mi. W Lindsborg, 1. *Marion County:* 1½ mi. NE Lincolnville, 1; 1 mi. SE Lincolnville, 1. *Chase County:* 1 mi. E, .5 mi. N Courthouse, Cottonwood Falls, 1. *Coffey County:* Unspecified, 1. *Anderson County:* Unspecified, 1. *Miami County:* 1 mi. N, 3 mi. E Fontana, 1; 6 mi. N Paola, 4. *Harvey County:* Unspecified, 4. *Greenwood County:* Willow Creek, 4 mi. N Hamilton, 3 (GCR); 2 mi. W Hamilton, 1 (GCR); Hamilton, 2 (GCR); ½ mi. S Hamilton, 1 (GCR); 2½ mi. SE Hamilton, 1 (GCR); 3 mi. SE Hamilton, 2 (GCR); Willow Creek, 8 mi. SE Hamilton, 1 (GCR); 10 mi. SE Hamilton, 1 (GCR); 8 mi. SW Toronto, 2. *Woodson County:* Neosho Falls, 1; Unspecified, 1. *Allen County:* 1 mi. N, 1 mi. W Humboldt, 1. *Kiowa County:* Unspecified, 1. *Crawford County:* Unspecified, 1. *Meade County:* 2 mi. N, ¼ mi. W Fowler, 1; 2 mi. N Fowler, 3; 1 mi. N, ¼ mi. E Fowler, 1; 14 mi. SW Meade, 1. *Clark County:* 7 mi. SW Kingsdown, 1. *Harper County:* 6½ mi. NW Harper, 1; Unspecified, 1. *Montgomery County:* 4 mi. N Caney, 1. *Labette County:* 10 mi. E Parsons, 1; 10 mi. SW Oswego, 2. *Cherokee County:* 8 mi. SW Columbus, 2; 9 mi. SW Columbus, 1.

Additional records.—Phillips Co.: Long Island, 4 (Allen, 1895A:270). *Riley County:* Unspecified (Dice, 1923A:45). *Ellis County:* Hays (Bugbee and Riegel, 1945:199).

TABLE 10.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF SCIURUS.

Sex	Number averaged or catalogue number	Greatest length	Basilar length	Zygomatic breadth	Nasal length	Alveolar length of upper tooth-row	Width of rostrum	Width across posterior tongues of premaxillary	Mastoidal breadth	Least interorbital constriction	Postorbital breadth
					Sciurus niger rufiventer, Douglas County, Kansas						
♂	5	64.3	49.8	36.6	21.4	11.6	10.5	16.9	28.1	18.6	20.1
	min.	60.7	47.0	34.9	20.0	11.0	9.0	16.4	27.1	17.7	20.1
	max.	66.0	51.5	37.6	22.6	12.2	11.2	17.6	28.9	19.0	20.1
♀	8058	65.1	50.9	37.2	22.3	12.1	11.7	18.5	27.8	18.9	20.0
♀	6038	62.6	48.4	34.2	19.6	11.4	9.6	16.4	26.7	17.6	19.1
♀	5132	66.4	50.9	37.7	22.6	11.8	10.4	16.2	29.3	19.3	21.3
					Sciurus carolinensis carolinensis, Douglas County, Kansas						
♂	5	61.1	46.7	33.8	20.5	11.0	....	14.7	26.3	17.6	16.6
	min.	60.2	46.2	32.2	19.2	10.7	....	14.1	26.9	16.2	17.7
	max.	63.3	47.8	34.6	21.9	11.4	....	15.5	25.4	18.1	19.4
♀	128	62.0	48.2	35.0	20.1	11.8	....	15.7	26.6	17.7	18.5
♀	136	64.0	49.9	34.6	21.4	11.6	....	15.4	26.8	17.9	18.8
♀	135	61.5	47.1	35.4	19.6	11.1	....	15.1	27.5	17.9	18.5

Genus **Marmota** Frisch

Marmots and Woodchucks

This genus occurs in North America, Europe, and Asia. One species of this genus occurs in Kansas, and it is by far the largest member of the squirrel family found in the state. Large size, up to 25 inches in length, and the heavy, compact body (five to ten pounds) supported by relatively short, powerful legs, readily distinguish the woodchuck from the other rodents in the state. Its dental formula is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{2}{1}$, m. $\frac{3}{3}$.

Marmota monax

Woodchuck

The woodchuck is adapted for digging. The front foot has four well-developed toes with long, slightly curved claws (the pollex is small, and high on the foot), the ears are small, and the tail is

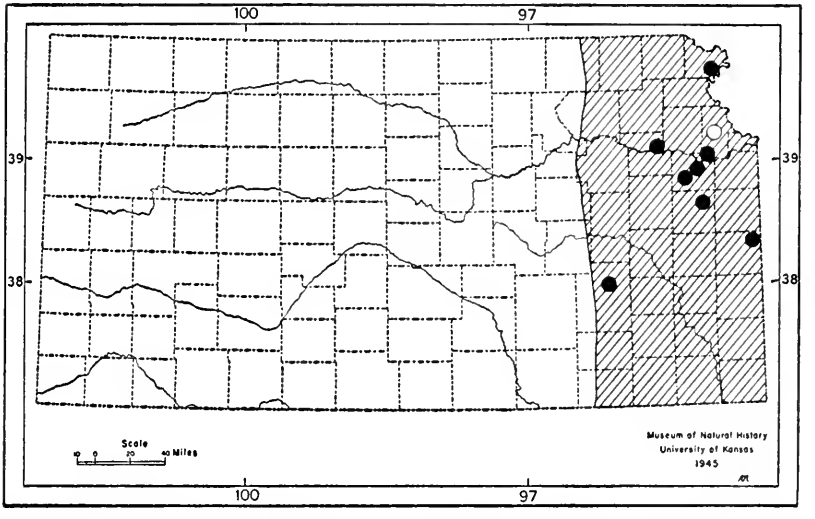

FIG. 30. Distribution of *Marmota monax bunkeri* in Kansas. See figure 5 for explanation of symbols.

short. Its home is an extensive burrow in the ground, often with two or more entrances which in many instances are beneath large stones or tree stumps. The burrow may extend to a depth of five to six feet and for 30 or more feet horizontally. One or more of the tunnels terminate in an enlarged chamber where a bulky grass nest is situated. Although not an aquatic animal, the woodchuck

can swim. Johnson (1923:106-107) observed one swimming leisurely across Wakarusa Creek, in Douglas County.

The woodchuck is a diurnal animal, being most active in the early morning and late afternoon. In spring and summer it spends much time eating green vegetation and storing up fat so that it may spend the winter in hibernation. The food includes a great variety of native grasses and plants as well as cultivated crops such as corn, clover, and alfalfa. In September or October the woodchuck disappears for the winter, remaining in the den until early March.

Mating occurs in March and April and the young, two to eight in number, usually four or five, are born in April or May after a gestation period of approximately four weeks. As described by Burt (1946:175): "The naked, blind young are about the size of an adult pine vole (*Pitymys*) at birth, weigh twenty-six grams, and are one hundred and five millimeters long, the tail being sixteen millimeters long."

Marmota monax bunkeri Black

Marmota monax bunkeri Black, Jour. Mamm., 16:319, 1935, type from seven miles southwest of Lawrence, Douglas County, Kansas; Black, Kansas State Board Agric., 30th Biennial Rept., p. 172, 1937; Swenk, Jour. Mamm., 19:352, 1938; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):30, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:72, 1944; Brumwell, Amer. Midland Nat., 45:210, 1951.

Marmota monax monax, Howell, N. Amer. Fauna, 37:25, 1915; Linsdale, Jour. Mamm., 9:142, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:238, 1933.

Marmota monax, Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Bryant, Amer. Midland Nat., 33:263, 1945.

Marmotta monax [sic], Lantz, Trans. Kansas Acad. Sci., 19:173, 1905.

Arctomys monax, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Distribution.—Eastern part of the state, west certainly to Shawnee County. See map, figure 30.

Remarks.—External measurements of nine males and five females from Douglas County, are: ♂ 614.0 (555-653), ♀ 613.0 (596-650); 142.5 (105-189), 128.2 (102-160); 92.4 (85-96), 88.7 (83-93); 32.3 (30-35), 29.8 (26.5-33). Weights of three males and one female from Douglas County, are: ♂ 7 lbs. 15 ozs., 8 lbs. 6 ozs., 9 lbs. 12 ozs.; ♀ 8 lbs. 6 ozs.

TABLE 11.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF MARMOTA.*

Sex	Number averaged	Condylobasal length	Palatal length	Post palatal length	Length of nasals	Zygomatic breadth	Greatest mastoid breadth	Least interorbital breadth	Breadth of rostrum	Maxillary tooth-row
				Marmota monax bunkeri, Douglas County						
♂	11	98.2	57.1	36.7	42.1	66.5	48.2	27.9	22.3	22.0
	min.	94.0	55.5	34.0	40.0	65.0	46.8	26.2	20.5	20.0
	max.	101.0	59.3	39.0	44.0	69.2	50.5	29.5	23.5	23.0
♀	7	98.5	57.9	36.1	42.5	66.1	47.0	27.7	22.3	22.2
	min.	95.0	56.0	35.5	41.6	64.5	45.5	27.0	20.6	21.0
	max.	100.5	59.5	37.2	42.7	66.8	49.0	30.0	23.7	23.0

* Measurements given by Black (1935:320).

Specimens examined.—Total, 58, distributed as follows: *Doniphan County:* Geary, 2; Doniphan Lake, 3. *Leavenworth County:* 7 mi. NE Lawrence, 1; Unspecified, 1. *Shawnee County:* 2½ mi. N Topeka, 1. *Douglas County:* 1 mi. N Lawrence, 1; 2 mi. W Lawrence, 1; 1½ mi. W KU Campus, Lawrence, 1; Lawrence, 8; Wakarusa Creek, Haskell Farm, 1; 3½ mi. S Lawrence, 2; 7 mi. SW Lawrence, 4; 7½ mi. SW Lawrence, 11; Washington Creek, 1; Horseshoe Lake, 1; Unspecified, 12. *Franklin County:* LeLoup, 1. *Linn County:* 5½ mi. SE Fontana, 2. *Greenwood County:* 2 mi. NE Hamilton, 1 (GCR); Hamilton, 3 (2, GCR).

Genus Cynomys Rafinesque

Prairie Dog

One species of this North American genus occurs in Kansas. The prairie dog is well known in the state. This medium-sized, robust, short-legged, and short-tailed rodent is readily distinguished from the other Kansan squirrels by its short, black-tipped tail and its pinkish-buff coat that is slightly grizzled with black. The dental formula is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{3}{1}$, m. $\frac{3}{3}$. The males are slightly larger than the females, reaching a total length of 14 to 16 inches. The tail is only three to four inches long.

Cynomys ludovicianus

Prairie Dog

The prairie dog inhabits open grasslands, and is always social. The animals live in a group of burrows called a "town." In a study of a small prairie-dog town, occupying an area of approxi-

mately 20 acres in the upper Solomon Valley, Scheffer (1938:391) found that there were 334 burrow openings in the colony, and by repeated observations, found that the total population "must have been close to 100—an average of five to the acre, one to every 3 1/3 open holes." He noted a few cases in which four to six animals, old and young, occupied a single burrow.

Prairie dogs cannot live in soft ground or tall grass. Overgrazing of pastures and the packing of the soil by cattle directly contribute to the increase of prairie dogs by improving their habitat. A striking example of this was pointed out by Mead (1885:92): "The

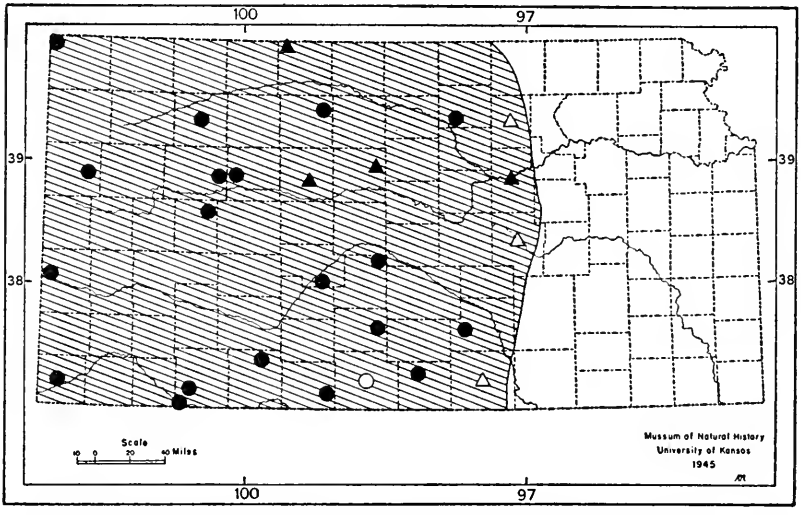

FIG. 31. Distribution of *Cynomys ludovicianus ludovicianus* in Kansas. See figure 5 for explanation of symbols.

great Chisholm Texas cattletrail through the Indian Territory, a hundred yards wide, became a Dogtown almost its entire distance."

In 1899, Mead, in recording some natural history notes of 1859, reported (1899:281) that: "The divide between the Saline and Solomon [rivers] in Ellsworth county and west was a continuous dog town for miles. . . . Prairie-dogs, except a few remnants, disappeared. The foot of the buffalo was necessary for their existence. As soon as the ground ceased to be tramped hard and the grass and weeds grew they perished."

Overgrazing of the range lands in western Kansas led to an increase in the prairie dogs. Merriam (1901:264) described the conditions as follows: "A cattle ranch in Logan County, Kans., which ten years ago pastured a thousand head of cattle, will barely support

500 at present, owing to the great increase in prairie dogs, which have overrun the range. Practically the whole of the southern half of Logan County is now one continuous dog town, estimated to cover about 300 square miles. In the past decade the population of this area has decreased, a post-office (Elkader) has been abolished, and many homes have been vacated, the result, it is said, of the great increase in prairie dogs."

Blades, stems, and basal portions of low grasses form most of the food of the prairie dog, but at times they also dig up and devour the roots and branches. For this reason farmers and ranchers wage war against the prairie dog, especially when it lives in pastures. Vernon Bailey (1931:122) stated that: "The drain thus put upon the grazing capacity of land occupied by numerous prairie-dog towns has been variously estimated at 50 to 75 per cent of its value for stock."

Man has destroyed many of the prairie dog towns, either directly by the use of poison baits and gas or indirectly by the cultivation of the prairies. According to Scheffer (1910B:219): "Under the provisions of an act passed by the legislature of Kansas in 1903 the purchase and use of poison in all townships infested by prairie-dogs was made compulsory. All expenses were defrayed from the township treasury, the county commissioners having previously made a special levy for the purpose. The vigorous campaign that followed the enactment of this law almost wiped the prairie-dog from the face of the land." Today (1951) few colonies of prairie dogs are known in Kansas.

The prairie dogs mate in late March or early April and after a gestation period of 28 to 32 days, two to ten young, usually five to six, are born in a nest below ground. In early June families of less than half grown appear at the surface. G. E. Johnson (1927:110-115) described the development of four young that were born in the laboratory on April 1st, 1926.

Cynomys ludovicianus ludovicianus (Ord)

Arctomys ludovicianus Ord, Guthrie's Geography, 2nd Amer. Ed., 2:292, description on p. 302, 1815, type from upper Missouri River ("Vicinity of the Missouri, and throughout the greater part of Louisiana").

Cynomys ludovicianus ludovicianus, Hollister, N. Amer. Fauna, 40:18, 1916; Hibbard, Trans. Kansas Acad. Sci., 36:239, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 177, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:506, 1939; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):32, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:72, 1944.

Cynomys ludovicianus, Knox, Trans. Kansas Acad. Sci., 4:22, 1875; Baker, Trans. Kansas Acad. Sci., 11:57, 1889; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:270, 1895; Merriam, U. S. Dept. Agric., Yearbook for 1901:257, 1901; Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Wade, Jour. Mamm., 9:150, 1928; Schaffner, Trans. Kansas Acad. Sci., 31:61, 1929.

Cynomys Ludovicianus, J. A. Allen, Bull. Essex Inst., 6:49, 1874.

Distribution.—Western part of the state, east certainly to Cloud, Dickinson, and Sedgwick counties. See map, figure 31.

Remarks.—External measurements of three males and two females from Hamilton County, are: ♂ 300, 380, 370, ♀ 350, 373; 54, 70, 70, 70, 85; 53, 65, 62, 60, 60; weight in pounds, – –, 2, 1¾, 1¾, 1¾.

Specimens examined.—Total, 121, distributed as follows: *Cheyenne County:* 23 mi. NW (by road) St. Francis, 2. *Sheridan County:* Hoxie, 1 (USBS). *Rooks County:* Woodson, 1. *Cloud County:* 1½ mi. E, ½ mi. N Glasco, 1. *Wallace County:* 2 mi. S Wallace, 3. *Gove County:* 4 mi. W Banner, 3. *Trego County:* Banner, 13 (10, USNM; 1, USBS). *Dickinson County:* Unspecified, 1 (USBS). *Lane County:* Pendennis, 1 (USBS). *Hamilton County:* 2 mi. N Coolidge, 2; Coolidge, 49; 1 mi. E Coolidge, 1. *Pawnee County:* 3 mi. E Garfield, 1. *Stafford County:* 6 mi. N Little Salt Marsh, 6; Little Salt Marsh, 1. *Pratt County:* Cairo, 2 (USBS). *Sedgwick County:* Garden Plain, 1 (USBS). *Morton County:* 10 mi. N, 3 mi. E Elkhart, 10. *Meade County:* State Park, 1 (GCR); 14 mi. SW Meade, 1 (GCR); 15 mi. SW Meade, 2 (GCR); 15¾ mi. SW Meade, 2; 17 mi. SW Meade, 3; XI Ranch, 28 mi. SW Meade, 4 (GCR). *Clark County:* E. A. Stephenson Ranch, 7 mi. S Kingsdown, 2. *Comanche County:* 4 mi. SW Aetna, 2. *Barber County:* Marty Ranch, 3. *Harper County:* 5 mi. NW Harper, 2.

Additional records.—Phillips Co.: Long Island, 3 (Hollister, 1916:18). *Clay County:* Unspecified (Schaffner, 1929:61). *Ellis Co.:* Fort Hays, 8 (Hollister, 1916:18). *Russell County:* Plymouth Township (see text); Coyote Station, 1 (Hollister, 1916:18). *Marion County:* Unspecified (Wade, 1928: 150). *Sumner County:* Unspecified (Wade, 1928:150).

Genus Citellus Oken

Ground Squirrels

Three species (including seven subspecies) of ground squirrels occur in Kansas. They may be distinguished from the chipmunks (genus *Tamias*), with which they are often confused, by the absence of stripes on the sides of the head. The dental formula is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{2}{1}$, m. $\frac{3}{3}$.

Citellus tridecemlineatus

Striped Ground Squirrel

The upper parts of this ground squirrel are striped with narrow alternate bands of dark and buffy white. The dark bands have central rows of whitish spots except on the neck and shoulders. This pattern readily distinguishes the striped ground squirrel from

the other ground squirrels in the state. They reach a total length of approximately 11 inches, of which the tail comprises approximately four inches.

Striped ground squirrels live chiefly on dry, grassy prairies and occur rarely in the brushy borders of timber tracts. They are only slightly gregarious and not at all social in habit. Individuals usually live a more or less solitary life and often dig a number of burrows, some of which are shallow and are used for temporary shelter;

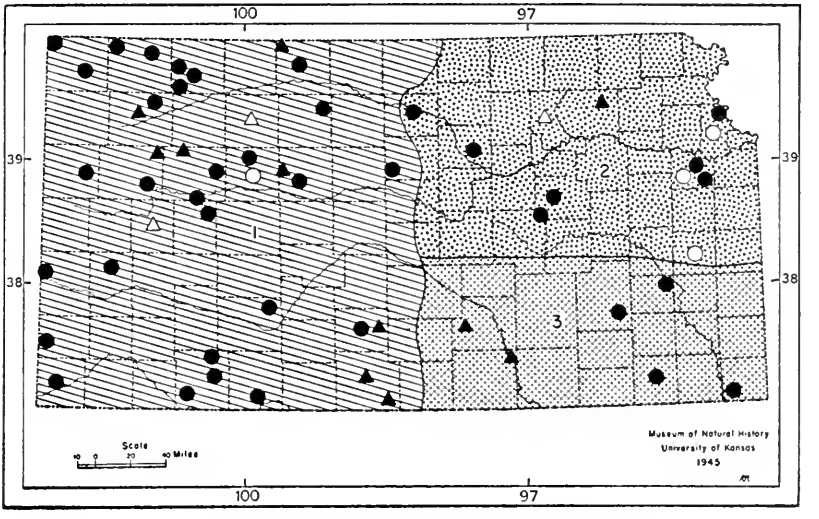

FIG. 32. Distribution of *Citellus tridecemlineatus* in Kansas. 1. *C. t. arenicola.* 2. *C. t. tridecemlineatus.* 3. *C. t. texensis.* See figure 5 for explanation of symbols.

others are of more elaborate construction for more permanent use. In the permanent burrows, many of which are as much as 20 feet in length and extend to a depth of three feet, is a nest of dry grass.

Mating occurs in April and, after a gestation period of 28 days, five to 13 young, usually six to ten, are born in the underground nest.

This ground squirrel feeds on a variety of wild plants and seeds, cultivated grains, and insects. Bailey (1893:39) found that half of the contents of 80 stomachs examined by him consisted of insects, including grasshoppers, crickets, caterpillars, beetles, ants, and insects' eggs. Hisaw and Emery (1927:41-44) found that, in captivity, animals of this species readily took insects, especially grasshoppers, even when grains were available.

The date of entering hibernation varies with the age, sex, and fatness of the individual as well as with the climatic conditions. For most individuals this date probably occurs in October or November. G. E. Johnson, Foster, and Coco (1933:266) found that in west-central Kansas the males appeared in numbers above ground about the middle of March while the females appeared about the last of March or the first of April. Johnson and others carried on an intensive study of hibernation in this species a few years ago at Kansas State College at Manhattan (see G. E. Johnson, 1929A, 1929B, 1930, and G. E. Johnson and others, 1932, 1933, and 1934). G. E. Johnson (1931:439) made an excellent summary of the results of his and other workers' findings on hibernation in mammals.

Citellus tridecemlineatus arenicola Howell

Citellus tridecemlineatus arenciola Howell, Proc. Biol. Soc. Washington, 41:213, 1928, type from Pendennis, Lane County, Kansas; Hibbard, Trans. Kansas Acad. Sci., 36:239, 1933; Johnson, Foster, and Coco, Trans. Kansas Acad. Sci., 36:250, 1933; Johnson, Gann, Foster, Coco, Endocrinology, 18:86, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 175, 1937; Howell, N. Amer. Fauna, 56:111, 1938; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:506, 1939; Hibbard, Trans. Kansas Acad. Sci., 47:72, 1944; Brown, Trans. Kansas Acad. Sci., 48:451, 1946.

Spermophilus tridecemlineatus pallidus, Allen, Bull. Amer. Mus. Nat. Hist., 7:270, 1895.

Citellus tridecemlineatus pallidus, Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Johnson, Amer. Nat., 63:172, 1929; Johnson, Biol. Bull., 59:115, 1930; Johnson, Trans. Kansas Acad. Sci., 34:282, 1931; Johnson and Challans, Endocrinology, 16:278, 1932; Hibbard, Trans. Kansas Acad. Sci., 36:238, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 175, 1937; Howell, N. Amer. Fauna, 58:112, 1938 (part.—all of his *pallidus* from Kansas); Wooster, Trans. Kansas Acad. Sci., 42:515, 1939; P. B. Allen, State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):32, 1940.

C[itellus] tridecemlineatus pallidus, Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905.

Citellus tridecumlineatus pallidus [sic]., Riegel, Trans. Kansas Acad. Sci., 44:98, 1941.

Citellus tridecemineatus pallidus [sic]., Hibbard, Trans. Kansas Acad. Sci., 47:72, 1944.

Citellus tridecemlineatus texensis, Lantz, Trans. Kansas Acad. Sci., 20(2):214, 1907 (from Medicine Lodge and Kiowa, Kans.).

Citellus tridecemlineatus tridecemlineatus, Webb, Trans. Kansas Acad. Sci., 43:479, 1940.

Distribution.—Western part of the state, east certainly to Phillips, Lincoln, and Barber counties. See map, figure 32.

Remarks.—External measurements of two adult males from two miles north of Bellefont are: 247, 241; 87, 82; 35, 31; 10, 9; weight in grams 101.7, 108.9.

Specimens examined.—Total, 71, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 1; 6 mi. W Bird City, 1. *Rawlins County:* 7 mi. N, 16½ mi. W Atwood, 1; 2 mi. NE Ludell, 7; 1½ mi. E Ludell, 1; 2 mi. E Ludell, 1; 10 mi. E Atwood, 1. *Decatur County:* 2 mi. S, 6 mi. W Oberlin, 1; 11 mi. S, 4 mi. W Oberlin, 1; 12½ mi. S Oberlin, 1. *Phillips County:* Phillipsburg, 1. *Thomas County:* 10 mi. N, 6 mi. E Colby, 1. *Rooks County:* 2 mi. SW Woodston, 1. *Wallace County:* 2 mi. S Wallace, 1. *Logan County:* 5 mi. W Elkader, 2. *Gove County:* 3½ mi. W, 2 mi. S Banner, 3; 7 mi. NW Pendennis, 2 (GCR). *Trego County:* Wakeeney, 1; Unspecified, 3. *Ellis County:* 3 mi. W, ¼ mi. S Hays, 2200 ft., 1. *Lincoln County:* 7 mi. SW Sylvan Grove, 1. *Lane County:* Pendennis, 2 (1, GCR). *Hamilton County:* Coolidge, 2; 1 mi. E Coolidge, 2. *Kearny County:* Oanica, 3. *Stanton County:* 7½ mi. W, 1 mi. N Manter, 1. *Ford County:* 2 mi. N Bellefont, 2. *Pratt County:* Pratt, 2; Unspecified, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 15. *Meade County:* 6 mi. N Fowler, 1; 6 mi. S Fowler, 1; Meade Co. State Lake, 1; State Park, 14 mi. SW Meade, 3 (GCR). *Clark County:* 9 mi. S Ashland, 2.

Additional records.—Phillips Co.: Long Island, 2 (Allen, 1895:270). *Thomas Co.:* Colby, 1 (Howell, 1938:114). *Graham Co.:* Solomon River, 1 (Howell, 1938:114). *Ellis Co.:* Ellis, 1 (Howell, 1938:114); Hays, 1 (Howell, 1938:114). *Gove Co.:* Grinell, 2 (Howell, 1938:112); Oakley, 1 (Howell, 1938:112). *Trego Co.:* Unspecified, 10 (Howell, 1938:114). *Scott Co.:* Scott City, 3 (Howell, 1938:112). *Lane Co.:* Pendennis, 10 (Howell, 1938:112). *Pratt Co.:* Cairo, 1 (Howell, 1938:112). *Barber Co.:* Medicine Lodge, 1 (Howell, 1938:112); Kiowa, 4 (Howell, 1938:112).

Citellus tridecemlineatus tridecemlineatus (Mitchell)

Sciurus tridecem-lineatus Mitchell, Med. Repository, N. S., 6(21):248, 1821, type from central Minnesota.

[Citellus] tridecemlineatus, Trouessart, Cat. Mamm., Sup., p. 341, 1904.

Citellus tridecemlineatus tridecemlineatus, Dice, Ecology, 4:51, 1923; Dice, Jour. Mamm., 4:111, 1923; Hibbard, Trans. Kansas Acad. Sci., 36:238, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 175, 1937; Howell, N. Amer. Fauna, 56:107, 1938; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):31, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:72, 1944; Brumwell, Amer. Midland Nat., 45:211, 1951.

Spermophilus tridecemlineatus, Dyche, Trans. Kansas Acad. Sci., 12:29, 1890; Bailey, U. S. Dept. Agric., Div. Ornith. and Mamm. Bull., 4:31, 1893.

C[itellus] tridecemlineatus, Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905.

Citellus tridecemlineatus, Lantz, Trans. Kansas Acad. Sci., 19:173, 1905.

Spermophilus tridecemlineata, Williston, Trans. Kansas Acad. Sci., 6:40, 1877.

Distribution.—Northeastern Kansas, west, certainly to Mitchell and Ottawa counties and south certainly to Anderson County. See map, figure 32.

Remarks.—External measurements of three males and three females from Douglas County, are: males 233, 255, 245, females 295, 272, 266; 61, 87.5, 67, 118, 95, 103; 34, 32.5, 36, – –, 36, 34; 8, – –, 9, – –, – –, – –.

Specimens examined.—Total, 45, distributed as follows: *Mitchell County:* 3½ mi. W, ½ mi. S Beloit, 1. *Leavenworth County:* Fort Leavenworth, 1; Unspecified, 5. *Ottawa County:* 4 mi. N Bennington, 1 (AJK). *Morris*

County: 10 mi. E Herington, 1; 3 mi. SW Burdick, 1. *Douglas County:* Lawrence, 16; 5 mi. NW Baldwin, 1; Unspecified, 17. *Anderson County:* Unspecified, 1.

Additional records.—Riley Co.: Fort Riley, 1 (Howell, 1938:109). *Pottawatomie Co.:* Onaga, 5 (Howell, 1938:109).

Citellus tridecemlineatus texensis (Merriam)

Spermophilus tridecemlineatus texensis Merriam, Proc. Biol. Soc. Washington, 12:71, 1898, type from Gainesville, Cooke County, Texas.

[*Citellus tridecemlineatus*] *texensis,* Trouessart, Cat. Mamm., Sup. p. 342, 1904.

Citellus tridecemlineatus texensis, Hibbard, Trans. Kansas Acad. Sci., 36:239, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 175, 1937; Howell, N. Amer. Fauna, 56:110, 1938; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):32, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:73, 1944.

Distribution.—Southeastern Kansas, west certainly to Sedgwick and Sumner counties and north certainly to Greenwood and Woodson counties. See map, figure 32.

Remarks.—External measurements of one male and two females from Neosho Falls are: males 233, females, 229, 242; 82, 88, 87; 33, 33, 34; 10, 9, 9.

This subspecies, *C. t. texensis,* is intermediate in size between *C. t. tridecemlineatus* and *C. t. arenicola. Citellus t. tridecemlineatus* is the darkest colored subspecies in the state; *C. t. arenicola* is the lightest. The color of the dorsal stripes is fuscous or fuscous black in *C. t. tridecemlineatus,* russet or mars brown in *C. t. texensis,* and snuff brown in *C. t. arenicola.*

Specimens examined.—Total, 8, distributed as follows: *Greenwood County:* 8 mi. SW Toronto, 1. *Woodson County:* Neosho Falls, 3. *Montgomery County:* Independence, 2. *Cherokee County:* 8 mi. SW Columbus, 1; 9 mi. SW Columbus, 1.

Additional records.—Sedgwick Co.: Garden Plain, 2 (Howell, 1938:111). *Sumner Co.:* Belle Plain, 1 (Howell, 1938:111).

Citellus spilosoma

Spotted Ground Squirrels

The upper parts of these ground squirrels are light brown, indistinctly spotted on the back and rump with roundish, white spots. They reach a length of approximately nine and a half inches, of which the tail comprises approximately three inches. They prefer dry, sandy soil, and are quite common in drifted sand along the rivers in the southwestern part of the state. In general this is a desert species, being much more common in the southwestern United States than in Kansas.

Their food includes plants, mainly seeds, and insects. They construct burrows that may be as much as 12 feet in length and 18 inches in depth. The two or more entrances to the burrow are usually concealed under bushes, in a weed patch, or under an overhanging rock.

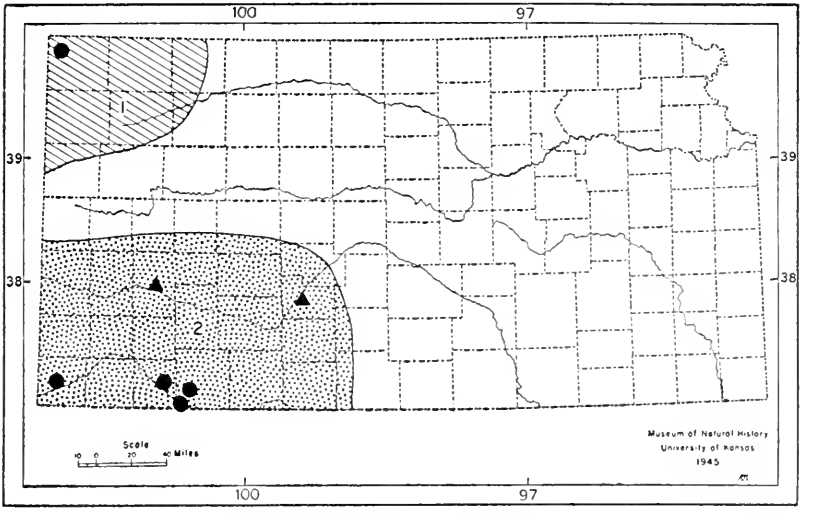

FIG. 33. Distribution of *Citellus spilosoma* in Kansas. 1. *C. s. obsoletus.* 2. *C. s. major.* See figure 5 for explanation of symbols.

Two litters per year are usual, with five to 12 young in each litter. Rinker (1942B:376) presented some records of size of litters of females taken in Meade County. Of five adult females taken in the first nine days of August, 1941, two were carrying embryos; one had eight, the other, six. A third female: ". . . was captured after being ploughed up in a wheat field. With her were 4 young, two of which were captured and proved to be about two-thirds grown."

Like the other ground squirrels in the state, this species spends part of the winter in hibernation.

Citellus spilosoma obsoletus (Kennicott)

Spermophilus obsoletus Kennicott, Proc. Acad. Nat. Sci. Philadelphia, p. 157, 1863, type from fifty miles west of Fort Kearney, Nebraska.

Citellus spilosoma obsoletus, Howell, N. Amer. Fauna, 56:130, 1938; Hibbard, Trans. Kansas Acad. Sci., 47:73, 1944.

Citellus obsoletus, Hibbard, Trans. Kansas Acad. Sci., 36:238, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 174, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):31, 1940.

Distribution.—Northwestern part of the state, known only from Cheyenne County. See map, figure 33.

Remarks.—External measurements of one female from nine miles northwest of St. Francis are: 245; 69; 33.

Specimens examined.—Total, 1, from the following locality: *Cheyenne County:* 9 mi. NW St. Francis, 1.

Citellus spilosoma major (Merriam)

Speromophilus spilosoma major Merriam, N. Amer. Fauna, 4:39, 1890, type from Albuquerque, Bernalillo County, New Mexico.

[Citellus spilosoma] major, Trouessart, Cat. Mamm., Sup., p. 340, 1904.

Citellus spilosoma major, Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:344, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:238, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 174, 1937; Sprague, Jour. Mamm., 19:246, 1938; Howell, N. Amer. Fauna, 56:126, 1938; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:506, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):31, 1940; Rinker, Trans. Kansas Acad. Sci., 45:376, 1943; Hibbard, Trans. Kansas Acad. Sci., 47:73, 1944.

Distribution.—Southwestern part of the state, east certainly to Edwards County. See map, figure 33.

Remarks.—External measurements of three females from the XI Ranch, 16 miles east of Liberal and three-fourths of a mile north of the Cimarron River are: 261, 252, 265; 75, 73, 80; 37, 35, 35; 11, 11, 10.

C. s. obsoletus is slightly smaller than *C. s. major* in all external measurements. The dorsal spots are small and often obscure in *C. s. obsoletus* while in *C. s. major* the dorsal spots are evident.

Specimens examined.—Total, 11, distributed as follows: *Morton County:* 9 mi. N, 3 mi. E Elkhart, 1. *Seward County:* 1 mi. E Arkalon, 1. *Meade County:* 17 mi. SW Meade, 2; XI Ranch, 16 mi. E Liberal, ¾ mi. N Cimarron River on Forgan Road, 7.

Additional records.—Edwards Co.: Kinsley (Howell, 1938:127). *Finney County:* Garden City, 1 (AMNH).

Citellus franklinii

Franklin Ground Squirrel

This ground squirrel is superficially similar to the gray squirrel, but the shorter and less bushy tail, tawny body, and shorter ears serve to distinguish it from the latter. It often reaches a length of 14 inches, larger than the other ground squirrels found in Kansas.

Franklin ground squirrels are more or less social and their burrows are usually found in small groups. They prefer denser cover than the other Kansas ground squirrels, and are usually found in brushy or grassy fence rows and in pasture lands.

They become fat in the fall and retire to their burrows in October where they remain in hibernation until April. They mate in mid-April and after a gestation period of 28 to 32 days two to 11 young, usually six, are born in an underground nest.

Food taken includes grasses, seeds, grains, fruits, berries as well as insects and their eggs.

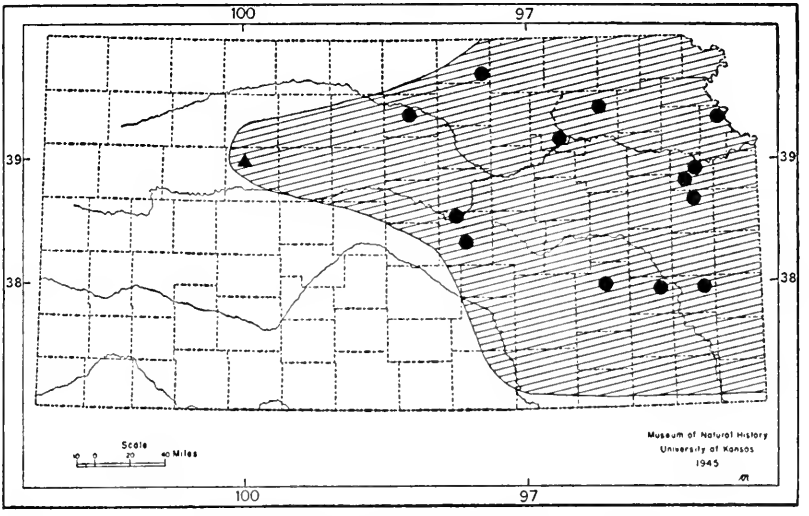

FIG. 34. Distribution of *Citellus franklinii* in Kansas. See figure 5 for explanation of symbols.

Citellus franklinii (Sabine)

Arctomys franklinii Sabine, Trans. Linn. Soc. London, 13:587, 1822, type from vicinity of Carlton House, Saskatchewan, Canada.

[*Citellus*] *franklini*, Trouessart, Cat. Mamm., Sup. p. 342, 1904.

Citellus franklinii, Dice, Ecology, 4:51, 1923; Dice, Jour. Mamm., 4:111, 1923; Linsdale, Jour. Mamm., 9:143, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:238, 1933; Howell, N. Amer. Fauna, 56:133, 1938; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):30, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:73, 1944.

Citellus franklini, Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Black, Kansas State Board Agric., 30th Biennial Rept., p. 176, 1937; Brumwell, Amer. Midland Nat., 45:210, 1951.

Sperophilus [sic.] *Franklinii*, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Spermophilus Franklini, Dyche, Trans. Kansas Acad. Sci., 12:29, 1890.

Spermophilus franklini, Bailey, U. S. Dept. Agric., Div. Ornith. and Mamm. Bull., 4:48, 1893.

Distribution.—Northeastern and north-central Kansas, west certainly to Trego County and south certainly to Greenwood and Allen counties. See map, figure 34.

Remarks.—External measurements of three males from one-half mile east of McPherson are: 386, 412, 379; 130, 160, 123; 53, 56, 54; 16, 18, 18; weight in grams 377.9, 508, 435.

Specimens examined.—Total, 30, distributed as follows: *Republic County:* Agenda, 1. *Mitchell County:* 3½ mi. W, ½ mi. S Beloit, 1. *Riley Co.:* Manhattan, 1 (USBS). *Pottawatomie Co.:* Onaga, 1 (USBS). *Leavenworth County:* Fort Leavenworth, 1. *Douglas County:* Lawrence, 3; 4½ mi. W no. 6 schoolhouse, Lawrence, 1; Wakarusa Creek, Haskell Farm, Lawrence, 1; 2½ mi. S, ¼ mi. W no. 6 schoolhouse, Lawrence, 1; 3 mi. SW Lawrence, 1; 3 mi. S Lawrence, 1; 3½ mi. S Lawrence, 1; 7½ mi. SW Lawrence, 1; Unspecified, 2. *McPherson County:* Smoky Hill River, 1 mi. S, ½ mi. W Lindsborg, 2; 1½ mi. E McPherson, 5. *Franklin County:* 8 mi. N Ottawa, 1. *Greenwood County:* Hamilton, 1. *Woodson County:* Neosho Falls, 3. *Allen County:* 5½ mi. N Moran, 1.

Additional records.—*Trego County:* 9 mi. W Wakeeney, 1 (MVZ).

Genus Tamias Illiger

Chipmunks

The chipmunk is a brightly colored rodent, similar to the ground squirrel in general build. The presence of stripes on the side of the head, the color, a grizzled grayish rusty marked with five longitudinal stripes of black from the shoulders to the rump, and the dental formula, i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$, all serve to distinguish the chipmunks in Kansas from the ground squirrels.

Tamias striatus

Eastern Chipmunk

The chipmunk reaches a length of ten to 11 inches, of which the tail comprises approximately four inches. Two subspecies of the eastern chipmunk occur in Kansas.

This beautiful animal is apparently nowhere abundant in the state. The number of specimens in museums indicate that it was formerly much more abundant and widespread in the state than it is now. Perhaps this has been a result of man's activity. In Webster County, Iowa, Damon (1941:326-327) found that no one species of tree was necessary for the occurrence of the chipmunk; however, "This rodent was not found in timber that was open enough to permit the growth of dense grass. With the exception of clipped lawns the chipmunk apparently avoids all dense grassy areas." In Kansas, where most of the original forests have been destroyed or cut-over, few forests dense enough to prevent the growth of grasses and weeds exist today.

Asdell (1946:221) reported that this chipmunk may mate "from March onward, and young born late in the previous season may

mate and produce young in July or August." The usual number of young is from three to five; they are born after a gestation period of 31 days.

Their food consists of nuts, especially acorns and hazelnuts, berries, various wild seeds, and some insects and other animal materials. They are found around rock fences and ledges and in open

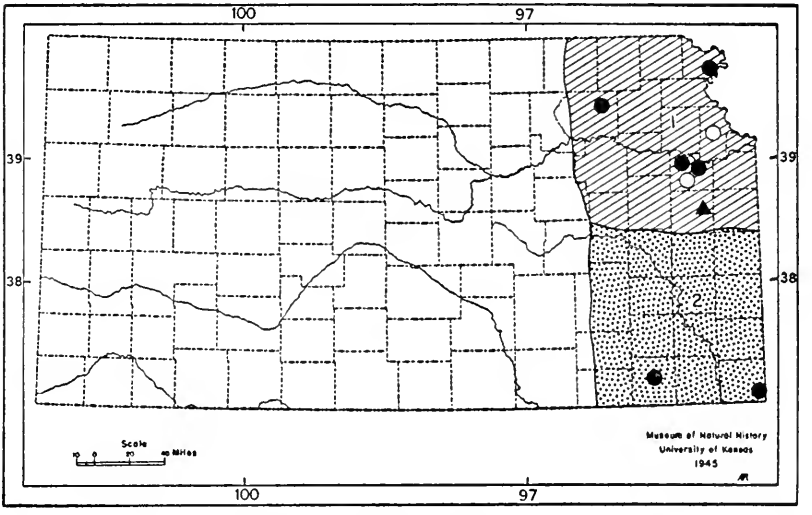

FIG. 35. Distribution of *Tamias striatus* in Kansas. 1. *T. s. griseus.* 2. *T. s. venustus.* See figure 5 for explanation of symbols.

woodlands, never far from nut-bearing trees. They are more or less active throughout most of the winter, at least in Kansas, and probably hibernate only in the coldest weather.

Tamias striatus griseus Mearns

Tamias striatus griseus Mearns, Bull. Amer. Mus. Nat. Hist., 3:231, 1891, type from Fort Snelling, Hennepin County, Minnesota; Linsdale, Jour. Mamm., 9:143, 1928; Howell, N. Amer. Fauna, 52:20, 1929; Hibbard, Trans. Kansas Acad. Sci., 36:239, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 178, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):33, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:73, 1944; Brumwell, Amer. Midland Nat., 45:211, 1951.

Tamias striatus, Knox, Trans. Kansas Acad. Sci., 4:22, 1875; Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905.

Distribution.—Formerly in northeastern Kansas, west certainly to Pottawatomie County and south to Franklin County. See map, figure 35.

Remarks.—External measurements of one male from Doniphan County and one female from Lawrence are: ♂ 239, ♀ 261; 90, 100; 35, 36; 14, – –.

Specimens examined.—Total, 8, distributed as follows: *Doniphan County:* Lower part of bluff on Missouri River, 1; Missouri River bank, 1. *Pottawatomie Co.:* Onaga, 1 (USBS). *Leavenworth County:* Unspecified, 1. *Douglas County:* 10 mi. W Lawrence, 1; Lawrence, 2; Unspecified, 1.

Additional records.—Franklin County: Peoria (Hall, 1939:766).

Tamias striatus venustus Bangs

Tamias striatus venustus Bangs, Proc. Biol. Soc. Washington, 10:137, 1896, type from Stilwell, Adair County, Oklahoma, Hibbard, Trans. Kansas Acad. Sci., 36:239, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 178, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):34, 1940; Hibbard, Trans. Kansas Acad, Sci., 47:73, 1944.

Distribution.—Known only from Montgomery and Cherokee counties in the southeastern part of the state. See map, figure 35.

Remarks.—External measurements of two males and one female from Independence, are: ♂ 250, 252, ♀ 247; 91, 90, 91; 36, 38, 37; 19, 18, 18.

Tamias s. venustus is larger (except in the length of the tail which is slightly shorter) and more brightly colored than *T. s. griseus.* The dorsal stripes are slightly shorter in *T. s. venustus* than in *T. s. griseus.*

Specimens examined.—Total, 4, distributed as follows: *Montgomery County:* Independence, 3. *Cherokee County:* 1½ mi. S Galena, 1.

Genus Glaucomys Thomas

American Flying Squirrels

This genus occurs only in North America. One species occurs in Kansas. The flying squirrel, with its fur-covered gliding membranes connecting the fore- and hind-limbs, its soft, silky pelage, and its flat tail, is one of the most readily identifiable rodents in the state. Its dental formula is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{2}{1}$, m. $\frac{3}{3}$. It reaches a length of approximately nine inches, of which the tail comprises approximately four inches.

Glaucomys volans

Flying Squirrel

Flying squirrels are so rare in Kansas that few people are familiar with them. They are known only from wooded areas where standing dead timber is available for shelter. They build nests in hollow trees where they spend most of the day. At night they leave their nests and then, as described by Black (1937:180):

"They travel by an alternate series of jumps, or 'flights,' landing with uncanny skill at the base of a tree, climbing to the described elevation and then hurling themselves out into space, gliding a remarkable distance before finally coming near the ground, where they alight on a tree trunk, and climb up again for another jump."

According to Asdell (1946:216), the flying squirrel "may breed several times a year, probably usually twice," usually in late February or early March and again in July. After a gestation period of 40 days, the birth of the one to four young, usually three or four, takes place in a nest in a hollow tree. Hamilton (1943:240) states

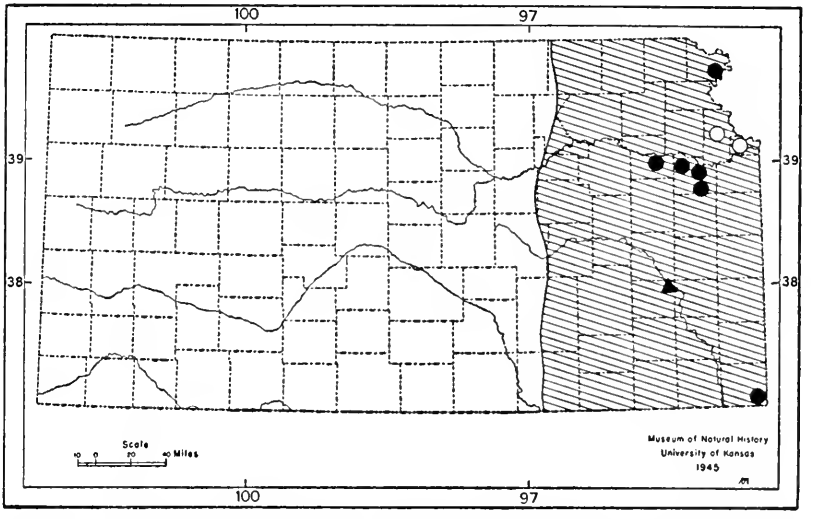

FIG. 36. Distribution of *Glaucomys volans volans* in Kansas. See figure 5 for explanation of symbols.

that the "young are born in an undeveloped condition, quite blind and naked but with a prominent lateral fold of skin which foreshadows the flying patagium. Generic characters may be recognized at one week; when four weeks old the young have opened their eyes and resemble the parents." The flying squirrels are quite social; several often share a crowded nest during the day. In the coldest part of the winter several will curl together in the nest, and thus benefiting from their combined heat, often remain inactive for several weeks at a time.

Their food is principally various acorns and nuts but includes berries, fruits, and insects. I have caught them in rat traps nailed to the trunks of trees, some of these traps were baited with dried prunes and others with strips of bacon.

Glaucomys volans volans (Linnaeus)

[*Mus*] *volans* Linnaeus, Syst. Nat. ed. 10, 1:63, 1758, type from Virginia.

Glaucomys volans volans, Howell, N. Amer. Fauna, 44:23, 1918; Linsdale, Jour. Mamm., 9:144, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:240, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 180, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):35, 1940; Brumwell, Amer. Midland Nat., 45:212, 1951.

Glaucomys volans nebrascensis, Hibbard, Trans. Kansas Acad. Sci., 47:74, 1944.

Pteromys volucella, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Sciuropterus volans, Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Lantz Kansas State College Exp. Sta. Bull., 129:334, 1905.

Distribution.—In wooded areas in eastern Kansas, west certainly to Shawnee and Woodson counties. See map, figure 36.

Remarks.—External measurements of three females from Douglas County, are: 218, 222, 230; 103, 78, 96; 28, 33, 27; 17, --, --.

Swenk (Univ. Nebraska Studies, 15:151, September 25, 1915) named, as *Pteromys volans nebrascensis,* the flying squirrel of Nebraska as new. The type specimen came from Nebraska City, Otoe County, in southeastern Nebraska. Howell (1918:20) listed this name as a synonym of *Glaucomys volans volans* (Linnaeus) and commented (*op. cit.* :22-23): "The type of *Pteromys volans nebrascensis* Swenk has been examined and found to agree essentially with typical specimens of *volans* from the vicinity of Washington, D. C. It is a rather pronounced example of the gray phase. . . . The skull and hind feet measure exactly as in typical examples."

Although I have not had specimens from Nebraska available for comparisons, I have compared the flying squirrels from Kansas with examples of *G. v. volans* from Michigan, Missouri, Kentucky, Massachusetts, and West Virginia, as well as with the description of *G. v. volans* as given by Howell (*op. cit.*). I could find no consistent differences between the specimens of flying squirrels from Kansas and typical *G. v. volans,* neither in cranial nor external features. I concur with Howell (*op. cit.*) in listing *nebrascensis* as a synonym of *G. v. volans.*

Specimens examined.—Total, 34, distributed as follows: *Doniphan County:* 1 mi. SW Geary, 1. *Leavenworth County:* Unspecified, 3. *Wyandotte County:* Unspecified, 1. *Shawnee County:* Topeka, 4. *Douglas County:* Deer Creek (9½ mi. W Lawrence), 3; Lawrence, 10; 7 mi. SW Lawrence, 5; 7½ mi. SW Lawrence, 1; 14 mi. S Lawrence, 1; Unspecified, 4. *Cherokee County:* 1½ mi. S Galena, 1.

Additional records.—Woodson Co.: Unspecified, 1 (Howell, 1918:23).

TABLE 12.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF CYNOMYS, CITELLUS, TAMIAS, AND GLAUCOMYS.

Sex	Catalogue number or number averaged	Greatest length	Zygomatic breadth	Cranial breadth	Interorbital breadth	Postorbital breadth	Length of nasals	Maxillary tooth-row
	Cynomys ludovicianus ludovicianus, Coolidge, Hamilton County							
♂	10309	....	41.1	....	12.5	13.7	22.2	16.5
♂	12728	63.7	45.6	31.0	12.9	13.6	24.0	15.9
♂	12730	63.3	44.8	30.8	12.3	13.4	24.0	16.3
♀	12729	59.5	41.5	28.7	11.7	13.7	22.5	15.8
♀	12931	61.4	44.2	31.0	11.5	13.0	22.5	16.3
	Citellus tridecemlineatus arenicola, Lane and Morton counties							
♂	8*	39.1	23.2	17.2	8.1	12.0	13.9	7.2
	min.	38.3	22.6	16.8	7.4	11.6	13.2	6.8
	max.	40.3	24.3	17.6	8.9	12.5	14.9	7.7
♀	8*	38.1	22.7	17.0	7.6	13.5	13.5	7.0
	min.	37.3	21.9	16.2	7.0	13.0	13.0	6.7
	max.	39.7	23.4	17.8	8.2	14.4	14.4	7.2
	C. t. tridecemlineatus, Douglas County							
♂	8057	41.5	23.2	17.7	7.2	11.1	14.8	7.2
♂	6494	42.1	24.3	18.5	8.2	12.0	14.2	8.0
♂	221	42.1	24.6	17.8	7.3	10.5	14.0	7.7
♀	2516	41.7	22.7	17.2	7.7	11.5	14.2	7.6
♀	3933	37.5	22.6	17.4	7.6	12.0	13.3	7.6
♀	3054	41.5	22.8	17.6	7.1	12.4	14.6	7.3
	C. t. texensis, Woodson County							
♂	4993	37.5	21.4	17.1	7.0	11.3	11.9	7.5
♀	4994	38.3	22.0	18.0	7.2	11.6	13.2	7.9
	C. t. texensis, Montgomery County							
♀	5009	38.5	21.7	16.8	7.4	10.4	12.5	7.5
	Cherokee County							
♀	2535	41.9	23.9	18.1	7.8	10.9	14.9	7.3
	C. spilosoma obsoletus, Cheyenne County							
♀	3454	41.5	25.3	18.6	9.5	14.6	13.5	7.9
	C. s. major, Seward County							
♂	13037	39.1	23.9	19.5	8.0	14.4	12.6	7.9
	Meade County							
♀	14005	41.7	....	20.4	9.0	14.1	14.0	7.4
♀	14009	42.7	25.3	20.1	9.0	13.0	13.9	7.8

TABLE 12.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF CYNOMYS, CITELLUS, TAMIAS, AND GLAUCOMYS—*Concluded.*

Sex	Catalogue number or number averaged	Greatest length	Zygomatic breadth	Cranial breadth	Interorbital breadth	Postorbital breadth	Length of nasals	Maxillary tooth-row
				C. franklinii, McPherson County				
♂	16245	53.1	29.8	24.0	9.8	12.5	17.1	11.4
♂	16249	55.5	31.6	24.6	10.5	13.0	18.7	11.2
♂	16247	....	....	....	10.0	....	18.0	12.0
♀	16248	56.7	31.2	25.0	9.7	12.7	19.5	11.0
♀	16246	55.0	31.1	24.2	9.9	12.9	18.5	11.5
				Tamias striatus griseus, Doniphan County				
♀	13701	43.4	23.5	18.9	11.0	....	14.4	....
				Leavenworth County				
♀	204	42 8	22.9	19.0	11.0	....	14.9	....
				T. s. venustus, Independence, Montgomery County				
♂	4944	41.8	22.1	17.4	11.5	....	13.4	....
♀	5081	41.0	....	18.0	10.0	....	14.1	....
				Glaucomys volans volans, Douglas County				
♂	9648	33.8	20.1	17.3	7.0	8.9	9.0	6.6
♂	8075	....	21.0	17.9	....	....	9.2	6.4
♀	5077	33.8	....	16.9	6.5	8.9	9.3	6.8
♀	2315	....	20.4	16.5	7.5	8.9	....	6.5
?	2943	34.4	20.6	17.8	7.7	9.2	9.1	6.6

° Measurements given by Howell (1938:112).

Family Geomyidae

Pocket Gophers

Only one genus, *Geomys*, of this family is known to occur in the state today; however, there is some evidence that a second genus, *Cratogeomys*, has occurred within the state in recent times, if not at present. Members of this family, with their minute external ears, small eyes, forelimbs enlarged into digging claws, and naked, tactile tail, are adapted for a life underground. The skull is large, heavy, and angular, with widespreading zygomatic arches and a sturdy rostrum. These and many other skeletal features also are adaptations to a subterranean life. The dental formula is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$.

The following key will aid in the separation of the two species of pocket gophers which may occur in Kansas.

1. Upper incisors with two longitudinal grooves. . . . *Geomys bursarius*, p. 137
1'. Upper incisors with one longitudinal groove. . *Cratogeomys castanops*, p. 279 (see hypothetical list).

Genus Geomys Rafinesque

Pocket Gophers

This genus occurs in eastern North America, west to the Rocky Mountains. All members are well adapted to a subterranean habitat. They remain underground practically all the time, and they are active throughout the year. One species, with five subspecies, of this genus occurs in Kansas.

Geomys bursarius

Pocket Gopher

Pocket gophers occur throughout most of the state, being absent only in the southeastern counties. Scheffer (1940:473-478) and Charles F. Smith (1948:313-315) have reported on excavations of runway systems of gophers. Smith excavated the runway system of a single gopher one-fourth mile south and two miles west of Lawrence and found that it consisted of one main tunnel, 206 feet in length; from which branched many short lateral tunnels. The lateral tunnels were usually plugged with soil. Most of the tunnel system was between six and nine inches below the surface of the ground, but in the region of the nest the depth was 38 inches. Smith (*op. cit.*:314) found that all fecal material was "in short, plugged-up tunnels approximately nine inches in length that originally branched from the main burrow. After the tunnel was almost full of feces, the gopher plugged the remaining part with soil. As a result, the main tunnel was free of fecal material." Smith also found two food stores in the burrow system he excavated, both stores consisting entirely of tubers of the sunflower, *Helianthus tuberosa.*

Scheffer carried on an intensive study of the habits and economic importance of the pocket gopher in Kansas and found (1910B:205) that: "The natural food of the pocket gopher consists of the fleshy roots and underground stems of various plants growing wild on the prairies. To this bill of fare he adds occasionally a small quantity of succulent vegetation drawn down into his burrow from the surface at points where exits are dug for removing earth."

Scheffer (*op. cit.*:203-205) found that the pocket gopher has but one litter per year. The young, varying from one to six per litter, usually four, are born in March and April.

As pointed out by Scheffer (*op. cit.*:209): "The economic status of the pocket gopher has changed in the last few decades. There was a time when their work was a real benefit to the future interests of agriculture. For untold centuries they have been mixing the soil of the prairies, bringing up the subsoil to mellow, and covering up

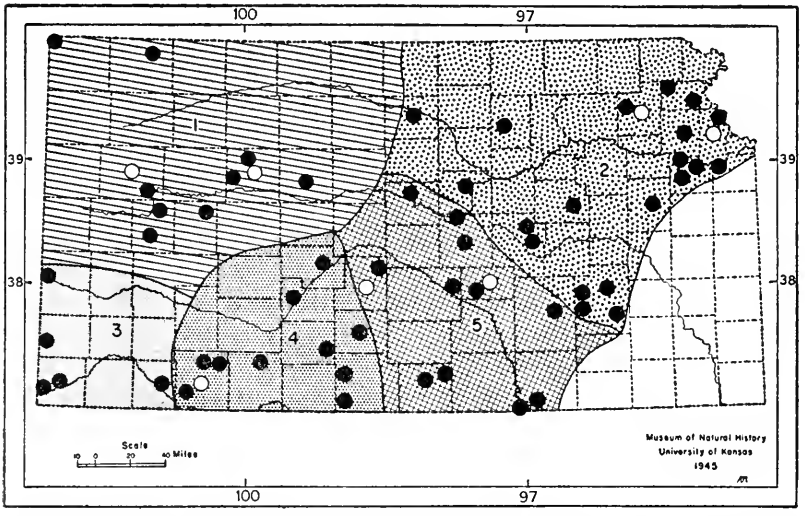

FIG. 37. Distribution of *Geomys bursarius* in Kansas. 1. *G. b. lutescens.* 2. *G. b. majusculus.* 3. *G. b. jugossicularis.* 4. *G. b. industrius.* 5. *G. b. major.* See figure 5 for explanation of symbols.

vegetation to molder and add humus to the clays and sand." He goes on to state that: "But now that the virgin soil has been prepared for us we would gladly dispense with their services, for their presence is now seriously detrimental to our interests." With this last statement I agree only in part. Pocket gophers in cultivated fields are seriously detrimental to man's interests, but in pastures and waste lands, they are useful in deepening the soil and promoting its fertility.

In the past, laws have been enacted, in Kansas, with the aim of exterminating the pocket gophers. Scheffer (*op. cit.*:216-219) gave a résumé of the attempts at extermination and discussed them at some length. In 1903, an act was passed authorizing county commissioners of those counties east of the Sixth Principal Meridian—that is, Washington, Clay, Dickinson, Marion, Butler, Cowley coun-

ties, and those to the east—to pay, at their discretion, a bounty of five to 25 cents apiece for the scalps of pocket gophers and "gray ground squirrels," probably *Citellus franklinii.* Scheffer (*op. cit.*: 218-219) reported that under this act eight counties paid premiums on gopher scalps for periods of three months to four years. The counties were: Atchison, Brown, Jefferson, Johnson, Leavenworth, Marshall, Morris, and Pottawatomie. Some of them reported the payment of only a few dollars per year in bounties, but in others the amounts were considerable. Leavenworth County, for example, paid $2480, after which the commissioners withdrew the bounty. Marshall County withdrew its bounty after paying $4200 in the year 1907. Township trustees from all parts of that county reported at the close of the year that the number of pocket gophers seemed to be as great in their respective townships as when they began paying bounty in the spring. It seemed that the trap was slower than the gopher's rate of increase. Wholesale fraud was suspected; it was thought that in a number of cases several scalps were manufactured from one skin.

In 1905 a compulsory gopher extermination law, House bill No. 184, Session Laws of 1905, was passed. It provided that, on petition of ten resident landholders of any township, the county commissioners might, at their discretion, direct the trustees of the township from which the petition came to appoint a person to see that the gophers were exterminated. The person appointed was to enter the premises of every resident of his district at least three times a year on a tour of inspection. If any landowner failed to exterminate the gophers on his premises, the inspector was to attend to the work, the costs being charged up in taxes to the delinquent landowner. Scheffer (*op. cit.*:216) stated that: ". . . unfortunately it does not appear that township officers care to avail themselves of its provisions [the gopher extermination law]. From correspondence with county officers in nearly all counties of the state, I have not been able to learn of a single case wherein the law has been made operative."

In 1909 a bounty law was passed which required all counties in the state to pay a bounty of five cents per head on pocket gophers and permitted them to pay ten cents at their discretion. Scheffer (*op. cit.*:217-218) pointed out several faults of such a law. He argued that: (1) ". . . the gopher roams about so little above ground that each individual is practically a permanent resident of the farm on which its burrow is located. . . . The principle of allowing the community at large to pay the expense of protect-

ing the careless man's crop, while his thrifty neighbor looks after his own fields, is theoretically wrong. It imposes a double burden upon thrift. . . ." (2) "The payment of ten cents for each scalp will put a premium on trapping and tend to discourage poisoning, the more thoroughly and easily applied method of ridding a badly infested locality of these pests. . . ." (3) "The expense of maintaining a bounty system is usually out of all proportions to the benefits gained. . . ." (4) "Finally, the opportunities for fraud in the matter of claiming bounties are much greater in the case of the pocket gopher than with the larger and better known mammals."

This gopher bounty law was in force in Kansas for several years.

TABLE 13.—NUMBER OF POCKET GOPHERS PRESENTED TO THE COUNTY CLERK OF COMANCHE COUNTY FOR PAYMENTS OF BOUNTIES.

YEAR	Number	YEAR	Number
1911	18	1923	700
1912	611	1924	1,050
1913	889	1925	800
1914	1,299	1926	1,200
1915	3,069	1927	2,000
1916	3,050	1928	2,500
1917	2,865	1929	1,800
1918	2,484	1930	800
1919	1,051	1931	3,000
1920	950	1932	2,500
1921	.....	1933	1,600
1922	.....	Total	34,236

I have not been able to secure data on the number of gophers presented for bounties in all the counties but in four years, 1908-11, a total of 15,137 gophers were presented for bounty in Jewell County, according to figures furnished me by the county clerk. In Comanche County, bounties were paid on pocket gophers every year from 1911 to 1933 except 1921 and 1922. There the bounty paid was ten cents per gopher, or $3423.60 in the twenty-one years. As can be seen in table 13, the number presented for bounty in Comanche County, while never so large as in Jewell County, tended to increase, not decrease, each year.

Poisoning, fumigation, and trapping are all methods of combating pocket gophers where their presence conflicts with man's interests.

Geomys bursarius lutescens Merriam

Geomys bursarius lutescens Merriam, N. Amer. Fauna, 4:51, 1890, type from Sandhills on Bird Creek, Lincoln County, Nebraska; Scheffer, Tech. Bull., U. S. Dept. Agric., 224:6, 1931; Villa-R. and Hall, Univ. Kansas Publs., Mus. Nat. Hist., 1:222, 1947.

Geomys lutescens, Merriam, N. Amer. Fauna, 8:127, 1895; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:258, 274, 1895; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:240, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 182, 1937; Swenk, Missouri Valley Fauna, 2:1, 1940; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):36, 1940.

G[*eomys*] *lutescens,* Lantz, Kansas State College Exp. Sta. Bull., 129: 335, 1905; Scheffer, Trans. Kansas Acad. Sci., 23:109, 1911.

Geomys lutescens lutescens, Hibbard, Trans. Kansas Acad. Sci., 47:74, 1944.

Geomys bursarius, Bailey, U. S. Dept. Agric., Div. Ornith. and Mamm. Bull., 15:37, 1895.

Distribution.—Northwestern part of the state, east to Ellis County and south to Scott and Lane counties. See map, figure 37.

Remarks.—External measurements of one male and two females from two miles northeast of Ludell are: ♂ 272, ♀ 230, 245; 92, 63, 70; 35, 31, 30.

Specimens examined.—Total, 37, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 3. *Rawlins County:* 2 mi. NE Ludell, 10. *Logan County:* 5 mi. W Elkader, 3; Unspecified, 1. *Trego County:* Wakeeney, 4; 12 mi. S Collyer, Perrington Ranch, 2; Unspecified, 5. *Ellis County:* Hays State College Campus, Hays 1. *Scott County:* 4 mi. S Scott City, 2; State Park, 2 (GCR). *Lane County:* Pendennis, 4.

Geomys bursarius majusculus Swenk

Geomys bursarius majusculus Swenk, Missouri Valley Fauna, 1:6, 1939, type from Lincoln, Lancaster County, Nebraska; Hibbard, Trans. Kansas Acad. Sci., 47:74, 1944; Villa-R. and Hall, Univ. of Kansas Publs., Mus. Nat. Hist., 1:223, 1947; Brumwell, Amer. Midland Nat., 45:212, 1951.

Geomys bursarius, Baird, Mamm. N. Amer., p. 377, 1858; Knox, Trans. Kansas Acad. Sci., 4:21, 1875; Dyche, Trans. Kansas Acad. Sci., 12:30, 1890; Bailey, U. S. Dept. Agric., Div. Ornith. and Mamm. Bull., 15:36, 1895; Merriam, N. Amer. Fauna, 8:120, 1895; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:309, 1907; Scheffer, Kansas State College Ento. and Zool. Dept. Bull., 172:199, 1910; Scheffer, Trans. Kansas Acad. Sci., 23:109, 1911; Dice, Ecology, 4:51, 1923; Dice, Jour. Mamm., 4:111, 1923; Johnson, Jour. Mamm., 7:35, 1926; Linsdale, Jour. Mamm., 9:144, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:240, 1933; Scheffer, Trans. Kansas Acad. Sci., 43:476, 1938.

Geomys bursarius bursarius, Scheffer, U. S. Dept. Agric. Tech. Bull., 224:6, 1931; Black, Kansas State Board Agric., 30th Biennial Rept., p. 181, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):35, 1940.

Geomys breviceps, Baird, Mamm. N. Amer., p. 380, 1858; Knox, Trans. Kansas Acad. Sci., 4:21, 1875; Lantz, Trans. Kansas Acad. Sci., 20(5):215, 1907.

Distribution.—Northeastern part of the state, west to Mitchell and Saline counties and south to Greenwood County. See map, figure 37.

Remarks.—External measurements of 16 males and 17 females from Douglas County, are: ♂ 289 (273-308), ♀ 265 (222-304); 79 (70-95), 78.6 (59-92); 36.3 (32-55), 32.8 (30-35).

Specimens examined.—Total, 250, distributed as follows: *Mitchell County:* 3½ mi. W, ½ mi. S Beloit, 21. *Clay County:* 6 mi. SW Clay Center, 3. *Jackson County:* 10½ mi. WSW Holton, 1; Unspecified, 1. *Atchison County:* ½ mi. E, 1 mi. S Horton, 1; 1½ mi. S Muscotah, 3; 3 mi. N Cummings, 2. *Jefferson County:* Oskaloosa, 1. *Leavenworth County:* Ft. Leavenworth, Pope Hill formation, 1; Ft. Leavenworth, Engineer Hill Vicinity, 1. Ft. Leavenworth, 3; Unspecified, 20. *Saline County:* Debold Farm, Salina, 2 (AJK); 4 mi. E Salina, 4 (AJK). *Morris County:* 1½ mi. N Council Grove, 3. *Osage County:* 3 mi. N Lyndon, 1. *Douglas County:* 1 mi. NW Midland, 1; 1 mi. N Lawrence, 1; 1 mi. W Lawrence, 1; ½ mi. W Lawrence (W Fort Lake), 3; Lawrence, 24; Univ. Kansas, 9; 2½ mi. S Lawrence, 1; 7-7½ mi. SW Lawrence, 7; 10 mi. SW Lawrence, 1; Unspecified, 28. *Johnson County:* 1 mi. W Desoto, 1. *Marion County:* 1½ mi. NE Lincolnville, 6; 4 mi. SE Lincolnville, 1; 6 mi. S Lincolnville, 1. *Greenwood County:* 1½ mi. W Hamilton, 2 (GCR); Hamilton, 41 (36, GCR); ¼ mi. E Hamilton, 6 (GCR); ½ mi. E Hamilton, 1 (GCR); ¾ mi. E Hamilton, 2 (GCR); 2 mi. E Hamilton, 1 (GCR); ¼ mi. S Hamilton, 4 (GCR); ½ mi. SE Hamilton, 1 (GCR); ¾ mi. SE Hamilton, 1 (GCR); ½ mi. S Hamilton, 15 (GCR); 1 mi. SW Hamilton, 4 (GCR); 4 mi. S, 14 mi. W Hamilton, 6; 14 mi. S, 17 mi. W Hamilton, 1 (GCR); 8 mi. SW Toronto, 1; 8¼ mi. SW Toronto, 5; Unspecified, 6.

Geomys bursarius jugossicularis Hooper

Geomys lutescens jugossicularis Hooper, Occas. Papers Mus. Zool., Univ. Michigan, 420:1, 1940, type from Lamar, Prowers County, Colorado; Hibbard, Trans. Kansas Acad. Sci., 47:75, 1944.

Geomys bursarius jugossicularis, Villa-R. and Hall, Univ. Kansas Publs., Mus. Nat. Hist., 1:226, 1947.

Distribution.—Extreme southwestern part of the state, north to Hamilton County and east to Seward County. See map, figure 37.

Remarks.—External measurements of four males and two females from nine miles north and three miles east of Elkhart, are: ♂ 265 (250-285), ♀ 244, 230; 82.0 (68-92), 72, 72; 34.2 (30-37), 30, 30.

Specimens examined.—Total, 25, distributed as follows: *Hamilton County:* Conard Farm, 1 mi. E Coolidge, 4; *Stanton County:* 6 mi. W, 1 mi. N Manter, 2. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 11; 12 mi. NE Elkhart, 2; 7 mi. N, 2 mi. W Elkhart, 2. *Seward County:* 1 mi. E Arkalon, 4.

Geomys bursarius industrius Villa-R. and Hall

Geomys bursarius industrius Villa-R. and Hall, Univ. Kansas Publs., Mus. Nat. Hist., 1:226, 1947, type from 1½ miles north of Fowler, Meade County, Kansas.

Geomys lutescens, Merriam, N. Amer. Fauna, 8:127, 1895.

Geomys breviceps llanensis, Lantz, Trans. Kansas Acad. Sci., 20(2):215, 1907; Hibbard, Trans. Kansas Acad. Sci., 36:240, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 181, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:507, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. of Information, Nat. Hist. Surv., 20(5):36, 1940.

Geomys lutescens jugossicularis, Hooper, Occas. Papers Mus. Zool., Univ. Michigan, 420:1, 1940.

Distribution.—Southwestern part of the state from Meade County east to Pratt and Clark counties and north to Pawnee County. See the distribution map, figure 37, on page 138.

Remarks.—External measurements of eight males and seven females from Meade County, are: ♂ 265 (247-280), ♀ 238 (231-256); 82.0 (70-90), 73.0 (65-75); 35.0 (33-36), 31.3 (30-32).

Specimens examined.—Total, 69, distributed as follows: *Pawnee County:* Jct. Pawnee and Arkansas rivers, Larned, 6; 1 mi. S, 1 mi. E Larned, 7. *Edwards County:* 1 mi. W, 3½ mi. S Kinsley, 1. *Kiowa County:* Rezeau Ranch, 5 mi. N Belvidere, 2. *Pratt County:* Pratt, 14; Unspecified, 1. *Meade County:* 3½ mi. NE Fowler, 2; 2 mi. N Fowler, 2; 1½ mi. N Fowler, 2; 7 mi. N Meade, Cudahy Ash Pit, 2; 13 mi. SW Meade, 9; State Lake and Park, 15 (11, GCR); Unspecified, 4. *Clark County:* 7 mi. SW Kingsdown, Stephenson Ranch, 1; 6 mi. S Kingsdown, 1.

Geomys bursarius major Davis

Geomys lutescens major Davis, Texas Agric. Exp. Sta. Bull., 590:32, 1940, type from eight miles west of Clarendon, Donley County, Texas; Hibbard, Trans. Kansas Acad. Sci., 47:75, 1944.

Geomys bursarius major, Villa-R. and Hall, Univ. Kansas Publs., Mus. Nat. Hist., 1:229, 1947.

Geomys lutescens, Merriam, N. Amer. Fauna, 8:129, 1895.

Geomys bursarius lutescens, Scheffer, U. S. Dept. Agric., Tech. Bull., 224:7, 1931, part from Sun City, Barber County.

Geomys breviceps llanesis, Lantz, Trans. Kansas Acad. Sci., 20(2):215, 1907; Hibbard, Trans. Kansas Acad. Sci., 36:240, 1933; Black, Kansas State Board Agric. 30th Biennial Rept., p. 182, 1937; Swenk, Missouri Valley Fauna, 2:12, 1940.

Geomys breviceps cf. *dutcheri*, Hibbard, Trans. Kansas Acad. Sci., 47:75, 1944.

Distribution.—South-central part of the state, from Barber County east to Cowley County and north to Ellsworth County. See the distribution map, figure 37, on page 138.

Remarks.—External measurements of one male and two females from three miles southeast of Arkansas City, are: ♂ 246, ♀ 230, 246; 76, 82, 83; 32, 30, 32.

Specimens examined.—Total, 79, distributed as follows: *Ellsworth County:* 2 mi. S Ellsworth, 1. *McPherson County:* Smoky Hill River, 1 mi. S, ½ mi. W Lindsborg, 6; ½ mi. E McPherson, 1. *Stafford County:* Little Salt Marsh, 15 mi. N, 3 mi. E Stafford, 15; Unspecified, 2. *Reno County:* 8 mi. N, 1 mi. E Haven, 2. *Harvey County:* 1 mi. E, ½ mi. N Halstead, 1; Halstead, 2; Unspecified, 1. *Butler County:* 8 mi. W Rosalia, 2. *Barber County:* Near South Bridge, Sun City, 1; 2 mi. S Sun City, 1; Aetna, Wills Ranch, 2; 1 mi. W (Wills) Ranch, Aetna, 3; Near South Bridge, Aetna, 1; Near Bridge, 1 mi. S Aetna, 2. *Harper County:* 1 mi. N Harper, 11; 3 mi. S Harper, 1; 4½ mi. NE Danville, 8. *Cowley County:* 3.5 mi. E Arkansas City, 2; 3 mi. SE Arkansas City, 8; 3 mi. SW Arkansas City, 3; 3 mi. S Arkansas City, 1; Unspecified, 2.

TABLE 14.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF GEOMYS.*

Sex	Number averaged or catalogue number	Basilar length	Length of nasals	Zygomatic breadth	Mastoidal breadth	Breadth of rostrum	Interiorbital constriction	Alveolar length of maxillary tooth-row	Extension of premaxilla posterior to nasals	Depth of skull	Length of rostrum
					Geomys bursarius lutescens, 2 mi. NE Ludell, Rawlins County						
♂	12088	43.2	19.1	32.2	27.7	11.3	6.6	8.4	2.8	18.0	22.1
♀	11733	35.3	15.1	26.5	24.1	9.3	6.1	7.5	2.4	15.0	18.2
♀	12155	35.6	14.6	25.2	24.1	10.6	6.4	7.5	3.1	14.9	18.2
					G. b. majusculus, Douglas County						
♂	16	47.1	21.0	34.1a	30.4	12.1	6.8	9.3	3.7	18.5	24.9
	min.	44.7	18.9	30.5	27.5	11.1	6.5	8.2	2.9	17.3	22.9
	max.	49.9	23.2	38.0	34.5	13.5	7.6	10.3	5.7	20.0	28.1
♀	17	40.6b	17.2	28.6a	26.4	10.9	6.5	9.1	3.6	16.6	21.0
	min.	37.1	15.9	26.7	24.9	10.0	5.9	8.5	2.0	15.2	18.8
	max.	47.0	20.1	33.4	29.1	12.3	7.3	10.0	5.9	19.1	24.1
					G. b. jugossicularis, Morton County						
♂	4	40.7	16.9	30.0	27.9	10.7	6.0	8.6	5.2	17.3	21.2
	min.	38.5	16.1	29.0	27.5	10.5	5.5	8.2	4.7	16.4	20.2
	max.	42.4	17.4	31.1	28.4	11.0	6.2	9.2	5.5	17.9	22.0
♀	5012	36.2	16.4	25.4	25.0	10.0	5.9	8.0	4.2	16.0	19.3
♀	5395	34.6	13.9	24.7	24.8	9.8	5.8	8.0	4.5	15.2	17.5
					G. b. industrius, Meade County						
♂	8	40.9	18.1	30.0	28.0	11.0	6.2	8.8	4.3	17.7	21.8
	min.	37.9	15.5	28.2	26.5	9.9	5.7	8.0	2.9	16.8	19.5
	max.	43.4	21.0	32.4	29.5	11.6	7.0	9.1	5.2	19.1	24.2
♀	7	36.4c	14.9	26.3	24.8	10.0	6.0	8.4	4.1	16.2	18.6
	min.	35.4	14.0	25.8	24.5	9.5	5.6	8.1	3.6	15.5	17.5
	max.	37.8	16.1	27.8	25.9	10.3	6.5	8.7	4.7	17.6	19.9
					G. b. major, Cowley County						
♂	12870	42.1	16.0	33.7	29.7	11.5	6.3	9.4	4.5	17.6	21.3
♂	12892	41.7	17.3	....	27.7	10.8	6.4	8.9	4.2	17.2	21.5
♀	12872	38.1	15.0	28.0	26.2	10.3	6.3	7.8	4.5	16.1	19.1
♀	12894	38.5	15.5	28.0	25.6	10.0	6.7	8.7	4.0	16.6	19.5
♀	12893	36.5	14.2	25.6	24.8	9.6	6.6	8.7	4.6	15.4	18.1

a. 15 averaged.
b. 16 averaged.
c. 5 averaged.
* Compiled from measurements given by Villa-R and Hall (1947:232-233).

Family Heteromyidae

Pocket Mice and Kangaroo Rats

Two genera, *Perognathus* and *Dipodomys*, of this family, occur in Kansas, and are characteristic of arid and semi-arid regions of western North America. In Kansas they are found in the more arid, western part of the state. They are small and, with their tiny forefeet and elongated hind feet, are adapted for a saltatorial life. The tail is long and, in *Dipodomys*, tufted at the tip. The skull has a long rostrum and enormously inflated auditory regions. The dental formula is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$.

The following key will aid in the separation of the species of this family that occur in the state:

1. Soles of hind feet naked; greatest width of head less than distance between tip of nose and posterior end of eye; interparietal more than ¼ greatest width of skull.....2
1'. Soles of hind feet densely haired; greatest width of head more than distance between tip of nose and posterior end of eye; interparietal less than ¼ greatest width of skull.....*Dipodomys ordii*, p. 152
2.(1) Total length less than 150 mm.; hind foot less than 19 mm.; occipitonasal length less than 25 mm.; mastoids greatly developed, projecting beyond plane of the occiput; interparietal length less than interparietal width.....3
2'. Total length more than 150 mm.; hind foot more than 19 mm.; occipitonasal length of skull more than 25 mm.; mastoids not so greatly developed; interparietal length equal to or greater than interparietal width.....*Perognathus hispidus*, p. 148
3. (2) Post-auricular patches twice the length of the ears; interparietal breadth less than 4.1 mm.....*Perognathus flavus*, p. 147
3'. Post-auricular patches approximately the length of the ears; interparietal breadth more than 4.1 mm.....*Perognathus flavescens*, p. 145

Genus **Perognathus** Maximilian
Pocket Mice

This genus occurs only in western North America. Many species occur in the deserts of southwestern United States and Mexico. Pocket mice all have long tails and long hind feet as well as fur-lined cheek pouches. Three species, including five subspecies, occur in Kansas.

Perognathus flavescens
Plains Pocket Mouse

Two subspecies of this small pocket mouse occur in the state. Although it is known from many scattered localities in the southwestern part of the state, it is apparently nowhere common. A total of ten specimens of this species is known from Kansas.

Little is known of the habits of this species anywhere in its range. Asdell (1945:231) indicated that it has four young in a litter.

Perognathus flavescens flavescens Merriam

Perognathus fasciatus flavescens Merriam, N. Amer. Fauna, 1:11, 1889, type from Kennedy, Cherry County, Nebraska.

Perognathus flavescens flavescens, Miller, Bull. U. S. Nat. Mus., 128:273, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:240, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 183, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):36, 1940; Hibbard, Trans. Kanasas Acad. Sci., 47:75, 1944.

Perognathus flavescens, Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905.

Distribution.—Probably throughout the western one-third of the state, east certainly to Clark County. See map, figure 38.

Remarks.—External measurements of one male and one female from one mile east of Coolidge, are: 113, 118; 47, 53; 17, 15; 7, 6.

Specimens examined.—Total, 5, distributed as follows: *Hamilton County:* 1 mi. E Coolidge, 2. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 1. *Seward County:* Unspecified, 1. *Clark Co.:* Sand Creek, Cimarron R., 1 (USNM).

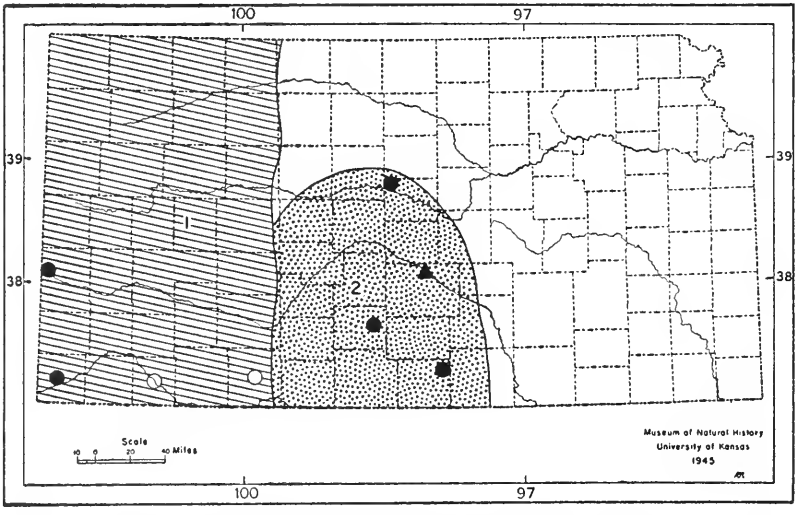

FIG. 38. Distribution of *Perognathus flavescens* in Kansas. 1. *P. f. flavescens.* 2. *P. f. copei.* See figure 5 for explanation of symbols.

Perognathus flavescens copei Rhoads

Perognathus copei Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1893, p. 404, type from Mobettie, Texas.

Perognathus flavescens copei, Bailey, N. Amer. Fauna, 25:143, 1905.

Perognathus flavus, Knox, Trans. Kansas Acad. Sci., 5:65, 1887.

Distribution.—Central part of the state, known from Ellsworth, Pratt, Reno, and Harper counties. See map, figure 38.

Remarks.—External measurements of one female from four and one-half miles northeast of Danville, are: 114; 51; 17; 6.

In *P. f. flavenscens* the dorsal surface is pale and the dorsal tail-stripe is very light, presenting little contrast with the ventral surface of the tail. In *P. f. copei* the dorsal surface is heavily suffused with black, resulting in a dark color and the dorsal tail-stripe is black.

Specimens examined.—Total, 5, distributed as follows: *Ellsworth County:* 1½ mi. S Wilson, 1. *Pratt Co.:* Cairo, 3 (USBS), *Harper County:* 4½ mi. NE Danville, 1.

Additional records.—*Reno County:* Nickerson (Knox, 1877:65).

Perognathus flavus

Baird Pocket Mouse

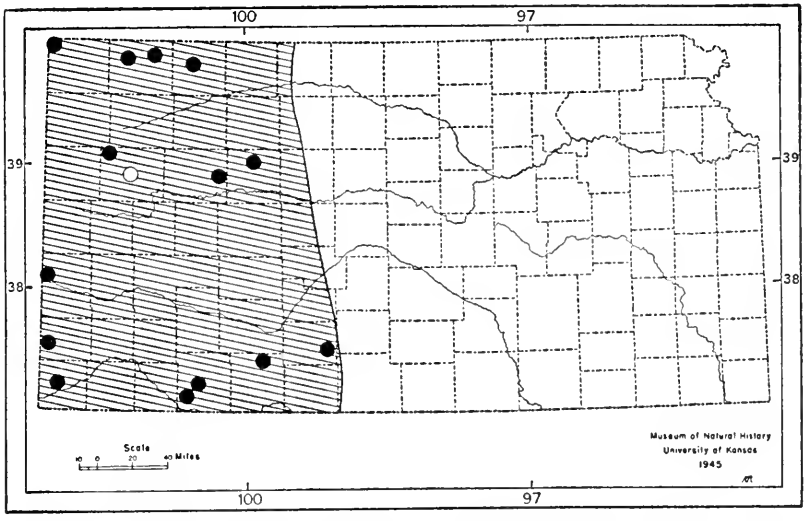

FIG. 39. Distribution of *Perognathus flavus flavus* in Kansas. See figure 5 for explanation of symbols.

Little is known of the habits of this species in Kansas. Bailey (1932:274) found the animals to be abundant one mile east of Deming, New Mexico, and living in burrows, usually closed during the day, that had runways or lines of tracks which led from them to neighboring patches of wild sunflower and other seed-laden plants. The animals seemed to be finding an abundance of choice food at that season for they avoided all his traps and such bait as he could offer them. The food of this mouse consists mainly of seeds. These seeds usually are shelled and only the inner parts are eaten, as evidenced by the pure white color of contents of their stomachs (Bailey, *op. cit.*:275).

Bailey (*op. cit.*:275) found that in New Mexico this species has two to six young; probably two or more litters are raised each season. In the state of Kansas no detailed studies seem to have been made on reproduction.

Perognathus flavus flavus Baird

Perognatus [*sic*] *flavus* Baird, Proc. Acad. Nat. Sci. Philadelphia, 7:332, 1885, type from El Paso, El Paso County, Texas.

Perognathus flavus flavus, Miller, Bull. U. S. Nat. Mus., 128:274, 1924, Hibbard, Trans. Kansas Acad. Sci., 36:240, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 183, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:507, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):37, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:76, 1944.

Perognathus flavus, Lantz, Kansas State College Exp. Sta. Bull., 129: 335, 1905; Lantz. Trans. Kansas Acad. Sci., 19:175, 1905.

Distribution.—Western Kansas, east certainly to Trego and Kiowa counties. See map, figure 39.

Remarks.—External measurements of eight males and two females from nine miles north and three miles east of Elkhart, are: ♂ 111.8 (100-119), ♀ 108, 110; 49.6 (44-52), 50, 56; 15.4 (15-16), 16, 15; 6.4 (6-7), 6, 7.

Specimens examined.—Total, 44, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 1. *Rawlins County:* 12 mi. NE McDonald, 1; 2 mi. NE Ludell, 1. *Decatur County:* 2 mi. S, 6 mi. W Oberlin, 1. *Logan County:* Vincent Ranch, N Fork Smoky R. [= 4 mi. W 8 mi. N McAllaster], 2; Unspecified, 1. *Gove County:* Castle Rock, 1 (GCR). *Trego County:* Wakeeney, 3. *Hamilton County:* 1 mi. E Coolidge, 8. *Stanton County:* 6 mi. W, 1½ mi. S Manter, 1; 8½ mi. W, 2½ mi. S Manter, 1. *Kiowa County:* Rezeau Ranch, 5 mi. N Belvidere, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 18. *Meade County:* 9 mi. SW Meade, 1; 17 mi. SW Meade, 2. *Clark County:* Stephenson Ranch, 7 mi. S Kingsdown, 1.

Perognathus hispidus

Hispid Pocket Mouse

Two subspecies of this pocket mouse occur in Kansas. There is little danger of confusing this pocket mouse with other species that occur in the state since it is larger and has harsh fur.

Hispid pocket mice occur widely over the open plains of the western United States and, in Kansas, occur much farther east than other members of this family. They construct shallow burrows, often opening on bare ground. In New Mexico, Bailey (1932: 280) found that: "Even in the desert valleys, where low shrubby vegetation is abundant, they make their burrows in the open more often than under the shrubbery." They are active food gatherers, storing many seeds and grains in their burrows. In Rogers County, Oklahoma, Blair (1937:188) found this pocket mouse only on rocky, uncultivated prairies where it constructed burrows, usually at least partly under limestone rock fragments. Mounds of dirt, resembling those of the pocket gopher, were found at the entrances to the burrows. Large amounts of seeds were found stored in the

burrows and there was evidence that some insects were also taken as food.

Four to seven young are born in each litter. Several litters are born each season.

Perognathus hispidus paradoxus Merriam

Perognathus paradoxus Merriam, N. Amer. Fauna, 1:24, 1889, type from Banner, Trego County, Kansas; Allen, Bull. Amer. Mus. Nat. Hist., 7:265, 1895.

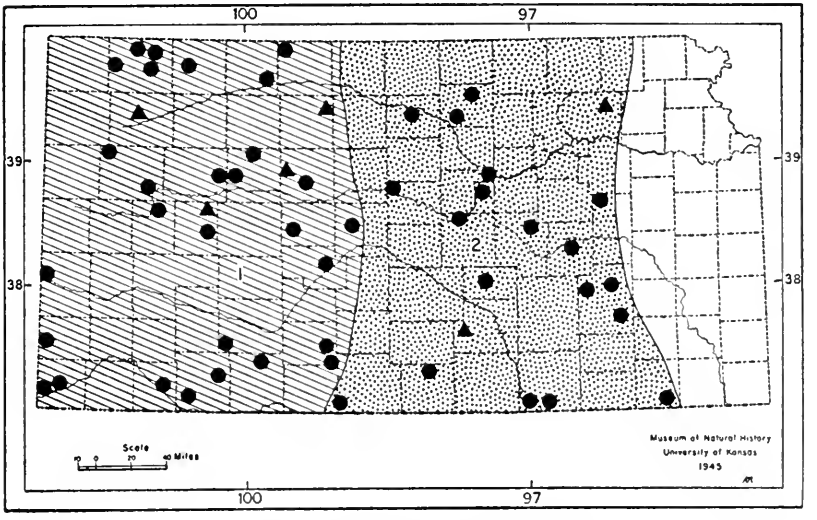

FIG. 40. Distribution of *Perognathus hispidus* in Kansas. 1. *P. h. paradoxus.* 2. *P. h. spilotus.* See figure 5 for explanation of symbols.

Perognathus hispidus paradoxus, Osgood, N. Amer. Fauna, 18:44, 1900; Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:160, 1901; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Dice, Ecology, 4:51, 1923; Dice, Jour. Mamm., 4:111, 1923; Hibbard, Trans. Kansas Acad. Sci., 36:240, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 183, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:507, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):37, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:76, 1944; Brown, Trans. Kansas Acad. Sci., 48:451, 1946; Glass, Jour. Mamm., 28:178, 1947.

Perognathus hispidus, Wooster, Trans. Kansas Acad. Sci., 43:303, 1940.

Distribution.—Western Kansas, east to Barton and Kiowa counties. See map, figure 40.

Remarks.—External measuremnts of two males and four females from 14 miles southwest of Meade, are: ♂ 207, 213, ♀ 217, 198, 207, 220; 100, 99, 98, 102, 103, 113; 27, 25, 27, 26, 27, 27; 8, 12, 12, 12, 11, 12.

Specimens examined.—Total, 79, distributed as follows: *Rawlins County:* 2 mi. NE Ludell, 2; 4 mi. N Atwood, 1; 1 mi. N McDonald, 1; 6 mi. S Atwood, 1. *Decatur County:* 2 mi. S, 6 mi. W Oberlin, 2. *Norton County:* 4 mi. W, 1 mi. S Logan, 1. *Phillips County:* 2 mi. S, 1 mi. E Long Island, 2. *Logan County:* Vincent Ranch, 1; 5 mi. W Elkader, 2. *Gove County:* Castle Rock, 2 (GCR). *Trego County:* Saline River, 8 mi. N Wakeeney, 1; Banner, 5; Hackberry Creek, "Banner", 3; Perrington Ranch, 7; Unspecified, 1. *Ellis County:* Ft. Hays State College (¼ mi. W Dairy Barns), 1. *Scott County:* State Park, 1 (GCR). *Lane County:* Walnut Creek, 12 mi. S Pendennis, 1. *Rush County:* Nekoma, 1. *Barton County:* 3 mi. N, 2 mi. W Hoisington, 5. *Hamilton County:* 1 mi. E Coolidge, 2. *Pawnee County:* 1 mi. S Larned, 1. *Stanton County:* 6 mi. W, 1½ mi. N Manter, 1. *Ford County:* 1 mi. E, 8 mi. N Fowler, 2. *Kiowa County:* 5 mi. N Belvidere, Rezeau Ranch, 1; SE corner of county, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 5; 8 mi. N Elkhart, 1. *Seward County:* 1 mi. E Arkalon, 1. *Meade County:* 11½ mi. E Meade, 2 (GCR); Meade County State Lake, 3 (2, GCR); Meade County State Park, 4 (1, GCR); 14 mi. SW Meade, 6 (2, GCR); 17 mi. SW Meade, 7. *Clark County:* 7 mi. SW Kingsdown, 1.

Additional records.—Thomas Co.: Colby, 1 (USBS). *Rooks Co.:* 4 mi. E Stockton, 1 (Ralph H. Imlerr Coll.). *Ellis County:* Ellis, 2 (USBS); Hays, 5 (USBS). *Lane County:* Pendennis, 1 (Glass, 1947:179). *Kiowa County:* 15 mi. N Belvidere, 5 (Glass, 1947:179). *Meade County:* 13 mi. SW Meade, 6 (Glass, 1947:179).

Perognathus hispidus spilotus Merriam

Perognathus paradoxus spilotus Merriam, N. Amer. Fauna, 1:25, 1889, type from Gainesville, Cooke County, Texas.

Perognathus hispidus spilotus, Black, Kansas State Board Agric., 30th Biennial Rept., p. 183, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):37, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:76, 1944; Glass, Jour. Mamm., 28:177, 1947.

Perognathus hispidus maximus, Hibbard, Trans. Kansas. Acad. Sci., 36:240, 1933.

Perognathus fasciatus, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Distribution.—Central Kansas, west certainly to Mitchell, Ellsworth, and Barber counties and east certainly to Pottawatomie, Lyon, and Montgomery counties. See map, figure 40.

Remarks.—External measurements of two males and three females from Greenwood County, are: ♂ 198, 190, ♀ 197, 196, 235; 71, 90, 93, 94, 110; 26, 25, 25, 25, 27; 12, 11, 11, 12, 13.

The color of the upper parts is an ashy ochraceous in *P. h. paradoxus* and a bright, dark ochraceous in *P. h. spilotus.* The color of the lateral line encroaches on the forearm of *P. h. spilotus,* and is white or ochraceous in *P. h. paradoxus* and dark ochraceous in *P. h. spilotus.*

Specimens examined.—Total, 49, distributed as follows: *Mitchell County:* 3½ mi. W, ½ mi. S Beloit, 1. *Cloud County:* 4 mi. E Concordia, 11; Bullock Farm, 3½ mi. E, 1 mi. N Glasco, 1. *Ellsworth County:* 1½ mi. S Wilson, 1; 2½ mi. S Wilson, 1. *Saline County:* 3½ mi. NW Solomon, 2 (AJK); 3 mi. W Solomon, 1 (AJK); 8½ mi. E Salina, 1 (AJK). *Lyon County:* 2 mi. S Chalk, 1. *McPherson County:* Smoky Hill River, 1 mi. S, ½ mi. W Linds-

borg, 1. *Marion County:* ½ mi. E Lincolnville, 1. *Chase County:* 2 mi. W Cottonwood Falls, 2. *Harvey County:* 8 mi. W Newton, 1. *Greenwood County:* 7 mi. NW Hamilton, 1 (GCR); Hamilton, 3 (GCR); ¼ mi. S Hamilton, 1 (GCR); 4 mi. S, 14 mi. W Hamilton, 1; 4 mi. S, 17 mi. W Hamilton, 1 (GCR); 7 mi. SW Toronto, 2; 8 mi. SW Toronto, 1. *Barber County:* Near South Bridge, Sun City, 1; 6 mi. N Aetna, 1. *Harper County:* 5 mi. N Harper, 1; 5 mi. NW Harper, 6. *Cowley County:* Arkansas City, 3; 8.6 mi. E Arkansas City, 1. *Montgomery County:* Coffeyville, 1 (Kansas St. Coll., Manhattan).

TABLE 15.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF PEROGNATHUS.

Sex	Number averaged or catalogue number	Occipitonasal lenth	Frontonasal length	Mastoidal breadth	Length of bulla	Interorbital breadth	Alveolar length of upper tooth-row	Interparietal width
	P. flavus flavus, 9 mi. N, 3 mi. E Elkhart, Morton County							
♂	6	21.1	14.2	12.1	8.1	4.6	6.2	3.5
	min.	20.0	13.5	11.3	7.4	4.4	3.0	3.3
	max.	22.2	15.0	13.0	8.9	4.8	3.2	3.9
♀	5295	19.6	13.5	11.3	7.0	4.2	2.8	3.1
♀	5050	20.2	13.8	10.2	7.2	4.7	3.0	3.0
	P. flavescens flavescens, 9 mi. N, 3 mi. E Elkhart, Morton County							
♀	5419	....	....	11.6	6.8	5.0	2.6	4.7
	Seward County							
♂	2866	....	14.1	....	7.8	4.8	2.9	5.0
	P. f. copei, 1½ mi. S Wilson, Ellsworth County							
♂	14045	20.9	14.1	11.5	7.0	5.0	2.8	4.8
	4½ mi. NE Danville, Harper County							
♀	13045	20.3	13.3	10.4	6.6	4.7	2.8	4.3
	P. hispidus paradoxus, Meade County							
♂	14046	....	21.5	....	....	7.6	4.4	....
♂	14053	31.2	21.6	15.4	8.3	7.4	4.2	7.8
♀	14047	32.9	22.3	16.3	8.5	7.4	4.5	7.9
♀	14048	....	21.0	16.7	8.9	7.5	4.5	....
♀	14050	30.4	21.3	15.3	8.0	6.8	4.3	7.7
	P. h. spilotus, Greenwood County							
♂	13647	32.9	21.7	16.5	8.5	7.5	4.5	8.1
♀	8649	28.4	19.1	14.3	7.3	6.6	4.0	8.2
♀	8647	28.8	19.5	14.1	7.7	6.9	4.6	8.0
♀	8648	33.9	23.0	16.1	8.6	8.0	4.4	7.8

Additional records.—Pottawatomie Co.: Onaga, 1 (OU). *Sedgwick Co.:* Garden Plain, 1 (USBS).

Genus Dipodomys Gray

Kangaroo Rats

This genus occurs in western North America, from southern Canada south to the southern limits of the Mexican Tableland and from the Pacific Coast east to the eastern limits of the Great Plains in Kansas, Oklahoma, and Nebraska. The genus is characteristically found in areas of sandy soils.

Dipodomys ordii

Ord Kangaroo Rat

The kangaroo rat occurs in most areas of sandy soil in central and western Kansas. It is readily distinguished from all other rodents in the state by the long white hairs on its ventral surface,

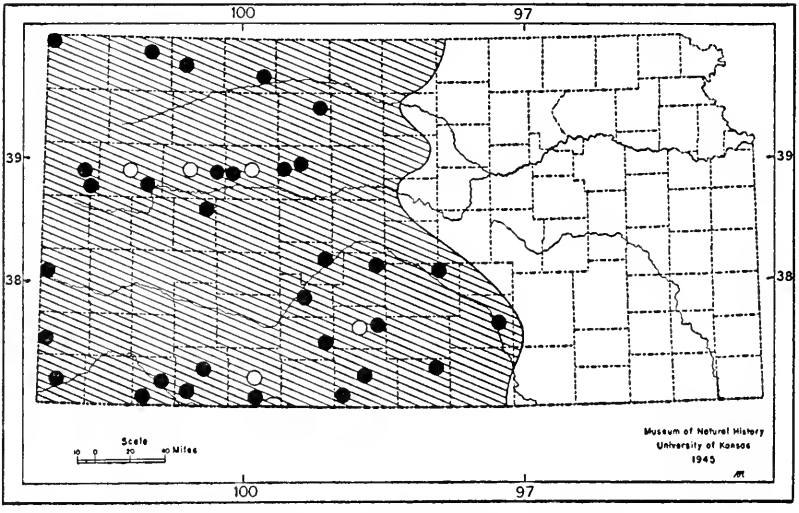

FIG. 41. Distribution of *Dipodomys ordii richardsoni* in Kansas. See figure 5 for explanation of symbols.

the prominent rump-stripe of white across the thighs, the buffy ochraceous upper parts, its long tail, weak front legs, and its long hind legs. The total length of this rat is approximately ten inches, of which the tail makes up approximately five and one-half inches.

Asdell (1945:230) reports that the young are born in the spring and fall, and that there are one to five young in each litter, the average being 3.6. Three specimens in the collection at the University of Kansas Museum of Natural History, taken in September, each contained three embryos.

Dipodomys ordii richardsoni (Allen)

Dipodops richardsoni Allen, Bull. Amer. Mus. Nat. Hist., 3:277, 1891, type from "one of the sources of the Beaver [North Canadian] River in the extreme northwestern corner of the [Indian] Territory of the so-called neutral strip." Probably Harper County, Oklahoma (Blair, 1939:116).

Dipodomys ordii richardsoni, Grinnell, Jour. Mamm., 2:96, 1921; Hibbard, Trans. Kansas Acad. Sci., 36:241, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 184, 1937; Sprague, Jour. Mamm., 20:111, 1939; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:507, 1939; Wooster, Trans. Kansas Acad. Sci., 43:303, 1940; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:76, 1944; Setzer, Univ. Kansas Publs., Mus. Nat. Hist., 1:511, 1949.

P[erodipus] ordi, Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905.

Perodipus richardsoni, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:260, 1895; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905.

Perodipus montanus richardsoni, P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):38, 1940.

P[erodipus] longipes, Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905.

D[ipodomys] Phillippi [*sic*], Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Dipodomys phillipsi ordi, Baker, Trans. Kansas Acad. Sci., 11:57, 1889.

Dipodomys Ordii, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Distribution.—Western Kansas, east certainly to Rooks, Ellis, Reno, and Sedgwick counties. See map, figure 41.

TABLE 16.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF DIPODOMYS.

Sex	Catalogue number	Greatest length of skull	Greatest breadth across bullae	Breadth across maxillary arches	Width of rostrum	Length of nasals	Least interorbital width	Basilar length
			D. ordii richardsoni, Pawnee County					
♂	16286	39.9	24.1	20.6	7.0	14.7	12.9	....
♂	16288	42.5	24.1	22.0	7.6	15.2	13.4	26.4
♂	16290	40.6	25.0	21.8	7.5	14.9	13.0	25.8
♀	16284	42.3	26.3	23.1	7.8	15.2	13.6	28.2
♀	16287	39.3	23.6	21.3	7.8	13.8	13.6	25.3
♀	16289	38.8	23.8	21.5	7.3	14.1	13.0	25.4

Remarks.—External measurements of five males and three females from three miles south and one and one-half miles west of Larned, are: ♂ 254.6 (247-263), ♀ 262, 258, 258; 140.2 (136-147),

140, 133, 131; 40.2 (39-42), 40, 42, 42; 13.2 (13-14), 14, 14, 13; weight in grams, 69.0 (54.4-81.9), 73.7, 93.6, 68.8.

Specimens examined.—Total, 243, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 7. *Rawlins County:* 2 mi. NE Ludell, 2; 1½ mi. W Ludell, 1. *Decatur County:* 2 mi. S, 6 mi. W Oberlin, 4. *Norton County:* 4 mi. W, 1 mi. S Logan, 1. *Rooks County:* 1 mi. S Woodston, 1. *Wallace County:* Lacey Ranch, 4½ mi. E, 9 mi. S Wallace, 1; 2 mi. S Wallace, 2. *Logan County:* 5 mi. W Elkader, 3; Unspecified, 2. *Gove County:* Castle Rock, 10 (GCR); Unspecified, 1. *Trego County:* Banner, 8 (USNM); Perrington Ranch, 12 mi. S Collyer, 2; Unspecified, 8 (USNM). *Ellis County:* Ellis, 1 (USBS); 12 mi. N, 3 mi. W Hays, 2000 ft., 1. *Lane County:* Pendennis, 10 (USBS). *Hamilton County:* Coolidge, 1 (CNHM); 1 mi. E Coolidge (Conard Farm), 5. *Pawnee County:* 1 mi. S Larned, 4; 2 mi. S, ¼ mi. W Larned, 2; 3 mi. S, 1½ mi. W Larned, 10. *Edwards County:* Kinsley, 3 (USBS); 3½ mi. E Kinsley, 5; S side Arkansas River, 2 mi. S Kinsley, 1; 1 mi. W, 3½ mi. S Kinsley, 9. *Stafford County:* Little Salt Marsh, 15 mi. N, 3 mi. E Stafford, 2. *Reno County:* Medora, 1 (MZ); 2 mi. W, ½ mi. S Medora, 4. *Stanton County:* 6 mi. W, 1½ mi. N Manter, 2; 6 mi. W, 1 mi. N Manter, 3. *Kiowa County:* 5 mi. N Belvidere, 1. *Pratt County:* Cairo, 2 (USBS); Unspecified, 1. *Sedgwick County:* Wichita, 6 (AMNH). *Morton County:* 9 mi. N, 3 mi. E Elkhart, 36. *Seward County:* 1 mi. E Arkalon, 7; Liberal, 1; Unspecified, 1. *Meade County:* Meade, 1 (USNM); 13 mi. SW Meade, 6; 14 mi. SW Meade, 1; 17 mi. SW Meade, 7. *Clark Co.:* 12 mi. S Ashland, 4 (1, MZ); Unspecified, 1. *Barber County:* Medicine Lodge, 4; 1 mi. NW Aetna, 1; 1 mi. W Aetna, 5; ½ mi. W Aetna, 1; Aetna, 5; 1 mi. SW Aetna, 11; 1 mi. S Aetna, 2; 1½ mi. SW Aetna, 1; 2 mi. S Aetna, 5; Unspecified, 2. *Harper County:* 2 mi. NE Runnymede, 3; 4½ mi. NE Danville, 12.

Family Castoridae

Beavers

This family has only one living genus, *Castor*, and it is known from North America, Europe, and Asia. The beaver scarcely needs description; its adaptations for a semi-aquatic life, the broad, scaly, horizontally flattened tail, and its webbed hind feet, are known to almost everyone. The dental formula is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{3}{3}$.

Castor canadensis

American Beaver

When the early settlers first came to Kansas they found the beaver to be common along most of the streams in the state. Mead (1905:8) reported them to be common along the Saline River in 1859. J. A. Allen (1874:49) reported that they were "still quite frequent along the timbered portions of the streams" in middle and western Kansas. In 1875 Knox reported (1875:22) that beaver were: "common along most of the large streams. Getting scarce in the eastern parts of the State. Does much damage to timber along the streams." Kellogg (1915, unpublished thesis) reported that: "Mr. Jay Swink who trapped near Timber Canyon Ranch in

Scott County collected in 1884 nearly two hundred skins from the creeks in that vicinity." In 1889, Baker (1889:57) wrote that the beaver was formerly common in western Kansas, being ". . . found along all streams whose banks are not too sandy; it is now rapidly disappearing." Lantz (1905B:334) stated that beaver were ". . . common along most Kansas Streams as late as 1880; now rare." Dyche (1907:165) reported that "The beaver in Kansas is a rare animal, and it will not be many years until it will be placed on the list with the deer, buffalo, bear, and other animals that have

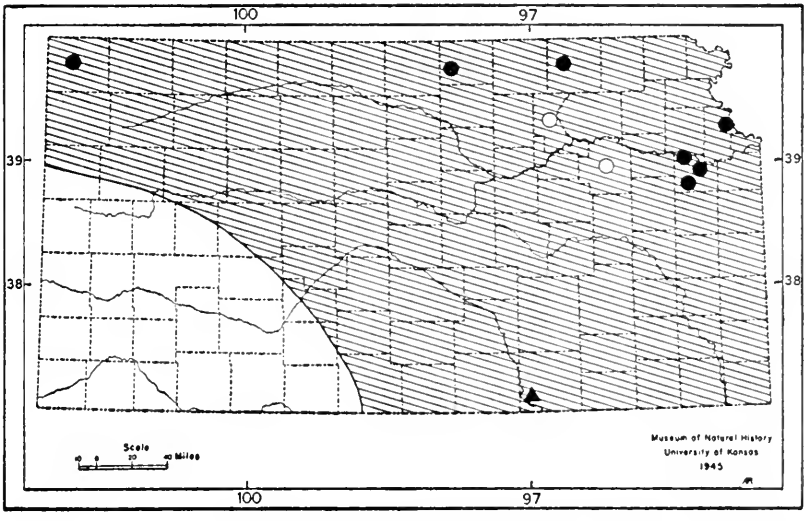

FIG. 42. Distribution of *Castor canadensis missouriensis* in Kansas. See figure 5 for explanation of symbols.

become extinct. There is no law to protect them, and the old beaver trappers will travel miles to get just one more, each trapper making the excuse that if he does not catch the beaver the other fellow will. . . . The first winter (1877 and 1878) I spent at Lawrence there were a number of beavers living within a mile of the city. . . . I have not heard of a beaver being taken anywhere near Lawrence since the winter of 1888 and 1889, until November of this year [1907], when one was taken within a few miles of Lawrence."

Legislation protecting the beaver was enacted sometime between the years of 1907 and 1924, the exact date being unknown to me. Dyche (1907:165) stated that no protecting law existed at that time and the Fifth Biennial Report of the Kansas Fish and Game De-

partment for the years 1923-24, states (p. 19) merely that, "Beaver are protected.", without further comment.

Bailey (1922:22) indicated that beaver did not occur in Kansas at that time. Later (1927:3) he published a map indicating that beaver were more widespread in distribution in the United States than he had indicated earlier, but Kansas still was indicated as an area not having beaver. Dr. E. Raymond Hall tells me, however, that he saw beaver sign on the Wakarusa River directly south of Lawrence, Douglas County, in the period 1920-1923 and a specimen taken at Lecompton, Douglas County, on November 12, 1920, is preserved in the Museum of Natural History. The Fifth Biennial Report of the Kansas Fish and Game Department for 1923-1924, states (p. 19): "Beaver are protected. They appear in the Republican, Saline, Arkansas and Solomon valleys, being more numerous in the Republican valley. . . ." It seems, therefore, that Bailey (1922, 1927) had incomplete information concerning the status of the beaver in Kansas.

Hibbard (1933:241) and Black (1937:185-186) thought that the beaver found here when white men arrived was representative of the eastern subspecies, *Castor canadensis carolinensis*, that this beaver was exterminated by the white man by 1900, and that later another subspecies, *Castor canadensis missouriensis*, invaded the state from the northwest.

Hibbard and Black probably obtained this idea from the late Charles Dean Bunker of the University of Kansas Museum of Natural History, and possibly also from an unpublished manuscript prepared in 1915 by Remington Kellogg. At any rate, Kellogg (oral information, 1951) believes that he obtained the idea from Bunker.

The beaver now in Kansas are probably descendants of native beaver that remained in isolated colonies in central and northwestern Kansas. Mr. William "Billie" Wilson, a fur buyer at Olathe, Kansas, is a keen observer and is well informed on the history and conditions of game and fur-bearing mammals in the Great Plains. Mr. Wilson recounted to me (in January, 1952) an example of an isolated colony of beaver in north-central Kansas. In the winter of 1899-1900, Mr. Wilson and two companions spent several months trapping for fur bearers in north-central and northeastern Kansas. They left Fairbury, Nebraska, and went downstream on the Little Blue River to the Big Blue River, upstream on the Big Blue to the Kansas-Nebraska state line, downstream again to the Kansas River and down that stream to Lawrence, Kansas. The only sign of beaver seen on this trip was that of one "family" seen on the

Little Blue River above Manhattan at the mouth of Walnut Creek. At that same time, however, several scattered colonies of beaver were on the Republican River upstream from Concordia, Kansas.

Many beaver have been transplanted within the state. Each of the biennial reports of the Kansas Forestry, Fish, and Game Commission for the periods ending in 1930, 1938, 1942, 1944, 1946, 1948, and 1950, report that beaver had been live trapped from over-populated areas and released elsewhere in the state. Data as to the localities of capture and release were not given. W. C. Justice (*in litt.*) informs me that beaver were released between 1930 and 1935 in the Arkansas River in Cowley County. Perhaps these were transplanted by the Forestry, Fish, and Game Commission.

At least since 1929 the Forestry, Fish, and Game Commission has trapped and pelted some beaver. Table 17 shows, by years, the numbers of such skins taken in the state. These figures were compiled from the sources given in table 1 and were checked by Mr. Dave Leahy, Director of the Kansas Forestry, Fish, and Game Commission.

TABLE 17.—NUMBERS OF BEAVER PELTS TAKEN IN KANSAS BY YEARS; COMPILED FROM THE SOURCES GIVEN IN TABLE 2. NO PELTS WERE REPORTED IN 1934 AND 1940.

1929	1930	1938	1941	1942	1943	1944	1945	1946	1947-48	1948-49	1949-50
66	280	30	368	292	350	246	218	205	237	269	355

The beaver has but a single litter each year. Four to six young is the usual size of the litter although it may vary from one to eight. The length of the gestation period is approximately three months. Beavers grow rather slowly and do not reach full size for three or more years.

Castor canadensis missouriensis Bailey

Castor canadensis missouriensis Bailey, Jour. Mamm., 1:32, 1919, type from Apple Creek, 7 mi. E Bismarck, Burleigh County, North Dakota; Hibbard, Trans. Kansas Acad. Sci., 36:241, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 185, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):38, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:76, 1944; Brumwell, Amer. Midland Nat., 45:212, 1951.

Castor fiber, J. A. Allen, Bull. Essex Inst., 6:49, 1874.

Castor Canadensis, Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Castor canadensis, Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Dyche, Trans. Kansas Acad. Sci., 21:165, 1907.

Castor canadensis canadensis, Dice, Jour. Mamm., 4:111, 1923.

Castor canadensis carolinensis, Hibbard, Trans. Kansas Acad. Sci., 36:241, 1933.

Distribution.—Probably in suitable habitats throughout all but the southwestern corner of the state. See map, figure 42.

TABLE 18.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF CASTOR.

Sex	Catalogue number	Occipitonasal length	Condylobasal length	Basilar length	Zygomatic breadth	Mastoidal breadth	Interorbital constriction	Length of nasals	Greatest width of nasals
				C. canadensis missouriensis, Clay County					
♂	14397	127.4	126.8	114.1	96.5	....	25.5	43.9	24.5
♂	14391	109.6	106.3	....	78.4	61.3	23.7	35.2	22.1
♀	14390	111.5	....	....	80.9	....	23.0	38.6	20.6
♀	14395	134.5	133.5	115.8	92.0	72.2	26.0	49.0	24.0
♀	14393	138.7	139.2	127.4	103.0	79.6	27.0	52.8	23.1

Remarks.—External measurements of two females, one from the west side of the Missouri River, one and three-fourths miles downstream from Leavenworth and one from North Lawrence, are: 965, 967; 410, 330; 174, 160; 33, 33.

Specimens examined.—Total, 33, distributed as follows: *Cheyenne County:* St. Francis, 7. *Republic County:* Scandia, 4. *Marshall County:* Marysville, 2. *Riley County:* Unspecified, 5. *Leavenworth County:* W side Missouri River, 1¾ mi. downstream from Leavenworth, 1. *Wabaunsee County:* Unspecified, 1. *Douglas County:* Lecompton, 1; Near Lecompton, 1; Kaw River, 1; ½ mi. N Lawrence, 1; North Lawrence, 1; 3 mi. E Lawrence, 3; 10 mi. SW Lawrence, 1; Unspecified, 4.

Family Cricetidae

Native Rats and Mice

Nine genera and 15 species of this family occur in Kansas. These animals are diverse in appearance, but all are small, have well-furred bodies and a dental formula of: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{0}{0}$, m. $\frac{3}{3}$. The tail usually is sparsely haired and, depending on the species, varies from short to long. The molar crowns are either prismatic or tuberculate, with, in the latter, only two longitudinal rows of tubercles. The following key will aid in the separation of the species in Kansas.

1. Tail scaly and laterally compressed (rudder-shaped); toes on hind feet with stiff bristles; skull more than 50 mm. in length, *Ondatra zibethicus*, p. 197

1′. Tail not scaly nor compressed; toes of hind feet without stiff bristles; skull less than 50 mm. in length.....2

2.(1′) Cheek teeth with cusps; no flat occlusal area composed of tracts of dentine surrounded by enamel.....3

2'. Cheek teeth without cusps, flat occlusal area composed of tracts of dentine surrounded by enamel and separated by reentrant angles 11

3.(2) Cusps on cheek teeth not flattened and not divided into S-shaped lophs; tooth row less than 5.0 mm.; guard hairs not prominent and pelage smooth to the touch 4

3'. Cusps on cheek teeth flattened and divided into S-shaped lophs; tooth row more than 5.0 mm.; guard hairs prominent and pelage rough to the touch ..... *Sigmodon hispidus*, p. 184

4.(3) Tail less than 60 per cent of length of head and body; coronoid process of mandible high ..... *Onychomys leucogaster*, p. 160

4'. Tail more than 60 per cent of length of head and body; coronoid process of mandible low 5

5.(4') Upper incisors grooved on anterior face 6

5'. Upper incisors not grooved on anterior face 8

6.(5) Upperparts golden brownish; venter grayish white, usually washed with buff; length of tail more than 77 mm., *Reithrodontomys fulvescens*, p. 163

6'. Upperparts grayish or brownish; venter never washed with buffy; length of tail less than 77 mm. 7

7.(6') Dorsal tail-stripe wide, covering dorsal surface of tail; venter grayish; middorsal stripe faintly defined; length of tail usually more than 65 mm.; greatest length of skull usually more than 20.3 mm.; in unworn dentition, small accessory cusp evident on outer surface of first lower molar between first and second larger cusps ..... *Reithrodontomys megalotis*, p. 164

7'. Dorsal tail-stripe narrow, not covering dorsal surface of tail; middorsal stripe usually well defined; length of tail usually less than 65 mm.; greatest length of skull less than 20.3 mm.; no accessory cusp evident ..... *Reithrodontomys montanus*, p. 167

8.(5') Total length more than 225 mm.; skull more than 30 mm.; temporal ridges forming pronounced beads on sides of skull above orbits ..... *Oryzomys palustris*, p. 280 (see hypothetical list)

8'. Total length less than 225 mm.; skull less than 30 mm.; temporal ridges not forming pronounced beads on sides of skull above orbits 9

9.(8') Length of hind foot more than 23.5 mm.; length of ear more than 18 mm.; skull more than 26.8 mm. ..... *Peromyscus boylii*, p. 180

9'. Length of hind foot less than 23.5 mm.; length of ear less than 18 mm.; skull less than 26.8 mm. 10

10.(9') Tail-length usually less than 65 mm., sharply bicolored; hind foot less than 21 mm.; skull usually less than 22 mm., *Peromyscus maniculatus*, p. 171

10'. Tail-length usually more than 65 mm., faintly if at all bicolored; skull usually more than 22 mm. ..... *Peromyscus leucopus*, p. 176

11.(2') Total length more than 300 mm.; skull more than 35 mm. 12

11'. Total length less than 300 mm.; skull less than 35 mm. 13

12.(11) Color fulvous or rufous above; length of incisive foramina less than 11 mm.....*Neotoma floridana*, p. 187
12'. Color gray above, without rufous tinge, pure white below; length of incisive foramina more than 11 mm....*Neotoma micropus*, p. 190
13.(11') Tail as short as, or shorter than, hind foot; upper incisors grooved on front surface.....*Synaptomys cooperi*, p. 193
13'. Tail one and one-half times, or more, longer than hind foot; upper incisors not grooved on front surface.....14
14.(13') Tail more than 25 mm.; adults dark grayish colored; second upper molariform tooth with five loops and triangles, *Microtus ochrogaster*, p. 201
14'. Tail less than 25 mm.; adults chestnut colored; second upper molariform tooth with four loops and triangles, *Pitymys pinetorum*, p. 199

Genus Onychomys Baird

Grasshopper Mice

There are two living species of this genus, only one of which occurs in Kansas. They resemble mice of the genus *Peromyscus* but have stouter bodies and shorter tails.

Onychomys leucogaster

Northern Grasshopper Mouse

Two subspecies of *Onychomys leucogaster* occur in the state. In each, the tail is less than half the length of the head and body and is thick and tapering, the hind feet have four tubercles, and the pelage is soft and silky. Immature specimens are grayish to blackish brown above, and are without the white ear tufts of the adults. The total length is approximately six inches; the tail comprises approximately one and one-half inches of the total.

These mice have been treated systematically by Hollister (1914), and Bailey (1929) gave data on their life history and habits.

Grasshopper mice feed on a great variety of insects, which make up most of their diet, but they take also seeds and other vegetable foods when insects are scarce. In captivity they have been seen to kill rodents of other species and then feed on their bodies. Grasshopper mice may dig shallow burrows, but some naturalists suggest that they generally use abandoned burrows or those of their victims. They are mainly nocturnal, spending most of the daytime in burrows.

According to Asdell (1945:242), the breeding season of the grasshopper mouse is from April to September, and after a gestation period of approximately 33 days, two to six young, usually four,

are born in an underground nest. One female may have more than one litter in each season. Bailey (1929:10) stated that the young weigh two and one-half to three grams each at birth and that: "The young were naked and helpless, with eyes and ears closed and no trace of teeth showing through, on the eleventh day their incisors were well out and their ears open, and on the fifteenth day their eyes opened. They were not weaned until they were about 24 days old and nearly half grown, but they had been eating seeds, rolled oats, and green food for a week."

The grasshopper mice are practically harmless to man's interests —in fact one may consider them to be actually beneficial in that insects do make up such a large percentage of their diet.

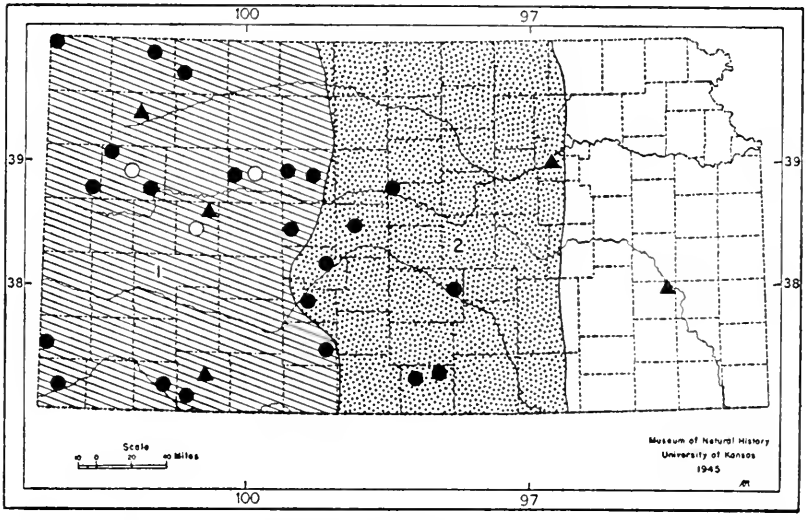

FIG. 43. Distribution of *Onychomys leucogaster* in Kansas. 1. *O. l. arcticeps.* 2. *O. l. breviauritus.* See figure 5 for explanation of symbols.

Onychomys leucogaster arcticeps Rhoads

Onychomys arcticeps Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 194, type from Clapham, Union County, New Mexico.

Onychomys leucogaster arcticeps, Hollister, Proc. U. S. Nat. Mus., 47(2057):439, 1914; Bailey and Sperry, U. S. Dept. Agric., Tech. Bull., 145:4, 1929; Hibbard, Trans. Kansas Acad. Sci., 36:241, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 187, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:507, 1939; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):38, 1940; Rinker, Trans. Kansas Acad. Sci., 45:376, 1942.

Onychomys leucogaster articeps [*sic*], Hibbard, Trans. Kansas Acad. Sci., 47:77, 1944.

Onychomys leucogaster, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:268, 1895; Elliot, Field Columbian Museum Publ., No. 115, Zool. Ser., 8:200, 1907; Wooster, Trans. Kansas Acad. Sci., 43:302, 1940.

Onychomys torridus, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905.

O[nychomys] torridus, Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905.

H[esperomys] leucogaster, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Hesperomys leucogaster, Baker, Trans. Kansas Acad. Sci., 11:56, 1889.

Distribution.—Western Kansas, east, certainly to Ellis, Rush and Kiowa counties. See map, figure 43.

Remarks.—External measurements of three males and one female from two miles northeast of Ludell, are: ♂ 157, 148, 156, ♀ 144; 48, 51, 36, 39; 23, 22, 23, 23; 18, 18, 18, 19.

Specimens examined.—Total, 142, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 1. *Rawlins County:* 1½ mi. NW Ludell, 1; 2 mi. NE Ludell, 8; 1½ mi. W Ludell, 3. *Decatur County:* 2 mi. S, 6 mi. W Oberlin, 1; 5 mi. S, 8 mi. W Oberlin, 1. *Wallace County:* Lacey Ranch, 2. *Logan County:* 5 mi. W Elkader, 14; Vincent Ranch, Sect. 7, T11S, R37W, 4 mi. W, 8 mi. N McAllaster, 1; Unspecified, 3. *Trego County:* Banner, Hackberry Creek, 1; Perrington Ranch, 2; 12 mi. S Collyer, 1; Unspecified, 6. *Ellis County:* 4 mi. N, 3 mi. E Hays, 2000 ft., 1; Ellis, 1. *Lane County:* Unspecified, 1. *Rush County:* Nekoma, 1. *Stanton County:* 7½ mi. W, 1 mi. N Manter, 1; 6 mi. W, 1 mi. N Manter, 1. *Kiowa County:* Rezeau Ranch, 5 mi. N Belvidere, 30 (2, GCR). *Morton County:* 9 mi. N, 3 mi. E Elkhart, 14. *Seward County:* 1 mi. E Arkalon, 1. *Meade County:* 13 mi. SW Meade, 9; State Lake, 8 (4, GCR); State Park, 3; 14 mi. SW Meade, 19 (5, GCR); 17 mi. SW Meade, 7.

Additional records.—Thomas Co.: Colby, 5 (Hollister, 1914:441). *Logan County:* Unspecified, 13 (Hollister, 1914:441). *Trego County:* Unspecified, 15 (Hollister, 1914:441). *Ellis Co.:* Ellis, 1 (Hollister, 1914:441). *Lane Co.:* Pendennis, 9 (Hollister, 1914:441). *Meade Co.:* Meade, 1 (Hollister, 1914:441).

Onychomys leucogaster breviauritus Hollister

Onychomys leucogaster breviauritus Hollister, Proc. Biol. Soc. Washington, 26:216, 1913, type from Fort Reno, Canadian County, Oklahoma; Hollister, Proc. U. S. Nat. Mus., 47(2057):453, 1914; Hibbard, Trans. Kansas Acad. Sci., 36:241, 1933; Black, Kansas State Board Agric., 30 Biennial Rept., p. 187, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):39, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:77, 1944.

Hesperomys leucogaster, Coues, Monograph N. Amer. Rodentia, p. 109, 1877.

Onychomys leucogaster, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905.

Distribution.—Central Kansas, from Edwards County north and east to Ellsworth County, and south to Harper County. Reported from Geary and Woodson counties. See map, figure 43.

Remarks.—External measurements of four males and one female from Harper County, are: ♂ 148.2 (140-152), ♀ 138; 43.5 (41-45), 42; 22.0 (22-22), 21.5; 16.0 (15-17), 15.

In *O. l. arcticeps* the upper parts are buffy brown, lightly washed

with pinkish; the tuft of hair at the base of the ear is white; the tail is white except for a narrow strip of brownish on the basal two-thirds of the upper surface. In *O. l. breviauritus* the upper parts are rich brown; the ear tufts are cinnamon buff; the upper surface of the tail is grayish brown almost to the tip.

Specimens examined.—Total, 32, distributed as follows: *Ellsworth County:* 1½ mi. S Wilson, 2. *Barton County:* 3 mi. N, 2 mi. W Hoisington, 5. *Pawnee County:* 2 mi. S, ¼ mi. W Larned, 1; 3 mi. S, 1½ mi. W Larned, 1. *Edwards County:* 3½ mi. E Kinsley, 5; 1 mi. W, 3½ mi. S Kinsley, 10. *Reno County:* 8 mi. N, 1 mi. E Haven, 1. *Harper County:* 2 mi. NE Runnymede, 2; 8 mi. NE Harper, 1; 5 mi. NW Harper, 3; 4½ mi. NE Danville, 1.

Additional records.—County Unknown: Republican River, 1 (Coues, 1877: 109). *Geary Co.:* Fort Riley, 1 (Hollister, 1914:454). *Woodson County.* Neosho Falls, 4 (1, Hollister, 1914:454 and 3, Coues, 1877:109). *Edwards Co.:* Kinsley, 1 (Hollister, 1914:454).

Genus Reithrodontomys Giglioli

Harvest Mice

Three species of this genus occur in Kansas. All three are mouselike in general appearance, with long, slender, sparsely haired tails; mammae in three pairs, one pectoral and two inguinal; and each upper incisor with a deep, longitudinal groove near its middle. Two species, *Reithrodontomys megalotis* and *R. montanus,* occur widely over all but the southeastern part of the state while the third, *R. fulvescens,* is found only in the southeastern area of the state.

Reithrodontomys fulvescens

Golden Harvest Mouse

This species differs from the other two species of *Reithrodontomys* in Kansas in that the color of the upper parts is rich ochraceous tawny, heavily intermixed with blackish brown, producing a general color effect of golden brown, and the length of the tail is more than 80 mm. This harvest mouse is approximately seven inches in length, of which the tail comprises three and one-half inches.

The golden harvest mouse has been taken in mixed brush and grass habitat, often in the lowlands along streams. Nothing is known of its habits in the state. According to Asdell (1946:243), on the basis of one record, two young are born in a litter.

Reithrodontomys fulvescens aurantius Allen

Reithrodontomys mexicanus aurantius J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:137, 1895, type from Lafayette, Lafayette Parish, Louisiana.

Reithrodontomys fulvescens aurantius, Howell, N. Amer. Fauna, 36:48, 1914; Hibbard, Trans. Kansas Acad. Sci., 36:242, 1933; Black, Jour. Mamm., 16:231, 1935; Black, Kansas State Board Agric., 30th Bien-

nial Rept., p. 189, 1937; Hibbard, Univ. Kansas Sci. Bull., 25:177, 1938; Sprague, Jour. Mamm., 20:102, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):40, 1940.

Reithrodontomys fluvescens aurantius [sic], Hibbard, Trans. Kansas Acad. Sci., 47:78, 1944.

R[eithrodontomys] chrysotis, Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905.

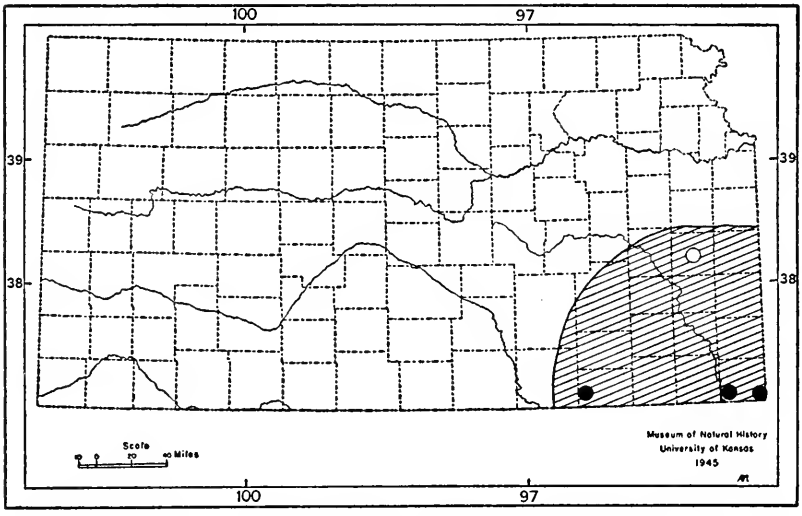

FIG. 44. Distribution of *Reithrodontomys fulvescens aurantius* in Kansas. See figure 5 for explanation of symbols.

Distribution.—Southeastern Kansas; known only from Anderson, Chautauqua, and Cherokee counties. See map, figure 44.

Remarks.—External measurements of three males from Cherokee County, are: 155, 165, 154; 83, 89, 85; 22, 19, 22; 15, – –, 13.

Specimens examined.—Total, 5, distributed as follows: *Anderson County:* Unspecified, 1. *Chautauqua County:* 1½ mi. SW Cedarvale, 1. *Cherokee County:* Mouth of Cherry Creek, Neosho River, 1; 18 mi. SW Columbus, 1; ½ mi. N, ½ mi. W Tristate monument, 1.

Reithrodontomys megalotis

Western Harvest Mouse

From *Reithrodontomys montanus* this species differs in that it is slightly larger in external measurements; the dorsal stripe is never so distinct; the dorsal black stripe on the tail is wide, usually between one-fourth and one-third of the tail-diameter; and the ventral surface has a decidedly grayish cast. This grayish cast of the ventral surface results from each hair having only a small amount of the end tipped with white. Other than a slightly larger average size

in *R. megalotis,* I know of no consistent cranial difference between these two species. In most young individuals of *R. megalotis,* with unworn or slightly worn teeth, a small accessory cusp can be found on the outer edge of the first lower molar, interposed between the first and second larger cusps. This accessory cusp is absent in young *R. montanus* and is not evident in *megalotis* with worn teeth.

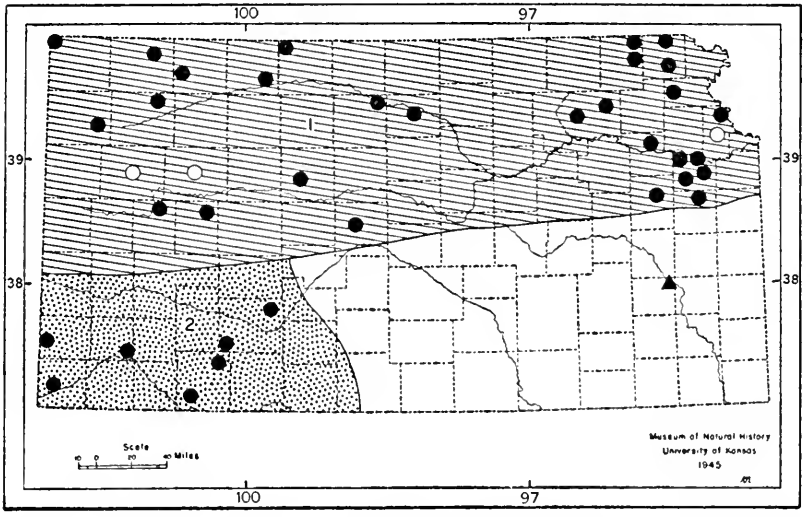

FIG. 45. Distribution of *Reithrodontomys megalotis* in Kansas. 1. *R. m. dychei.* 2. *R. m. aztecus.* See figure 5 for explanation of symbols.

In eastern Kansas the western harvest mouse is found in tall grasses, often associated with brush and tall weeds of fence rows. In western Kansas, Hill and Hibbard (1943:22) found this species in the sunflower-tall grass association.

These harvest mice may be active at any time of the day or night throughout the year. Their nest is usually a ball of grass with an opening in the side. The nest may rest on the ground or may be suspended a few inches above the ground in tall grass. Their food consists almost entirely of grass seeds and weed seeds.

According to Asdell (1946:239), the litter size at birth varies from one to seven. The period of gestation is 23 to 24 days, and the breeding period is at any time of the year but is mostly from April to October. Five specimens from Kansas in the collection of the University of Kansas Museum of Natural History have the number of embryos indicated on the labels. The number of embryos average 4.8 with extremes of four to six. By months these were distributed as follows: March, 1; June, 2; July, 1; and November, 1.

Reithrodontomys megalotis dychei Allen

Reithrodontomys dychei, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:120, 1895, type from Lawrence, Douglas County, Kansas; Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:96, 1901; Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Kansas State College Exp. Sta. Bull. 129:335, 1905.

Reithrodontomys megalotis dychei, Howell, N. Amer. Fauna, 36:30, 1914; Linsdale, Jour. Mamm., 8:52, 1927; Linsdale, Jour. Mamm., 9:144, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:242, 1933; Hibbard, Jour. Mamm., 18:102, 1937; Black, Kansas State Board Agric., 30th Biennial Rept., p. 189, 1937; Hibbard, Univ. Kansas Sci. Bull., 25(7):176, 1938; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):40, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:78, 1944; Brumwell, Amer. Midland Nat., 45:212, 1951.

Reithrodontomys megalotis, Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:137, 1947.

Reithrodontomys dychii [sic], Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:256, 1907.

Reithrodontomys megolantis duchei [*sic*], Brown, Trans. Kansas Acad. Sci., 48:451, 1946.

Reithrodontomys dychei nebrascensis, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905.

R[eithrodontomys] dychei nebrascensis, Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905.

Ochetodon humilis, Knox, Trans. Kansas Acad. Sci., 4:21, 1875; Coues, Monogr. N. Rodentia, p. 126, 1877; Cragin, Bull. Washburn College Lab. Nat. Hist., 147, 1885; Baker, Trans. Kansas Acad Sci., 11:58, 1889.

Distribution.—Northern half of Kansas, south certainly to Scott, Lane, Barton, and Franklin counties. See map, figure 45.

Remarks.—External measurements of 15 males and 12 females from Douglas County, are: ♂ 131.0 (118-147), ♀ 135.8 (119-151); 63.7 (55-76), 64.4 (55-72); 16.8 (14-18), 16.7 (16-18); 12.1 (10-13), 13.4 (11.5-16). Weights, in grams, of five males and five females are: 11.1 (8.7-14); 12.8 (9.5-16.4).

Specimens examined.—Total, 157, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 1. *Rawlins County:* 2 mi. NE Ludell, 17; 2 mi. S Ludell, 2. *Decatur County:* 5 mi. S, 8 mi. W Oberlin, 1. *Norton County:* 4 mi. W, 1 mi. S Logan, 4. *Phillips County:* 2¼ mi. SE Long Island, 1. *Nemaha County:* Nebraska-Kansas state line, 7 mi. N Sabetha, 1; 2½ mi. S Sabetha, 6. *Brown County:* 1 mi. E Reserve, 2; 5 mi. S Hiawatha, 4. *Doniphan County:* Geary, 1. *Sherman County:* 1½ mi. E, 1½ mi. S Edson, 1. *Thomas County:* 10 mi. N, 6 mi. E Colby, 3100 ft., 5. *Osborne County:* ½ mi. W Downs, 4. *Mitchell County:* 3½ mi. W, ½ mi. S Beloit, 1500 ft., 5. *Pottawatomie Co.:* 1 mi. NW Fostoria, 1; Onaga, 18 (USBS). *Atchison County:* 1½ mi. S Muscotah, 8; 4½ mi. S Muscotah, 2. *Leavenworth County:* Ft. Leavenworth, 2; Unspecified, 3. *Logan County:* Unspecified, 2. *Gove County:* Unspecified, 1. *Ellis County:* 4 mi. W, ½ mi. S Hays, 2250 ft., 6; 3½ mi. W, ½ mi. S Hays, 2250 ft., 6. *Shawnee County:* 1 mi. S Silver Lake, 2. *Douglas County:* 4½ mi. N Lawrence, 1; 4 mi. N, 1¾ mi. E Lawrence, 4; ½ mi. NW Lecompton, 1; 5 mi. W Lawrence, 1; 2 mi. W Lawrence, 3; 1 mi. W Lawrence, 4; Fort Lake, Lawrence, 1; Lawrence, 16; 1 mi. SW Lawrence, 1; 2 mi. SW Lawrence, 1; 7 mi. SW Lawrence, 1; Rock Creek,

850 ft., 10 mi. SW Lawrence, 3; N end of Lone Star State Lake, 9 mi. S, 7 mi. W Lawrence, 1; Unspecified, 1. *Scott County:* State Park, 2 (GCR). *Lane Co.:* Pendennis, 5 (USBS). *Barton County:* 3 mi. N, 2 mi. W Hoisington, 3. *Osage County:* 3 mi. N Lyndon, 1. *Franklin County:* 4 mi. N Ottawa, 2.

Additional records.—*Woodson Co.:* Neosho Falls, 1 (Howell, 1914:32).

Reithrodontomys megalotis aztecus Allen

Reithrodontomys aztecus J. A. Allen, Bull. Amer. Mus. Nat. Hist., 5:79, 1893, type from LaPlata, San Juan County, New Mexico.

Reithrodontomys megalotis aztecus, Howell, N. Amer. Fauna, 36:30, 1914; Hill and Hibbard, Jour. Mamm., 24:24, 1943; Hibbard and Rinker, Univ. Kansas Sci. Bull., 29:263, 1943; Hibbard, Trans. Kansas Acad. Sci., 47:77, 1944.

Reithrodontomys megalotis, Rinker, Trans. Kansas Acad. Sci., 45:376, 1942.

Distribution.—Southwestern Kansas, north, certainly to Stanton and Grant counties and east to Meade and Ford counties. See map, figure 45.

Remarks.—External measurements of nine males and three females from 14 miles southwest of Meade, are: ♂ 149.3 (142-155), ♀ 139, 143, 156; 72.1 (68-77), 67, 64, 77; 18.2 (17-20), 18, 17, 18; 13.7 (13-15), – –, 14, 13.

Specimens examined.—Total, 61, distributed as follows: *Stanton County:* 7½ mi. W, 1 mi. N Manter, 1; 6 mi. W, 1 mi. N Manter, 1. *Grant County:* 9 mi. W, 2 mi. S Satanta, 1. *Ford County:* ½ mi. NW Bellefont, 10; 6¼ mi. N Fowler, 2. *Morton County:* 8 mi. N Elkhart, 1; 7½ mi. N, 1½ mi. W Elkhart, 2. *Meade County:* 1 mi. N, 1 mi. E Fowler, 9 (GCR); 1¼ mi. N, ¾ mi. E Fowler, 2; 14 mi. SW Meade, 14; State Park, 16 (GCR); 17 mi. SW Meade, 2.

Reithrodontomys montanus

Pygmy Harvest Mouse

This species occurs only in the central United States, from South Dakota southward through Nebraska, eastern Colorado, Kansas, Oklahoma, eastern New Mexico, central and western Texas, and into northern Mexico. From the western harvest mouse, *R. megalotis*, *R. montanus* differs in its slightly smaller size, the presence of a dorsal stripe, a narrow dorsal black stripe on the tail, and a white ventral surface.

In general this species shows an ecological separation from the western harvest mouse. Hill and Hibbard (1943:22) found this species to be typical of short grass and prickly pear cactus associations. In eastern Kansas I have taken it only in areas of native grasses. It is not common anywhere in the state and is rare in the eastern part of the state. In Douglas County, for example, where the trapping of small mammals has been carried on since 1892, a total of 13 of this species have been taken and saved as specimens in the collection of the University of Kansas Museum of

Natural History. Of these 13, five are the young of a female that was taken alive and gave birth to the young in captivity. These five young were born on April 25.

Rinker (1942B:376) reported that on the first of July, 1941, in Meade County, he took three females bearing three, four, and five embryos each. In August, 1941, he found a nest of this species containing three young.

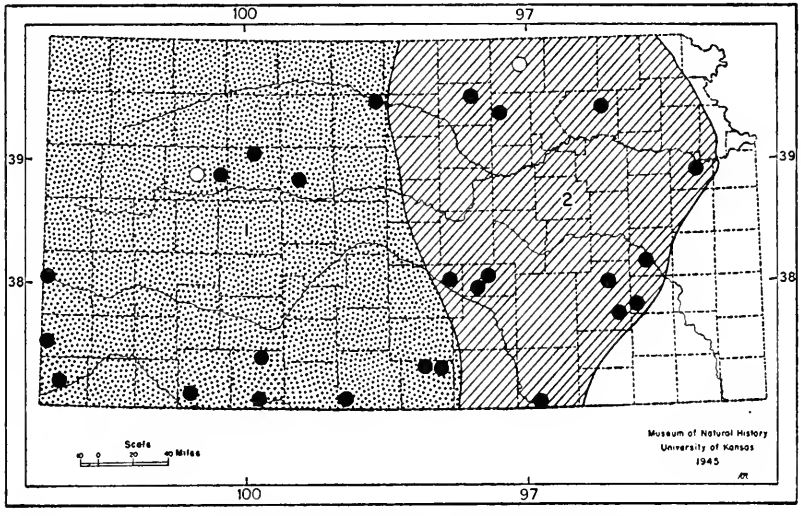

FIG. 46. Distribution of *Reithrodontomys montanus* in Kansas. 1. *R. m. albescens*. 2. *R. m. griseus*. See figure 5 for explanation of symbols.

Reithrodontomys montanus albescens Cary

Reithrodontomys albescens Cary, Proc. Biol. Soc. Washington, 16:53, 1903, type from 18 miles northwest of Kennedy, Cherry County, Nebraska.

Reithrodontomys montanus albescens, Benson, Jour. Mamm., 16:141, 1935.

Reithrodontomys albescens albescens, Hibbard, Kansas Univ. Sci., Bull., 25(7):174, 1938; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:507, 1939; Rinker, Trans. Kansas Acad. Sci., 45:376, 1942; Hill and Hibbard, Jour. Mamm., 24:23, 1943; Hibbard, Trans. Kansas Acad. Sci., 47:77, 1944.

Reithrodontomys griseus, Lantz, Trans. Kansas Acad. Sci., 20(2):214, 1907 (part from Pendennis and Wakeeney).

Reithrodontomys albescens griseus, Howell, N. Amer. Fauna, 36:24, 1914 (part from Pendennis and Trego County); Wooster, Trans. Kansas Acad. Sci., 42:515, 1939; Webb, Trans. Kansas Acad. Sci., 43:479, 1940.

Reithrodontomys montanus griseus, Brown, Trans. Kansas Acad. Sci., 48:450, 1946.

Distribution.—Western Kansas, east certainly to Osborne and Harper counties. See map, figure 46.

Remarks.—External measurements of eight males and three females from Meade County, are: ♂ 124.8 (117-133), ♀ 130.3 (123-143); 55.0 (51-61), 59 (57-63); 16 (15-17), 16.6 (16-17); 12.9 (12-15), 13 (13-13).

Specimens from Osborne and Harper counties show intergradation with *R. m. griseus,* especially in their slightly darker color.

Specimens examined.—Total, 39, distributed as follows: *Osborne County:* ½ mi. W Downs, 2. *Gove County:* Banner, 1; Unspecified, 1. *Trego County:* 8 mi. N Wakeeney on Saline R., 1. *Ellis County:* 4 mi. W, ½ mi. S Hays, 2250 ft., 1. *Hamilton County:* Coolidge, 1; 1 mi. E Coolidge, 3. *Stanton County:* 7½ mi. W, 1 mi. N Manter, 1; 7½ mi. W Manter, 1. *Morton County:* 12 mi. N Elkhart, 3; 9 mi. N, 3 mi. E Elkhart, 3. *Meade County:* 14 mi. SW Meade, 3; 17 mi. SW Meade, 9. *Clark County:* 4 mi. S Kingsdown, 1; 6 mi. S Kingsdown, 2; 12 mi. S Ashland, 3. *Barber County:* Wells Ranch, Aetna, 1. *Harper County:* 2 mi. NE Runnymede, 1; 5 mi. NW Harper, 1.

Additional records.—Trego County: Unspecified, 10 (Howell, 1914:24). *Lane Co.:* Pendennis, 5 (Howell, 1914:24).

Reithrodontomys montanus griseus Bailey

Reithrodontomys griseus Bailey, N. Amer. Fauna, 25:106, 1905, type from San Antonio, Bexar County, Texas; Lantz, Trans. Kansas Acad. Sci., 20(2):214, 1907 (part from Onaga, Pottawatomie County).

Reithrodontomys montanus griseus, Benson, Jour. Mamm., 16:141, 1935; Brumwell, Amer. Midland Nat., 45:212, 1951.

Reithrodontomys albescens griseus, Howell, N. Amer. Fauna, 36:24, 1914 (part from Onaga, Pottawatomie County); Hibbard, Trans. Kansas Acad. Sci., 36:241, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 188, 1937; Hibbard, Kansas Univ. Sci. Bull., 25(7):175, 1938; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):39, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:77, 1944.

Distribution.—Eastern Kansas, west certainly to Cloud, Reno, and Cowley counties; not known from the southeastern corner of the state. See map, figure 46.

Remarks.—External measurements of three males and one female from Douglas County are: ♂ 105, 107, 105, ♀ 110; 44, 43, 43, 50; 15, 15, --, 15; 11.5, 12.5, 13, 12.

Specimens from Reno County are intergrades between *R. m. griseus* and *R. m. albescens,* but are judged as being referable to the former subspecies.

Specimens examined.—Total, 42, distributed as follows: *Washington County:* Unspecified, 1. *Cloud County:* Concordia, 4. *Clay County:* 10 mi. W, 6 mi. N Clay Center, 1. *Pottawatomie County:* NE of Onaga, 1. *Douglas County:* 1¼ mi. S Lawrence, 1; Golf course, Lawrence, 2; Haskell Farm, Lawrence, 1; Haskell bottoms, S of Lawrence, 2; Young born in captivity of female taken in Haskell bottoms S of Lawrence, 5; Unspecified, 2. *Reno County:* 8 mi. NE Hutchinson, 6. *Coffey County:* 2½ mi. S Burlington, 1. *Harvey County:* 8 mi. W Newton, 3; 1 mi. E, ½ mi. N Halstead, 3. *Greenwood County:* Hamilton, 1; ½ mi. S Hamilton, 1; 8½ mi. SW Toronto, 3. *Woodson County:* 2½ mi. N Toronto, 1. *Cowley County:* 3 mi. SE Arkansas City, 1; Arkansas City, 1.

Additional records.—Pottawatomie Co.: Onaga, 18 (Howell, 1914:24).

TABLE 19.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF ONYCHOMYS AND REITHRODONTOMYS.

Sex	Catalogue number	Greatest length of skull	Basilar length	Greatest breadth of braincase	Least interorbital constriction	Length of nasals	Shelf of bony palate	Palatine slits	Diastema	Post palatal length	Alveolar length of maxillary tooth-row
					Onychomys leucogaster arcticeps, Rawlins County						
♂	12011	28.1	22.3	12.4	4.7	10.3	4.3	5.6	7.0	10.9	4.6
♂	12010	28.4	22.3	12.4	5.0	10.3	4.5	5.5	6.9	10.3	4.5
♂	12012	28.2	22.7	12.5	4.5	10.5	4.8	5.4	7.5	10.4	4.4
♀	12013	26.0	20.6	12.1	4.6	10.2	4.7	5.2	6.2	9.3	4.4
♀	12006	27.7	22.1	12.0	4.5	10.9	4.8	5.5	6.8	9.9	4.7
					O. l. breviauritus, Harper County						
♂	13046	29.3	23.3	12.9	4.9	11.5	5.1	5.5	7.4	10.9	4.5
♂	12683	28.2	22.1	12.9	4.9	10.8	5.4	5.3	7.1	10.5	4.1
♂	13542	27.3	21.7	12.4	4.7	10.8	4.4	5.5	7.4	9.7	4.2
♀	12934	27.8	21.7	12.6	4.7	10.5	4.9	5.3	7.0	9.9	4.3
					Reithrodontomys fulvescens, Cherokee County						
♂	2573	21.7	16.1	10.1	3.4	7.9	3.9	4.5	5.4	7.1	3.3
♂	1673	....	....	10.6	3.8	8.8	3.8	4.7	5.8	....	3.4
♂	14560	21.8	16.4	10.2	3.0	9.0	3.7	4.4	5.4	7.5	3.7
					R. megalotis dychei, Douglas County						
♂	11	20.8a	15.2a	9.9	3.1	7.6a	3.5	4.3	4.9	6.9a	3.0
	min.	20.0	14.7	9.6	2.8	7.1	3.1	4.0	4.8	6.6	2.8
	max.	22.0	15.8	10.3	3.5	8.0	3.9	4.5	5.1	7.2	3.2
♀	10	20.9b	15.3	9.8b	3.0b	7.8	3.5b	4.3b	4.9	6.8	3.0
	min.	20.0	14.7	9.3	2.9	7.1	3.1	4.1	4.6	6.5	2.9
	max.	22.1	16.2	10.1	3.2	8.5	3.9	4.6	5.2	7.2	3.2
					R. megalotis aztecus, Meade County						
♂	10	22.1c	16.0c	9.9d	3.1	8.5b	3.7	4.5	5.2	7.2	3.3
	min.	21.5	15.3	9.7	3.0	8.0	3.4	4.2	4.9	7.0	3.1
	max.	22.6	16.5	10.1	3.8	9.3	4.0	4.9	5.6	7.7	3.5
♀	14103	21.5	15.5	9.9	3.1	8.6	3.6	4.2	5.1	6.8	3.0
♀	13864	....	....	10.4	3.0	....	3.6	4.5	4.9	7.4	3.4
♀	13847	21.9	16.0	9.7	3.0	9.1	3.6	4.5	5.1	7.4	3.1
					R. montanus albescens, Meade County						
♂	8	19.9c	14.6	9.4c	2.9	7.4	3.4	4.0	4.6	6.6	3.0
	min.	19.2	14.0	9.0	2.8	7.2	3.2	3.7	4.5	6.3	2.9
	max.	20.8	15.3	10.0	3.0	7.5	3.6	4.6	4.9	6.9	3.3
♀	13744	19.8	14.0	9.8	3.0	6.7	3.4	3.6	4.5	6.1	3.0
♀	13742	20.1	15.1	9.5	3.0	7.5	3.6	3.9	4.7	6.8	3.4
♀	13741	....	14.7	9.5	2.9	....	3.0	4.3	4.6	6.7	3.1
					R. montanus griseus, Cloud County						
♂	308	19.5	14.7	9.3	3.0	7.1	3.5	3.6	4.6	6.5	3.0
					Cowley County						
♂	12922	19.7	14.3	9.6	3.1	7.9	3.5	3.6	4.4	6.3	3.2
♀	5175	19.9	14.8	9.7	2.9	7.7	3.5	3.7	4.7	6.5	2.8

a. 10 averaged.
b. 9 averaged.
c. 7 averaged.
d. 8 averaged.

Genus **Peromyscus** Gloger

White-footed Mice

Three species of *Peromyscus* occur in Kansas. In these nocturnal mice the tail is about as long as the head and body; these mice are usually bicolored, dark brown or blackish above and white below. More kinds are included in this genus than in any other mammalian genus of North America. These mice occur throughout the North American continent from the northern limit of tree growth southward into the high forests of Panama.

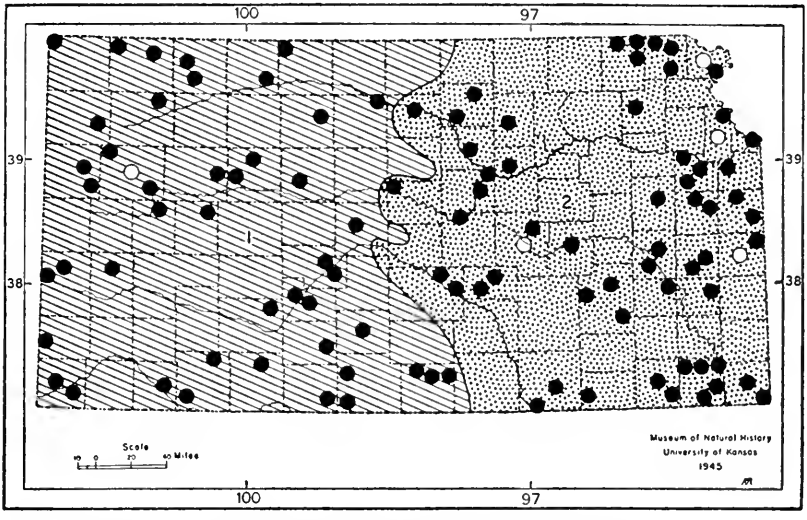

FIG. 47. Distribution of *Peromyscus maniculatus* in Kansas. 1. *P. m. nebrascensis.* 2. *P. m. bairdii.* See figure 5 for explanation of symbols.

Peromyscus maniculatus

Deer Mouse

This is the smallest species of *Peromyscus* in the state. The total length is approximately six inches; the tail comprises approximately two inches of this total. The small ears and the small size serve to distinguish this species from the brush mouse, *Peromyscus boylii.* The bicolored tail and the small hind foot, less than 20 mm. in length, as well as the slightly smaller size, distinguish *Peromyscus maniculatus* from *Peromyscus leucopus.* Sprague (1939D:495-497) described the differences between the bacula of *P. maniculatus* and *P. leucopus* obtained in Kansas.

The deer mouse inhabits grasslands in Kansas, being found in pastures, meadows, fence rows, and in fact almost everywhere except in woodlands. For nesting sites it utilizes old burrows and runways of other mice, old logs, boards, fence posts, and, when necessary, digs its own shallow burrow in the ground. It is the most common rodent in many parts of the state. Brown (1946:451), in investigating rodent activity in a mixed prairie two and one-half miles west of Hays, Ellis County, learned that this species ". . . was the most widely distributed and most abundant mammal found. It was caught from burrows, open nests, piles of weeds, cactus plants, holes beneath rocks, cracks in banks and from runs of the meadow mouse. The number caught was greatest on the lowland. Least activity was found on the short grass and artificial revegetation types. . . . Calculation from trapping records showed approximately 3232 [individuals] per square mile."

The deer mouse feeds on plant and animal materials. Brown (*loc. cit.*) found near Hays, Ellis County, that: "Caches of stored seeds and pellets near freshly eaten plants indicated that 24 different species, of which 7 were grasses and 17 were forbs, furnished some food for these animals. . . . The common sunflower was most heavily utilized, also buffalo grass and cactus seeds were extensively eaten. . . . Evidence from excavated burrows showed that much of the diet of this mouse consisted of crickets, beetles, moths, spiders, millipedes and grasshoppers."

Nests of the deer mouse are usually constructed of the leaves of grasses. According to Asdell (1946:238) this species tends to breed all the year; the gestation period is 22 to 27 days. The litter size ranges from two to eight, with an average of 5.38. In the fall and winter of 1944 and 1945 at Hays, Kansas, Brown (1945:309) caught 100 females of which 17 were with embryos. These were distributed by months as follows: September, 7 (4 of these with embryos); October, 4 (1); November, 7 (1); December, 21 (1); January, 28 (1); February, 16 (3); and March, 17 (6).

Peromyscus maniculatus nebrascensis (Coues)

Hesperomys sonoriensis var *nebrascensis* Coues, Monogr. N. Amer. Rodentia, p. 79, 1877, type from Deer Creek, western Nebraska.

Peromyscus maniculatus nebrascensis, Mearns, Proc. Biol. Soc. Washington, 24:102, 1911; Hibbard, Trans. Kansas Acad. Sci., 36:242, 1933; Hibbard, Jour. Mamm., 18:102, 1937; Black, Kansas State Board Agric., 30th Biennial Rept., p. 192, 1937; Sprague, Trans. Kansas Acad. Sci., 42:487, 1939; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:507, 1939; Wooster, Trans. Kansas Acad. Sci., 42:515, 1939; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; P. B. Allen, Kansas

State Teachers College Emporia, Bull. Information, Nat. Hist., Surv., 20(5):41, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:78, 1944; Brown, Ecology, 26:308, 1945; Brown, Trans. Kansas Acad. Sci., 48:450, 1946.

Peromyscus m[aniculatus] nebrascensis, Hibbard, Univ. Kansas Sci. Bull., 25(7):174. 1938.

Peromyscus maniculatus cf. *nebrascensis*, Hibbard and Rinker, Univ. Kansas Sci. Bull., 29 (pt. 2, no. 4): 263, 1943.

Peromyscus nebraskensis [sic], Riegel, Trans. Kansas Acad. Sci., 44:99, 1941.

Peromyscus texanus nebrascensis, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Lantz, Trans. Kansas Acad. Sci., 20(2):215, 1907.

Peromyscus texensis nebrascensis, Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:220, 1907.

Peromyscus maniculatus luteus, Osgood, N. Amer. Fauna, 28:79, 1909.

Peromyscus luteus, Lantz, Trans. Kansas Acad. Sci., 20(2):214, 1907.

Peromyscus maniculatus osgoodi, Hibbard, Trans. Kansas Acad. Sci., 47:242, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 192, 1937; Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):40, 1940.

Peromyscus maniculatus, Wooster, Trans. Kansas Acad. Sci., 43:302, 1940.

Hesperomys leucopus var. *sonoriensis*, J. A. Allen, Bull. Essex Inst., 6:49, 1874; Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Hesperomys leucopus sonoriensis, Baker, Trans. Kansas Acad. Sci., 11:58, 1889.

Peromyscus leucopus texanus, J. A. Allen, Bull. Amer. Mus. Nat Hist., 7:269, 1895.

Peromyscus texanus, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Trans. Kansas Acad. Sci., 20(2):215, 1907.

Distribution.—Western part of the state, east certainly to Phillips, Osborne, Barton, and Harper counties. See map, figure 47.

Remarks.—External measurements of six males and two females from 23 miles (by road) northwest of St. Francis, are: ♂ 144.5 (140-150), ♀ 153, 142; 59.8 (56-64), 62, 58; 19.8 (19-21), 20, 19; 16.1 (14-17), 17, 15.

Dice (1941:18) investigated the variation of the deer mouse in Nebraska. He concluded: "The tendency of the pelage color of deer-mice to be correlated with the soil color of the local habitat has resulted in the development of a pale-colored geographical race, *Peromyscus maniculatus nebrascensis*, on the pale-colored soils of the Nebraska sand hills. The sand-hill race, however, is nowhere uniform in pelage color, and every local population has a high degree of variability in shade of color. This variability is probably due in considerable part to constant interbreeding with the darker-colored populations which surround the sand hills on every side.

"The geographical gradients of pelage color and of body di-

mensions seldom proceed evenly, but are frequently broken by the occurrence of local races which do not conform to the general trends."

My assignment of the western Kansas specimens to the subspecies, *Peromyscus maniculatus nebrascensis* is tentative. As seen above, Dice is inclined to restrict the name, *P. m. nebrascensis* to the populations found in the Nebraska sand hills. The deer mice of the Great Plains need considerably more study before their relations are clearly understood.

Specimens examined.—Total, 346, distributed as follows: *Cheyenne County:* 23 mi. (by road) NW St. Francis, 8. *Rawlins County:* 2 mi. NE Ludell, 29; 1½ mi. W Ludell, 1; 27 mi. W Atwood [= 7 mi. N, 16½ mi. W Atwood], 3. *Decatur County:* 2 mi. S, 6 mi. W Oberlin, 6; 10½ mi. S, 3¾ mi. W Oberlin, 2; 10¾ mi. S, 4 mi. W Oberlin, 1. *Norton County:* 5 mi. W, 1 mi. N Logan, 10; 4. mi. W, 1 mi. S Logan, 5. *Phillips County:* Long Island, 1; 3 mi. SE Long Island, 2. *Sherman County:* 1½ mi. E, ½ mi. S Edson, 2. *Thomas County:* 10 mi. N, 6 mi. E Colby, 21. *Rooks County:* 6 mi. SW Woodston, 1. *Osborne County:* ½ mi. W Downs, 1. *Wallace County:* 2 mi. S Wallace, 1; Lacey Ranch, 1; 9 mi. S Wallace, Lacey Ranch, 1; 13 mi. SE Wallace, Lacey Ranch, 1. *Logan County:* Vincent Ranch, N Fork Smoky River, 3; 5 mi. W Elkader, 9; Unspecified, 5. *Gove County:* 4 mi. W Banner, 1; Castle Rock, 6 (GCR). *Trego County:* Hackberry Creek, Banner, 7; Saline R. 8 mi. N Wakeeney, 9; Wakeeney, 1; Unspecified, 1. *Ellis County:* 3½ mi. W, ½ mi. S Hays, 11. *Scott County:* State Park, 14 (GCR). *Lane County:* 2 mi. N Pendennis, 1. *Barton County:* 3 mi. N, 2 mi. W Hoisington, 12. *Hamilton County:* 7 mi. NE Coolidge, 1; 1 mi. E Coolidge, 10. *Kearny County:* Oanica, 1. *Pawnee County:* 1 mi. S Larned, 4; 2 mi. S, 1 mi. E Larned, 1; 3 mi. S, 1½ mi. W Larned, 3. *Edwards County:* 3½ mi. E Kinsley, 2; 1 mi. W, 3½ mi. S Kinsley, 3; S side Arkansas R., 2 mi. S Kinsley, 7. *Stanton County:* 7½ mi. W, 1 mi. N Manter, 1. *Ford County:* ½ mi. NW Bellefont, 3. *Kiowa County:* 5 mi. N Belvidere, 7. *Pratt County:* Pratt, 6. *Morton County:* Cimarron R. NW Rolla, 1; 9 mi. N, 3 mi. E Elkhart, 14; 7½ mi. N, 1½ mi. W Elkhart, 1. *Seward County:* 1 mi. E Arkalon, 2. *Meade County:* 1 mi. W, 5 mi. N Fowler, 1; 1 mi. N, 1 mi. E Fowler, 2 (GCR); 4 mi. W Fowler, 1; State Lake, 4; State Park, 35 (24, GCR); 13 mi. SW Meade, 7; 14 mi. SW Meade, 1; 17 mi. SW Meade, 31. *Clark County:* 7 mi. S Kingsdown, 3. *Comanche County:* Schwartz Canyon, 4 mi. W Aetna, 4. *Barber County:* 6 mi. W Aetna, 1; 1 mi. W Aetna, 1; Wells Ranch, Aetna, 2; 4⅗ mi. S Sun City, 2. *Harper County:* 4½ mi. NE Danville, 1; 1 mi. N Harper, 3; 5 mi. W Harper, 1; 3 mi. S Harper, 2.

Peromyscus maniculatus bairdii (Hoy and Kennicott)

Mus bairdii Hoy and Kennicott, in Kennicott, Agricultural Rept., U. S. Patent Office, 1856, p. 92, type from Bloomington, McLean County, Illinois.

Peromyscus maniculatus bairdii, Dice, Ecology, 4:46, 1923; Dice, Jour. Mamm., 4:109, 1923; Linsdale, Jour. Mamm., 9:144, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:242, 1933; Clark, Jour. Mamm., 17:44, 1936; Black, Kansas State Board Agric., 30th Biennial Rept., p. 193, 1937; Dice, Occ. Papers Mus. Zool., Univ. Mich., 351:2, 1937; Sprague, Trans. Kansas Acad. Sci., 42:488, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):41, 1940; Clark, Genetics, 26:286, 1941; Hibbard, Trans. Kansas Acad. Sci., 47:78, 1944; Brumwell, Amer. Midland Nat., 45:212, 1951.

Peromyscus m[aniculatus] bairdii, Hibbard, Univ. Kansas Sci. Bull., 25(7):174, 1938.

Peromyscus maniculatus bairdi, Osgood, N. Amer. Fauna, 28:82, 1909.

P[eromyscus] maniculatus bairdi, McNair, Jour. Mamm., 12:48, 1931.

Peromyscus maniculatus, Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:137, 1947.

Hesperomys (vesperimus) michiganensis, Coues, Monograph N. Amer. Rodentia, p. 97, 1877.

H[esperomys] Michiganensis, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Peromyscus michiganensis, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:239, 1907.

P[eromyscus] michiganensis, Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Lantz, Trans. Kansas Acad. Sci., 20(2):215, 1907.

Distribution.—Eastern part of the state, west certainly to Mitchell, Ellsworth, Reno, and Cowley counties. See map, figure 47.

Remarks.—External measurements of four males and four females from Anderson County, are: ♂ 131.5 (128-133), ♀ 132.7 (127-139); 52.2 (49-54), 52.7 (49-55); 19.5 (19-20), 19.0 (18-20); 14.5 (14-16), 14.0 (13-15).

Populations of deer mice in western Kansas, here referred to the subspecies *P. m. nebrascensis*, average larger in external measurement and are paler than populations in the eastern part of the state which are referred to *P. m. bairdii*. *P. m. nebrascensis* is variable, ranging from pale ochraceous buff, more or less intermixed with dusky, to a bright orange-tawny in dorsal coloration. *P. m. bairdii* is much darker, being a rich russet or warm brown in dorsal coloration. A dorsal blackish stripe is evident in *P. m. bairdii* and obscure in *P. m. nebrascensis*.

Specimens examined.—Total, 645, distributed as follows: *Nemaha County:* Nebraska-Kansas line, 7 mi. N Sabetha, 1; 10½ mi. N Seneca, 1; 6 mi. N Sabetha, 1; 2½ mi. S Sabetha, 2. *Brown County:* 7 mi. N, 9 mi. W Hiawatha, 3; 3 mi. N Hiawatha, 1; 5 mi. S Hiawatha, 1. *Doniphan County:* Geary, 4; Unspecified, 1. *Mitchell County:* 3½ mi. W, ½ mi. S Beloit, 6. *Cloud County:* 3 mi. E Concordia, 23; 3½ mi. E, 1 mi. N Glasco, 1. *Clay County:* 6 mi. SW Clay Center, 4. *Jackson County:* 10½ mi. WSW Holton, 1. *Leavenworth County:* Ft. Leavenworth, 14; Unspecified, 4. *Wyandotte County:* 1 mi. S, ½ mi. W court house, Kansas City, 1. *Ottawa County:* 3 mi. SW Minneapolis, 1. *Douglas County:* 1 mi. NNW Midland, 1; 4½ mi. N Lawrence, 2; 2 mi. N Lawrence, 1; 1 mi. N Lawrence, 2; 2½ mi. W Lawrence, 1; 1 mi. W Lawrence, 4; Lawrence, 151; 6 mi. S KU (Lawrence), 1; 7½ mi. SW Lawrence, 5; Washington Creek Swamp, 2; Washington Creek, 56; 9 mi. S, 7 mi. W Lawrence, 1; Unspecified, 18. *Johnson County:* 1 mi. NW Community Bldg., Sunflower, 1. *Ellsworth County:* 2½ mi. S Wilson, 1. *Saline County:* 4 mi. W Solomon, 4 (AJK); Solomon, 1; 4 mi. E Solomon, 1 (AJK); 4 mi. E Salina, 1 (AJK). *Dickinson County:* 3 mi. NW Abilene, 2 (AJK). *McPherson County:* 1 mi. S, ½ mi. W Lindsborg, 4; 1 mi. S Lindsborg, 1. *Marion County:* 1½ mi. NE Lincolnville, 5; Lincolnville, 1;

3 mi. SE Lincolnville, 1; Unspecified, 1. *Chase County:* 2 mi. W Cottonwood Falls, 1; 2 mi. E Cottonwood Falls, 1; 3 mi. E, 4 mi. S court house, Cottonwood Falls, 1. *Osage County:* 3 mi. N Lyndon, 1. *Coffey County:* 4 mi. N Burlington, 1; 2½ mi. S Burlington, 1. *Franklin County:* 1½ mi. S LeLoup, 1; 4 mi. N Ottawa, 6. *Anderson County:* 3 7/10 mi. S Garnett, 3; 6 mi. SW Garnett, 2; 7 mi. S Garnett, 5; ½ mi. SE Welda, 1. *Miami County:* 6 mi. SW Spring Hill, 5; 6 mi. N Paola, 2; 11 mi. SSE Paola, 3. *Linn County:* 6 mi. SE Fontana, 1; Unspecified, 1. *Reno County:* 8 mi. N, 1 mi. E Haven, 2, 2 mi. W, ½ mi. S Medora, 1. *Harvey County:* 6 mi. SW Newton, 1; 1 mi. E, 1½ mi. N Halstead, 18; 1 mi. E Halstead, 7; ½ mi. E Halstead, 1; ½ mi. E, 2 mi. S Halstead, 2; 1 mi. S, ½ mi. E Halstead, 17; 1 mi. S Halstead, 5; Unspecified, 2. *Greenwood County:* Hamilton, 141 (140, GCR); 1 mi. S Hamilton, 1; 4 mi. S, 14 mi. W Hamilton, 3; 8½ mi. SW Toronto, 25. *Woodson County:* Neosho Falls, 3. *Allen County:* Moran, 2. *Cowley County:* 6 mi. N, 12 mi. E Arkansas City, 1; Arkansas City, 2; 8.1 mi. E Arkansas City, 3; 3 mi. SE Arkansas City, 1. *Chautauqua County:* 1½ mi. SW Cedar Vale, 2. *Montgomery County:* Independence, 1; 3½ mi. E, 2 mi. N Coffeyville, 2. *Labette County:* 11 mi. W Parsons, 5; 10 mi. E Parsons, 3; 1½ mi. W, 3 mi. S Parsons, 3; Oswego, 4; 10 mi. SW Oswego, 1. *Cherokee County:* 4 mi. S Columbus, 2; 4 mi. SE Columbus, 5; 1 mi. S, 4¾ mi. E Baxter Springs, 3; 9 mi. SW Columbus, 1.

Peromyscus leucopus

Wood Mouse

Four subspecies of this species occur in Kansas. They differ from *P. maniculatus* in being larger, having a longer, more sparsely-haired and less bicolored tail, and larger hind feet; from *P. boylii* in being smaller, having a shorter, more sparsely-haired and less bicolored tail and smaller hind feet.

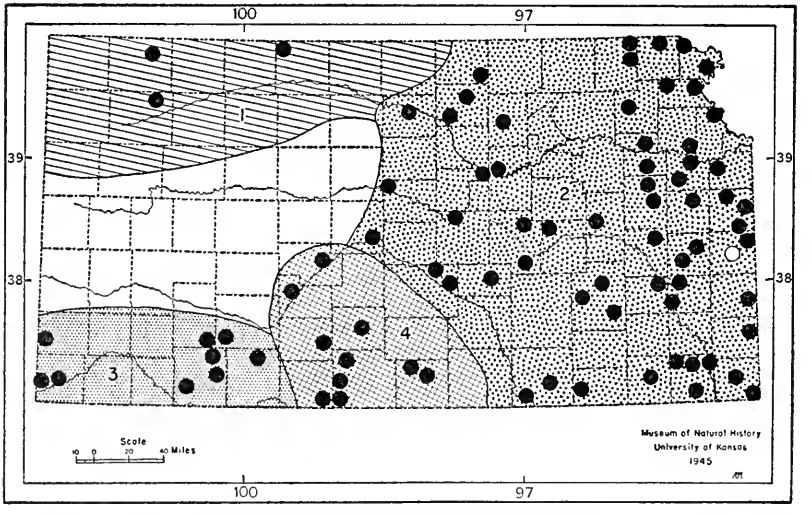

FIG. 48. Distribution of *Peromyscus leucopus* in Kansas. 1. *P. l. aridulus.* 2. *P. l. noveboracensis.* 3. *P. l. tornillo.* 4. *P. l. texanus.* See figure 5 for explanation of symbols.

Peromyscus leucopus is an inhabitant of woodlands, at least in the eastern part of the state. Farther west it is restricted to local patches of trees, usually in the river bottoms. In Morton and Stanton counties I have taken it in sage brush along rocky ledges bordering the Cimarron River and Rock Creek.

According to Asdell (1946:237) the wood mouse breeds from early April to the beginning of October in the northern part of its range. In the south it breeds at any time but reproduction tends to fall off in July and August. In specimens examined from Ontario, the litter size ranges from three to seven with an average of 5.04.

Seventeen specimens taken in Kansas have embryo counts available. These are distributed by months as follows: February, 1; March, 1; April, 3; June, 2; July, 2; August, 1; September, 5; October, 1; November, 3. The number of embryos ranged from three to seven with an average of 4.7.

This mouse usually nests in the ground, either in burrows of its own making or in those abandoned by some other mouse, but it may construct its nest in a hollow stump, log, or tree, or under rocks and logs on the ground.

Peromyscus leucopus aridulus Osgood

Peromyscus leucopus aridulus Osgood, N. Amer. Fauna, 28:122, 1909, type from Fort Custer, Yellowstone County, Montana; Black, Kansas State Board Agric., 30th Biennial Rept., p. 194, 1937; Hibbard, Jour. Mamm., 18:102, 1937; Sprague, Trans. Kansas Acad. Sci., 42:490, 1939 (part from Rawlins County); P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist., Surv., 20(5):42, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:79, 1944.

Peromyscus l[eucopus] aridulus, Hibbard, Univ. Kansas Sci. Bull., 25(7):174, 1938.

Distribution.—In suitable habitat in the northwestern part of the state, east certainly to Phillips County and south certainly to Thomas Couny. See map, figure 48.

Remarks.—External measurements of ten males and ten females from two miles northeast of Ludell, are: ♂ 174.3 (165-196), ♀ 178.9 (161-188); 79.7 (70-88), 80.6 (75-85); 22.6 (22-23), 22.2 (21-23); 16.9 (16-18), 16.6 (16-17).

Specimens examined.—Total, 66, distributed as follows: *Rawlins County:* 2 mi. NE Ludell, 61. *Phillips County:* Long Island, 4. *Thomas County:* 6 mi. E, 10 mi. N Colby, 3100 ft., 1.

Peromyscus leucopus noveboracensis (Fischer)

[*Mus sylvaticus*] *noveboracensis* Fischer, Synopsis mammalium, p. 318, 1829, type from New York.

Peromyscus leucopus noveboracensis, Miller, Proc. Boston Soc. Nat. Hist., 28:22, 1897; Osgood, N. Amer. Fauna, 28:117, 1909; Dice, Ecology, 4:44, 1923; Dice, Jour. Mamm., 4:109, 1923; Linsdale,

Jour. Mamm., 8:52, 1927; Linsdale, Jour. Mamm., 9:144, 1928; Hall, Jour. Mamm., 9:255, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:242, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 193, 1937; Hibbard, Univ. Kansas Sci. Bull., 25(7):174, 1938; Sprague, Trans. Kansas Acad. Sci., 42:489, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):41, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:79, 1944; Brumwell, Amer. Midland Nat., 45:212, 1951.

P[eromyscus] leucopus noveboracensis, McNair, Jour. Mamm., 12:48, 1931.

Peromyscus rufinus, Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:215, 1907.

Hesperomys leucopus, Coues, Monograph N. Amer. Rodentia, p. 62, 1877.

Peromyscus leucopus, Lantz, Trans. Kansas Acad. Sci., 20(2):214, 1907; Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:137, 1947.

Distribution.—Eastern part of the state, west certainly to Mitchell, Ellsworth, Reno, and Cowley counties. See map, figure 48.

Remarks.—External measurements of three males and three females from Douglas County, are: ♂ 193, 185, 176, ♀ 186, 177, 181; 89, 78, 85, 88, 83, 83; 21, 20, 22, 22, 23, 22; 16, 16, 16, 16, 16, 16; weight in grams, 30.3, 30.7, 28.3, 33.3, 28.0, 30.0.

Specimens examined.—Total, 594, distributed as follows: *Republic County:* ½ mi. E Agenda, 1. *Nemaha County:* Nebraska-Kansas line, 7 mi. N Sabetha, 1; 6 mi. N Sabetha, 1; ¾ mi. E, 3½ mi. S Sabetha, 1; 4 mi. S Sabetha, 1. *Brown County:* 7 mi. N, ½ mi. E Hiawatha, 1; 3 mi. N Hiawatha, 1. *Doniphan County:* 2 mi. N White Cloud, 2; 1½ mi. N White Cloud, 2; Geary, 15. *Mitchell County:* 3½ mi. W, ½ mi. S Beloit, 1500 ft., 4. *Cloud County:* 3 mi. E Concordia, 21; Bullock Farm, 4 mi. E Glasco, 4. *Clay County:* 4 mi. S Clay Center, 1; 6 mi. S Clay Center, 3. *Jackson County:* 10½ mi. WSW Holton, 12. *Atchison County:* 1.8 mi. N Atchison, 1; 1.8 mi. N, 1 mi. E Atchison, 1; 2 mi. S Atchison, 2; 1 mi. E, 1 mi. S Horton, 3. *Jefferson County:* 1½ mi. E, 7½ mi. N Lawrence, 1; 7 mi. N Lawrence, 1. *Leavenworth County.* Ft. Leavenworth Reservation, 49. *Dickinson County:* Solomon, 2. *Shawnee County:* 1 mi. S Silver Lake, 857 ft., 2; 3 mi. W, 4½ mi. N State Capitol Bldg., Topeka, 1; ½ mi. N, 1 mi. E Auburn, 1. *Osage County:* 3 mi. SE Carbondale, 2; 3 mi. N Lyndon, 1. *Douglas County:* 5 mi. N Lawrence, 1; 4 mi. N Lawrence, 1; 2 mi. N Lawrence, 9; 1 mi. N Lawrence, 1; Fort Lake, Lawrence, 7; 1 mi. W Lawrence, 2; Lawrence, 47; 7 to 7½ mi. SW Lawrence, 67; Rock Creek, 850 ft., 10 mi. SW Lawrence, 2; N end Lone Star State Lake, 9 mi. S, 7 mi. W Lawrence, 4; Unspecified, 39. *Johnson County:* ½ mi. E Sunflower Village, 1. *Barton County:* Arkansas R., 1½ mi. W, ½ mi. S Ellinwood, 7. *Ellsworth County:* 3 mi. S Wilson, 1. *Saline County:* 4 mi. W Solomon, 1 (AJK). *McPherson County:* Smoky Hill R., 1 mi. S, ½ mi. W Lindsborg, 3; 1 mi. S Lindsborg, 1. *Marion County:* 4½ mi. E Peabody, 2; 2 mi. N Lincolnville, 1; 1½ mi. NE Lincolnville, 16. *Chase County:* 9 mi. E Lincolnville, 2. *Lyon County:* 6 mi. W, 5 mi. N Emporia, 1. *Coffey County:* ¼ mi. W Waverly, 1. *Franklin County:* 4 mi. N Ottawa, 2. *Anderson County:* (near) Garnett, 1; 3 7/10 mi. S Garnett, 14; 4 3/10 mi. S Garnett, 2; 6 mi. SW Garnett, 1; 6 mi. S Garnett, 1. *Miami County:* 3 mi. SW Spring Hill, 2; 6 mi. N Paola, 1; 5½ mi. SE Fontana, 1; 11 mi. SSE Paola, 3. *Linn County:* 5½ mi. SE Fontana, 2; 6 mi. SE Fontana, 7; 6½ mi. SE Fontana, 3; ½ mi. S Pigeon Lake, 3; 2 mi. SW Pigeon Lake, 3; 2 mi. S Pigeon Lake, 4; 5½ mi. S Pigeon Lake, 1; Unspecified, 1. *Reno County:* 2 mi. W Medora, 4; 2 mi. W, ½ mi. S Medora, 1; 8 mi. N, 1 mi. E Haven, 1. *Harvey County:* 2 mi. N, ½ mi. E Newton, 1. *Greenwood County:* Hamilton, 86 (GCR); 4 mi. S, 11 mi. W Hamilton, 1; 12 mi. SW Hamilton, 1; 8½ mi. SW Toronto, 24; Unspeci-

fied, 3. *Woodson County:* Neosho Falls, 4. *Allen County:* 5½ mi. N, 4½ mi. W Iola, 2; 1½ mi. W, 2 mi. N Humboldt Bridge, Humboldt, 1. *Bourbon County:* 1 mi. W Ft. Scott, 1; Fort Scott, 1. *Crawford County:* ½ mi. W, 1½ mi. N Mulberry, 1; 1 mi. N Mulberry, 1. *Cowley County:* 6 mi. N, 12 mi. E Arkansas City, 2; 5 mi. N, 11 mi. E Arkansas City, 1; 1.7 mi. N, .8 mi. E Arkansas City, 1; 3 mi. SE Arkansas City, 15. *Chautauqua County:* 1½ mi. SW "Cedarvale," 2. *Montgomery County:* Independence, 5. *Labette County:* 10 mi. E Parsons, 1; 11 mi. W Parsons, 1; 2 mi. S Parsons, 600 ft., 1; Oswego, 3; 10 mi. SW Oswego, 9. *Cherokee County:* 4 mi. S Columbus, 2; ⅓ mi. N, 6 mi. E Baxter Springs, 1; 5½ mi. E, 1½ mi. S Baxter Springs, 3; 1½ mi. S Galena, 1; 3 mi. S Galena, 3; Tristate Monument, 2; Unspecified, 1.

Peromyscus leucopus tornillo Mearns

Peromyscus tornillo Mearns, Preliminary diagnosis of new mammals from the Mexican border of the United States, privately published, p. 3, March 25, 1896 (Reprint: Proc. U. S. Nat. Mus., 18:445, May 23, 1896), type from Rio Grande, about six miles above El Paso, El Paso County, Texas.

Peromyscus leucopus tornillo, Osgood, N. Amer. Fauna, 28:125, 1909; Hibbard, Trans. Kansas Acad. Sci., 36:242, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 195, 1937; Sprague, Trans. Kansas Acad. Sci., 42:490, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):42, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:79, 1944.

Distribution.—In suitable habitats in southwestern Kansas north certainly to Stanton County and east certainly to Meade County. See map, figure 48.

Remarks.—External measurements of six males and two females from nine miles north and three miles east of Elkhart, are: ♂ 161.1 (155-167), ♀ 174, 171; 69.8 (66-74), 76, 75; 20.6 (20-22), 22, 20; 15.3 (11-18), 16, 16.

Specimens examined.—Total, 116, distributed as follows: *Stanton County:* 6 mi. W, 1½ mi. N Manter, 2; 7½ mi. W, 1 mi. N Manter, 7; 6 mi. W, 1 mi. N Manter, 6. *Gray County:* 6¼ mi. NW Fowler, 13. *Ford County:* 1 mi. E, 8 mi. N Fowler, 13. *Morton County:* 81 Ranch, ½ mi. N Cimarron R. [= 9 mi. N, 3 mi. E Elkhart], 15; 7 mi. N, 2 mi. W Elkhart, 2. *Meade County:* 1 mi. W, 5 mi. N Fowler, 28; 11½ mi. E Meade, 1 (GCR); State Park, 14 mi. SW Meade, 29 (GCR). *Clark County:* 7 mi. S Kingsdown, 8.

Peromyscus leucopus texanus (Woodhouse)

Hesperomys texana Woodhouse, Proc. Acad. Nat. Sci., Philadelphia, 6:242, 1853, type probably from the vicinity of Mason, Mason County, Texas. (Osgood, 1909:129.)

Peromyscus leucopus texanus, Osgood, N. Amer. Fauna, 28:127, 1909.

Peromyscus leucopus tornillo, Hibbard, Jour. Mamm., 18:102, 1937.

Peromyscus leucopus aridulus, Sprague, Trans. Kansas Acad. Sci., 42:490, 1939 (part from Pratt, Comanche, and Barber counties).

Distribution.—South-central Kansas from Comanche County north certainly to Pawnee County and east certainly to Harper County. See map, figure 48.

Remarks.—External measurements of three males and three females from four and three-tenths miles south of Sun City, are: ♂ 182, 175, 177, ♀ 170, 178, 174; 82, 79, 84, 79, 80, 80; 23, 22, 22, 22, 21, 21; 17, 16, 16, 16, 16, 17.

Specimens examined.—Total, 133, distributed as follows: *Pawnee County:* 2 mi. S, ¼ mi. W Larned, 2. *Edwards County:* 1 mi. W, 3 mi. S Kingsley, 1; S side Arkansas River, 2 mi. S Kingsley, 7. *Kiowa County:* 5 mi. N Belvidere, 40. *Pratt County:* 3 mi. E Pratt, 1. *Comanche County:* 4 mi. SW Aetna, 15; Schwartz Canyon, 4 mi. W Aetna, 5. *Barber County:* Sun City (south Bridge), 3; 4¾10 mi. S Sun City, 6; 18 mi. S Sun City, 2; 1 mi. S Aetna, 1. *Harper County:* 1 mi. N Harper, 5; 4½ mi. NE Harper, 24; 7 mi. NW Harper, 1.

Peromyscus boylii

Brush Mouse

Only one subspecies of the brush mouse occurs in Kansas. It has been found only in the southeastern corner of the state. It occurs throughout the southwestern United States; the eastern limits of the species are in Missouri and Arkansas. As already indicated, this is the largest species of the genus that occurs in the

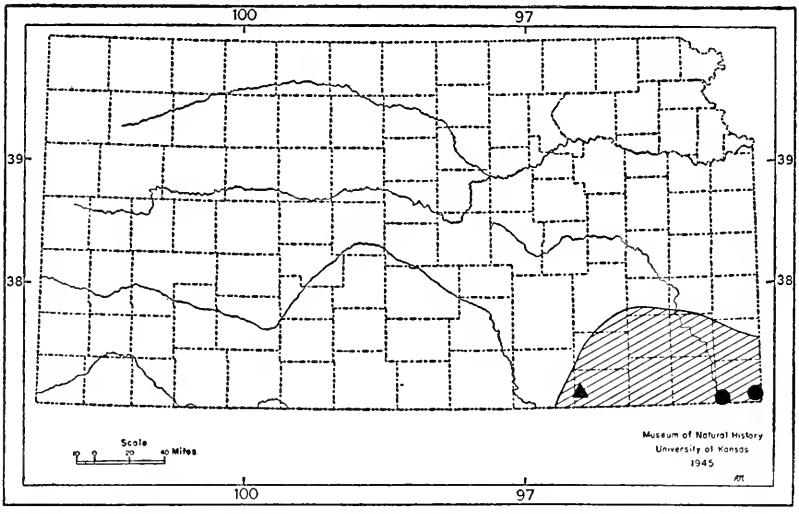

FIG. 49. Distribution of *Peromyscus boylii attwateri* in Kansas. See figure 5 for explanation of symbols.

state. The total length is approximately eight inches, of which the tail comprises four inches.

In Kansas this species has been found only on or near rocky ledges and cliffs. According to Black (1937:195) it builds nests in cracks between and under rocks, and piles up brush and sticks on a small scale after the fashion of the pack rat. Acorns, Black reports, are one of the favorite foods. Stomach contents of the two specimens taken at Shole Creek, Cherokee County, are indicated on the specimen labels as being "Insect and seed pulp" for one and

"Acorn and seed pulp" for the other. Both specimens were taken in September.

According to Asdell (1946:236) this species breeds all year in the lowlands of the western United States but in the mountains, young are not born until May. He states that the litter size is two to four, usually three.

An examination of specimens of this subspecies in the collection of the University of Kansas Museum of Natural History reveals that the embryo counts, as indicated by the collector on the skin labels, of three females from McDonald County, Missouri, were four, four, and six, respectively. These three females were taken on November 27. Lactating females have been taken on April 20 (Boone County, Arkansas) and October 9 (Stone County, Arkansas). Hall reported (1946:519), for different subspecies in Nevada, that one female contained six embryos and a second contained four. The range of the number of embryos, as given by Asdell (*loc. cit.*), should probably read "from two to six," rather than "two to four."

Peromyscus boylii attwateri Allen

Peromyscus attwateri J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:330, 1895, type from Turtle Creek, Kerr County, Texas; Lantz, Trans. Kansas Acad. Sci., 20(2):214, 1907.

Peromyscus boylii attwateri, Bailey, Proc. Biol. Soc. Washington, 19:57, 1906; Osgood, N. Amer. Fauna, 28:148, 1909; Hibbard, Trans. Kansas Acad. Sci., 36:243, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 199, 1937; Sprague, Trans. Kansas Acad. Sci., 42:491, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):42, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:79, 1944.

Distribution.—Known only from rocky ledges in Cherokee and Chautauqua counties, in southeastern Kansas. See map, figure 49.

Remarks.—External measurements of six males and four females from three miles south of Galena, are: males 182.8 (174-198), females 182.7 (110-195); 93.3 (83-104), 94.7 (88-103); 23.3 (23-25), 24.2 (24-25); 18.9 (18-20), 18.4 (17.5-19).

Cranially this species can be distinguished from *Peromyscus maniculatus* in Kansas by the larger size of the skull. From *Peromyscus leucopus* in Kansas, *P. boylii* can be distinguished by the pronouncedly greater width of the interorbital constriction and greater length of the tooth-row.

Specimens examined.—Total, 18, distributed as follows: *Cherokee County:* "Shole" Creek, 2; 1½ mi. S Galena, 3; 3 mi. S Galena, 850 ft., 11; ⅓ mi. N, 6 mi. E Baxter Springs, 850 ft., 2.

Additional records.—*Chautauqua Co.:* "Cedarvale," 1 (Osgood, 1909:149).

TABLE 20.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF PEROMYSCUS.

Sex	Number averaged or catalogue number	Basilar length	Mastoidal breadth	Interorbital constriction	Length of nasals	Zygomatic breadth	Alveolar length of upper tooth-row
		P. maniculatus nebracensis, Rawlins County					
♂	24	20.2c	10.4d	3.7e	9.5	12.4f	3.5
	min.	18.5	10.0	3.6	9.0	11.5	3.1
	max.	21.2	11.2	4.1	10.0	13.2	4.0
♀	6	19.8a	10.3a	4.0	9.3	12.5b	3.5
	min.	18.0	10.0	3.9	8.7	11.7	3.1
	max.	21.1	10.5	4.1	10.0	13.0	3.9
		P. m. bairdii, Douglas County					
♂	5	17.9	10.8	3.9	9.1	12.2	3.4
	min.	17.1	10.5	3.7	8.7	11.9	3.2
	max.	18.7	11.2	4.2	10.2	12.5	3.6
♀	6	17.7	10.8	3.9	9.0	11.9	3.4
	min.	17.1	10.0	3.5	8.2	11.3	3.3
	max.	18.9	12.0	4.2	9.4	12.7	3.5
		P. leucopus aridulus, Rawlins County					
♂	5	20.3	11.5	4.3	10.3	13.5	3.9
	min.	19.5	11.3	4.2	9.8	13.3	3.8
	max.	20.6	11.7	4.5	10.8	13.7	4.0
♀	5	20.9	11.5	4.3	10.3	14.1	3.8
	min.	19.7	11.1	4.2	9.5	14.0	3.7
	max.	22.0	12.0	4.5	11.3	14.2	4.0
		P. l. noveboracensis, Anderson County					
♂	5	20.2	11.3	4.2	9.9	13.6	3.7
	min.	19.5	10.9	4.0	9.5	13.1	3.6
	max.	21.1	11.7	4.5	10.5	14.1	3.8
♀	5	20.3	11.1	4.2	9.7	13.4	3.8
	min.	20.0	10.6	4.0	9.1	13.2	3.7
	max.	21.3	11.4	4.5	10.5	13.8	3.9
		P. l. tornillo, Morton County					
♂	4	19.4	11.5	4.4	9.8	13.5	3.7
	min.	18.9	11.1	4.3	9.4	13.0	3.6
	max.	20.0	12.0	4.5	10.1	13.9	4.0
♀	5470	20.6	11.5	4.3	11.1	14.4	3.9
♀	5477	20.0	11.4	4.4	10.1	14.0	3.7

TABLE 20.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF PEROMYSCUS.—*Concluded.*

Sex	Number averaged or catalogue number	Basilar length	Mastoidal breadth	Interorbital constriction	Length of nasals	Zygomatic breadth	Alveolar length of upper tooth-row
			P. l. texanus, Barber County				
♂	18967	21.5	11.8	4.3	10.8	14.4	3.8
♂	18969	20.5	10.7	4.1	10.2	14.1	3.6
♂	18972	20.8	11.5	4.3	10.3	14.1	3.7
♀	18968	19.9	11.0	4.4	9.8	14.0	3.9
♀	18970	20.1	11.4	4.1	10.7	14.1	3.8
♀	18971	20.7	11.5	4.1	10.6	14.1	3.8
			P. boylii attwateri, Cherokee County				
♂	14577	21.5	11.8	4.7	10.5	14.0	4.0
♂	14580	20.0	11.6	4.7	9.7	13.6	4.2
♂	14582	19.9	11.6	4.7	9.8	13.7	3.9
♀	14576	20.0	11.6	4.6	9.3	13.9	4.1
♀	14578	21.0	11.7	4.6	10.4	14.2	4.0
♀	14579	20.4	12.4	4.5	10.1	13.5	4.1

a. 5 averaged.
b. 3 averaged.
c. 21 averaged.
d. 19 averaged.
e. 23 averaged.
f. 20 averaged.

Genus **Sigmodon** Say and Ord

Cotton Rats

This genus occurs in North and South America from the central United States southward, through Mexico and Central America, into northern South America. Generic characteristics include: skull short and wide; rostrum short and swollen, auditory bullae relatively small; body stout; pelage long and coarse, more or less concealing the short ears; tail shorter than head and body; front feet small; hind feet long; soles naked. Only one species occurs in Kansas.

Sigmodon hispidus

Hispid Cotton Rat

The cotton rat weighs approximately four ounces and an adult is approximately ten inches in length, of which the tail comprises four inches. The color on the back and sides is grayish-brown to buffy-gray with an admixture of black, resulting in a grizzled appearance; the venter is paler (whitish), usually a light gray. The cotton rat can be distinguished from the Norway rat (*Rattus norvegicus*) and from the pack rats (*Neotoma* spp.) by the lesser total length and shorter tail. The pack rat is 14 to 15 inches in total

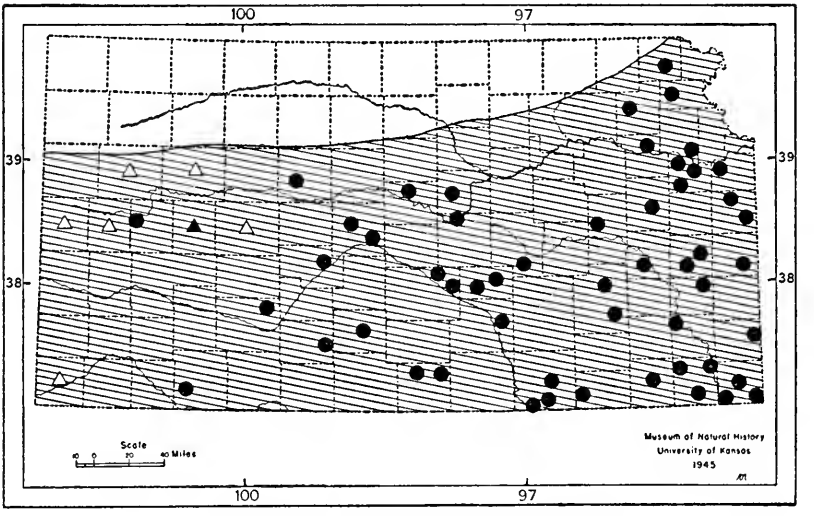

FIG. 50. Distribution of *Sigmodon hispidus texianus* in Kansas. See figure 5 for explanation of symbols.

length of which the tail makes up six to six and a half inches. The Norway rat has a total length ranging up to 16 inches; the tail makes up slightly less than half of this length.

The cotton rat, at times, becomes locally abundant, sometimes numerous. In areas of such abundance, it is often a pest—even a menace—to the farmer. Grain crops are often damaged and yields of hay are noticeably reduced by its ravages.

I have already presented data (Cockrum, 1948:306-312) showing that, at least in eastern Kansas in the period 1933 to 1947, the cotton rat expanded its range northward at least one hundred miles from Greenwood and Allen counties in 1933, northward into Brown County in 1947. Additional data and specimens reveal that, in the

western part of the state, the cotton rat has expanded its range westward and northward but not so rapidly nor so far as in eastern Kansas. I have examined a specimen taken on October 25, 1949, just south of Hays. This specimen is in the collection of the Fort Hays Kansas State College. E. P. Martin, formerly of that institution, who trapped the animal, reported (*in litt.*): "As far as I, or any one else here knows, this is the first record of *Sigmodon* in this area."

In 1948, five specimens of *Sigmodon* were taken along Beaver Creek, 12 miles west and six miles north of Scott City.

Field men for the U. S. Public Health Service, working primarily to ascertain if plague was present in the rodent population in the summer of 1949, trapped small mammals in 12 western Kansas counties. They reported taking *Sigmodon* in Logan and Gove counties and in six counties to the southward. The counties in which *Sigmodon* were taken, the number of *Sigmodon* taken, and the total number of mammals taken in each county, are as follows: Logan (10 *Sigmodon* in 140 mammals taken); Gove (6 in 133); Greeley (2 in 308); Wichita (16 in 526); Scott (55 in 333); Lane (3 in 197); Ness (5 in 178); and Morton (111 in 752). In Rawlins, Decatur, Thomas, and Trego counties no *Sigmodon* were taken, although a total of 976 small mammals were taken in these four counties.

In the summers of 1926 and 1927, parties from the University of Kansas Biological Survey collected birds, mammals, and reptiles in Morton County, the southwesternmost county of the state but took no *Sigmodon;* perhaps it was not present then in the southwestern county of the state.

In eastern Kansas the winter of 1948-49 was much more severe than several of those immediately preceding it. Sleet and ice covered the ground to a depth of two to three inches, and remained on the ground for approximately one month. In the summer of 1949 cotton rats were scarce in Douglas County. The following winter (1949-50) was mild, and in the summer of 1950 cotton rats were again numerous in most parts of Douglas County. Perhaps the severity of the winter restricts the northern expansion of the range of the cotton rat in Kansas, while a series of relatively mild winters permits a northward expansion, and one or a series of severe winters halts the expansion or even reduces the range.

Asdell (1946:239-240) reports that the cotton rat breeds from early spring to late fall. The gestation period is 27 days. The litters range in size from two to ten and average 5.6. Seventeen fe-

males from Kansas in the collection of the University of Kansas Museum of Natural History have the numbers of embryos written on the labels. These numbers range from three to 12 and average 6.0.

Sigmodon hispidus texianus (Audubon and Bachman)

Arvicola texiana Audubon and Bachman, Quadr. N. Amer., 3:229, 1853, type from Brazos River, Texas.

Sigmodon hispidus texianus, J. A. Allen, Bull. Amer. Mus. Nat. Hist., 3:287, 1891; Bailey, Proc. Biol. Soc. Washington, 15:106, 1902; Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:243, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 197, 1937; Sprague, Jour. Mamm., 19:246, 1938; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:508, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):43, 1940; Rinker, Trans. Kansas Acad. Sci., 45:377, 1942; Rinker, Jour. Mamm., 23:439, 1942; Hibbard and Rinker, Univ. Kansas Sci. Bull., 29(pt. 2 no. 4):266, 1943; Hibbard, Trans. Kansas Acad. Sci., 47:80, 1944.

Sigmodon hispidus, Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:137, 1947; Cockrum, Trans. Kansas Acad. Sci., 51:306, 1948.

Distribution.—Throughout all but the northwestern part of the state. See map, figure 50.

Remarks.—External measurements of three males and 12 females from three miles north and two miles west of Hoisington, are: ♂ 239.6 (225-265), ♀ 251.5 (202-277); 102.3 (95-111), 102.5 (87-110); 30.5 (29.5-32), 31.6 (29-35); 17 (16-18), 17.5 (16-20); weight in grams, 71.7 (50.2-98.0), 94.6 (56.5-203.4).

I have not had an opportunity to examine topotypical material of *Sigmodon hispidus alfredi* from Baca County, Colorado. Specimens from Meade, Ford, and Scott counties, Kansas, however, do not fit the description of *S. h. alfredi* as given by Goldman and Gardner (1947:57).

Specimens examined.—Total, 482, distributed as follows: *Brown County:* 5 mi. S Hiawatha, 1; 1 mi. N Horton, 2. *Jackson County:* 10½ mi. WSW Holton, 2. *Atchison County:* 1½ mi. S Muscotah, 6; 2 mi. S Muscotah, 6; 2.6 mi. S Atchison, 1. *Jefferson County:* Buck Creek, 900 ft., 1 mi. N, 3¾ mi. E Williamstown, 1; 1½ mi. E, 7½ mi. N Lawrence, 1; 1½ mi. E, 4½ mi. N Lawrence, 1. *Ellis County:* Near Hays, 1 (Fort Hays Kansas St. College). *Saline County:* 1 mi. N Bavaria, 1. *Shawnee County:* 3 mi. W, 4½ mi. N State Capitol Bldg., Topeka, 2. *Douglas County:* 1 mi. N Midland, 1; ½ mi. NW Lecompton, 1; Lakeview, 1; 3 mi. NE Lawrence, 3; ¼ mi. W Lawrence, 2; 1½ mi. WSW Lawrence, 1; 7½ mi. SW Lawrence, 4; Rock Creek, 850 ft., 10 mi. SW Lawrence, 2; N end Lone Star "State" Lake, 9 mi. S, 7 mi. W Lawrence, 3. *Johnson County:* 1 mi. NW Community Bldg., Sunflower, 1; Sunflower Village, 2 mi. SW DeSoto, 1. *Scott County:* Beaver Creek, 12 mi. W, 6 mi. N Scott City, 5. *Barton County:* 3 mi. N, 2 mi. W Hoisington, 16; 1½ mi. W, ½ mi. S Ellinwood, 1. *Ellsworth County:*

Ellsworth, 1. *McPherson County:* Smoky Hill River, 1 mi. S, ½ mi. W Lindsborg, 16; 1 mi. S Lindsborg, 2. *Marion County:* 2 mi. E, 1½ mi. N Peabody, 2; 4½ mi. E Peabody, 1. *Lyon County:* 6 mi. W, 5 mi. N Emporia, 3. *Coffey County:* 2½ mi. S Burlington, 1. *Osage County:* 3 mi. N Lyndon, 1. *Anderson County:* ½ mi. SE Welda, 12; 3.7 mi. S Garnett, 1; 7 mi. S Garnett, 1. *Miami County:* 9 mi. N Paola, 1; 11 mi. SSE Paola, 46. *Linn County:* ½ mi. N, 4 mi. W Prescott, 1. *Pawnee County:* 2 mi. S, 1 mi. E Larned, 3; 3 mi. S, 1½ mi. W Larned, 2. *Reno County:* 1 mi. N, 2 mi. W Medora, 2; 2 mi. W Medora, 1; 2 mi. W, ½ mi. S Medora, 10; 8 mi. N, 1 mi. E Haven, 2. *Harvey County:* ½ mi. NW Newton, 1; 1 mi. S Halstead, 9; 1 mi. S, ½ mi. E Halstead, 8; 2 mi. S, ½ mi. E Halstead, 1. *Greenwood County:* Hamilton, 43 (GCR); 2 mi. E Hamilton, 1; ½ mi. S Hamilton, 2; 1 mi. S Hamilton, 1; 5 mi. S Hamilton, 1; 8 mi. SW Toronto, 9; 8½ mi. SW Toronto, 16. *Allen County:* 2 mi. W Petrolia, 1. *Ford County:* ½ mi. NW Bellefont, 6. *Kiowa County:* Rezeau Ranch, 5 mi. N Belvidere, 3. *Pratt County:* Fish Hatchery, 1; Unspecified, 2. *Sedgwick County:* 4 mi. N, 2 mi. E Court house, Wichita, 1. *Neosho County:* 3 mi. NW Chanute, 1. *Crawford County:* ½ mi. E Mulberry, 1. *Meade County:* Meade County State Park, 4; 14 mi. SW Meade, 4; 17 mi. SW Meade, 63; Unspecified, 7. *Harper County:* 5 mi. NW Harper, 4; 3 mi. S Harper, 10; 4½ mi. NE Danville, 6. *Cowley County:* 6 mi. N, 12 mi. E Arkansas City, 1; 8.1 mi. E Arkansas City, 8; 3 mi. SE Arkansas City, 18. *Chautauqua County:* 1½ mi. SW "Cedarvale," 3. *Montgomery County:* Independence, 1. *Labette County:* 10 mi. E, 1½ mi. N Parsons, 4; 11 mi. W Parsons, 2; 10 mi. E Parsons, 3; 8½ mi. SE Parsons, 1; 8 mi. SW Oswego, 2; 10 mi. SW Oswego, 1. *Cherokee County:* ⅛ mi. N, ¼ mi. E Columbus, 1; Columbus, 1; 1 mi. W Columbus, 1; 4 mi. E Columbus, 22; 1½ mi. S Galena, 1; 3 mi. S Galena, 1; 18 mi. SW Columbus [by road], 22; 3 mi. E Baxter Springs, 900 ft., 3; ½ mi. N, ½ mi. W Tri-State Monument, 1.

Additional records.—Logan County: Unspecified (see text). *Gove County:* Unspecified (see text). *Greeley County:* Unspecified (see text). *Wichita County:* Unspecified (see text). *Lane County:* 2 mi. E Dighton, 1 (MZ, see Cockrum, 1948:309-10). *Ness County:* Unspecified (see text). *Morton County:* Unspecified (see text).

TABLE 21.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF SIGMODON.*

Sex	Number averaged	Greatest length	Condylobasal length	Zygomatic breadth	Least-interorbital constriction	Length of nasals	Width of braincase	Interparietal	Alveolar length maxillary tooth-row
Sigmodon hispidus texianus, 1 mi. S, ½ mi. W Lindsborg, McPherson County									
♂	7	34.6	32.6	19.3	5.1	12.9	14.4	2.6	6.5
	min.	31.0	29.5	17.5	4.8	11.4	13.8	2.0	6.1
	max.	38.6	36.2	21.0	5.5	15.1	15.0	3.2	6.8
♀	5	31.7	29.7	18.3	5.0	11.5	14.2	2.7	6.4
	min.	29.1	27.0	16.5	4.8	10.0	13.8	2.4	6.0
	max.	33.2	31.3	19.0	5.1	12.5	14.4	3.0	6.8

* Measurements taken as defined by Goldman and Gardner (1947:58).

Genus **Neotoma** Say and Ord

Wood Rats

Two species of this genus occur in Kansas. They can be readily distinguished from the introduced *Rattus* (Old World rats), the only other genus in Kansas which they closely resemble, by several characteristics. In *Rattus* the cheek teeth have definite cusps while in *Neotoma* the cheek teeth are made up of lakes of dentine surrounded by enamel, the lakes being more or less separated from one another by re-entrant angles. The resulting grinding surfaces of the cheek teeth are flat in *Neotoma* in contrast to the cuspate condition in *Rattus*. The tail is more hairy in *Neotoma*.

Neotoma floridana

Florida Wood Rat

The range of the species is, in general, the southeastern part of the United States. The two subspecies of *N. floridana* that occur in

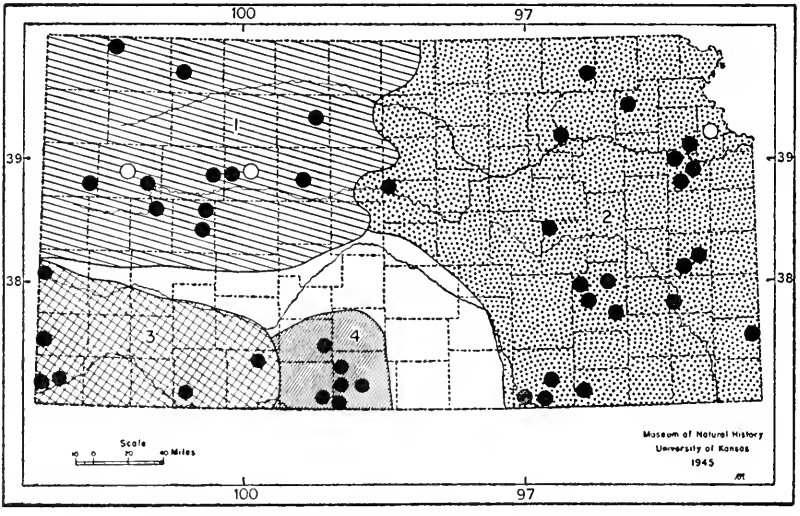

FIG. 51. Distribution of *Neotoma floridana* and *Neotoma micropus* in Kansas. 1. *N. f. campestris*. 2. *N. f. osagensis*. 3. *N. m. canescens*. 4. *N. m. micropus*. See figure 5 for explanation of symbols.

Kansas differ in their habits and choice of a den site. The eastern subspecies, *N. f. osagensis*, inhabits wooded areas and usually constructs a nest in a brush pile, under a fallen tree, around the base of a tree, or less frequently, in the branches of a tree. Its nests are often seen along fence rows of Osage orange trees.

The western subspecies, *N. f. campestris*, usually builds its nest in the cracks and crevices of rock ledges.

According to Asdell (1946:241) this species breeds all year and has one to four young per litter, the usual numbers being three and four.

Neotoma floridana campestris Allen

Neotoma campestris J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:322, 1894, type from Pendennis, Lane County, Kansas; Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:102, 1901; Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Lantz, Trans. Kansas Acad. Sci., 20(2):215, 1907; Elliot, Field Columbian Mus. Publ. 115, Zool. Ser., 8:275, 1907.

Neotoma floridana campestris, Kellogg, Kansas Univ. Mus. Nat. Hist., Publ. 1, Zool. Ser., 1:5, 1914; Hibbard, Trans. Kansas Acad. Sci., 36:243, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 198, 1937; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):44, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:80, 1944; Brown, Trans. Kansas Acad. Sci., 48:451, 1946.

Neotoma baileyi, Lantz, Trans. Kansas Acad. Sci., 20(2):215, 1907.

Neotoma floridana baileyi, Goldman, N Amer. Fauna, 31:24, 1910; Hibbard, Trans. Kansas Acad. Sci., 47:80, 1944.

Neotoma floridana, Knox, Trans. Kansas Acad. Sci., 4:21, 1875; Baker, Trans. Kansas Acad. Sci., 11:58, 1889; Wooster, Trans. Kansas Acad. Sci., 43:302, 1940.

Neotoma cinerea, J. A. Allen, Bull. Essex Inst., 6:49, 1874.

Distribution.—Northwestern Kansas, east to Rooks and Ellis counties and south to Scott and Lane counties. See map, figure 51.

Remarks.—External measurements of seven males and 14 females from Pendennis, are: ♂ 380.3 (368-392), ♀ 362.9 (338-395); 164.8 (155-174), 157.0 (144-175); 40.3 (38-42), 40.7 (38-42).

Specimens examined.—Total, 75, distributed as follows: *Rawlins County:* 7 mi. N, 16½ mi. W Atwood, 1. *Decatur County:* 5 mi. S, 8 mi. W Oberlin, 1. *Rooks County:* 6 mi. SW Woodston, 3. *Wallace County:* Lacey Ranch, 4½ mi. E, 9 mi. S Wallace, 1. *Logan County:* 5 mi. S Elkader, 4; Unspecified, 4. *Gove County:* Castle Rock, 8 (GCR). *Trego County:* Banner, 8 mi. S, 1 mi. E Collyer, 6; Unspecified, 1 (USNM). *Ellis County:* Hays, 7 (USBS); 3½ mi. W, ½ mi. S Hays, 1. *Scott County:* State Park, 1 (GCR). *Lane County:* 1 mi. N Pendennis, 10; Pendennis, 23 (USBS); 12 mi. S Pendennis, Walnut Creek, 2; Unspecified, 2.

Neotoma floridana osagensis Blair

Neotoma floridana osagensis Blair, Occas. Pap. Mus. Zool. Univ. Mich., 413:5, 1939, type from Okesa, Osage County, Oklahoma; Beamer, Penner, and Hibbard, Jour. Kansas Ent. Soc., 16:47, 1943; Hibbard, Trans. Kansas Acad. Sci., 47:81, 1944; Brumwell, Amer. Midland Nat., 45:213, 1951.

Neotoma floridana baileyi, Dice, Ecology, 4:45, 1923; Dice, Jour. Mamm., 4:109, 1923; Hibbard, Trans. Kansas Acad. Sci., 36:243, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 198, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):43, 1940.

Neotoma baileyi, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905.

N[eotoma] baileyi, Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905.

Neotoma floridana, Baird, Mamm. N. Amer., p. 490, 1858.

Distribution.—Eastern Kansas, west certainly to Cowley and Ellsworth counties. See map, figure 51.

Remarks.—External measurements of three males and three females from one mile northwest of Midland, are: ♂ 390, 331, 345, ♀ 339, 333, 310; 167, 129, 139, 142, 158, 132; 39, 35, 36, 36, 38, 35; – –, 26, 26, 26, 25, 18.

N. f. campestris is pale, being buffy-ochraceous; the tail is not strikingly bicolored. *N. f. osagensis* is dark, being a buffy-gray to brownish gray above; the tail is strikingly bicolored. *N. f. osagensis* averages larger in cranial measurements except in least interorbital constriction, which is smaller.

Specimens examined.—Total, 143, distributed as follows: *Marshall County:* 1 mi. W Vermillion, 2. *Riley County:* Manhattan, 5(USBS). *Jackson County:* Soldier Creek, 6 mi. S, 10 mi. W Holton, 1. *Jefferson County:* 13 mi. NE Lawrence, 2. *Leavenworth County:* Unspecified, 10. *Douglas County:* 7 mi. N Lawrence, 1; 6 mi. NW Lawrence, 1; 1 mi. N Midland, 2; 1 mi. W Midland, 3; 1 mi. NW Midland, 6; Lawrence, 2; 8 mi. SW Lawrence, 1; 8½ mi. SW Lawrence, 1; 10 mi. SW Lawrence, 3; Lone Star Lake, 1; Unspecified, 5. *Ellsworth County:* 3 mi. S Wilson, Smoky Hill River, 2. *Chase County:* 9 mi. E Lincolnville, 1. *Anderson County:* 3 7/10 mi. S Garnett, 1; 4½ mi. NNE Welda, 1. *Greenwood County:* 3 mi. NE Hamilton, 1 (GCR); 15 mi. W Hamilton, 1 (GCR); Slate Creek Bridge, Hamilton, 9 (GCR); Hamilton, 7 (5, GCR); 1 mi. E Hamilton, 2 (GCR); 2 mi. E Hamilton, 2 (GCR); 3 mi. E Hamilton, 5 (GCR); ½ mi. S Hamilton, 1 (GCR); ¾ mi. S Hamilton, 2 (GCR); 3 mi. SW Hamilton, 2 (GCR); 3 mi. SE Hamilton, 1 (GCR); 3½ mi. SW Hamilton, 2 (GCR); 4½ mi. SW Hamilton, 2 (GCR); 5 mi. SW Hamilton, 1 (GCR); 4 mi. S, 17 mi. W Hamilton, 3 (2, GCR); 12 mi. SW Hamilton, 12; 8 mi. SW Toronto, 8; 8½ mi. SW Toronto, 15; Unspecified, 2. *Allen County:* 2 mi. N, ½ mi. W Neosho R. bridge, Humboldt, 2. *Crawford County:* Mulberry, 1. *Cowley County:* 6 mi. N, 12 mi. E Arkansas City, 2; 8.6 mi. E Arkansas City, 2; 3 mi. SE Arkansas City, 2. *Chautauqua County:* "Cedarvale," 7 (USBS).

Neotoma micropus

Gray Wood Rat

Two subspecies of this species occur in Kansas. The range of the species is, in general, the southwestern United States and Mexico; southwestern Kansas is the northeastern part of the range.

In Kansas this species builds its nests among rock ledges, and was extremely numerous along Bear Creek in western Stanton County in July, 1950. Here the nests were under ledges and in crevices of the rocks exposed on the southern side of the stream.

According to Asdell (1946:242), in nature the young are born in late April and in captivity there is one litter per year, born in February. The gestation period is 33 days and the litter size is two to three young.

Neotoma micropus canescens Allen

Neotoma micropus canescens J. A. Allen, Bull. Amer. Mus. Nat. Hist., 3:285, 1891, type from North Canadian River, near the Oklahoma-New Mexico line, Cimarron County, Oklahoma (see Blair, 1939: 125); Hibbard, Trans. Kansas Acad. Sci., 36:243, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 199, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):44, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:81, 1944.

Distribution.—Southwestern Kansas north certainly to Hamilton County and east to Clark County. See map, figure 51.

Remarks.—External measurements of seven males and four females from nine miles north and three miles east of Elkhart, are: ♂ 329.8 (300-349), ♀ 329.7 (307-358); 136.5 (127-148), 142.2 (130-155); 37.0 (36-38), 37.5 (36-40); 25.3 (24-26), 25.0 (23-27).

Specimens examined.—Total, 56, distributed as follows: *Hamilton County:* Coolidge, 1. *Stanton County:* 7½ mi. W, 1 mi. N Manter, 2; 6 mi. W, 1 mi. N Manter, 2; 8 mi. W, 1 mi. S Manter, 5. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 16; 7 mi. N, 2 mi. W Elkhart, 1. *Meade County:* 13 mi. SW Meade, 7; 14 mi. SW Meade, 5; Meade County State Park, 4; 14½ mi. SW Meade, 1; 15 mi. SW meade, 1; 17 mi. SW Meade, 8. *Clark County:* 7 mi. S Kingsdown, Stephenson Ranch, 3.

Neotoma micropus micropus Baird

Neotoma micropus Baird, Proc. Acad. Nat. Sci. Philadelphia, 1885, p. 333, type from Charco Escondido, Tamaulipas, Mexico; Lantz, Trans. Kansas Acad. Sci., 20(2):214, 1907.

Neotoma micropus micropus, Miller, Bull. U. S. Nat. Mus., 128:378, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:243, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 198, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:508, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):44, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:81, 1944.

Distribution.—South-central Kansas, known only from Kiowa, Comanche, and Barber counties. See map, figure 51.

Remarks.—External measurements of one male and five females from five miles north of Belvidere, are: ♂ 380, ♀ 371.4 (350-390); 120, 155.2 (142-168); 38, 39.2 (37-41); 29, 29.2 (28-32).

N. m. micropus differs from *N. m. canescens* in having darker pelage, larger hind foot, slightly larger cranial measurements, and noticeably longer nasals (see table 22 for the cranial measurements of these two subspecies).

Specimens examined.—Total, 25, distributed as follows: *Kiowa County:* 5 mi. N Belvidere, 14. *Comanche County:* Cave Creek, 1. *Barber County:* 5 mi. S Sun City, Natural Bridge, 1; 8 mi. SW Medicine Lodge, 2; 6 mi. N Aetna, 1; 1 mi. SW Aetna, 1; Marty Ranch, 5.

TABLE 22.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF NEOTOMA.

Sex	Number averaged or catalogue number	Basilar length	Zygomatic breadth	Least interorbital constriction	Length of nasals	Length of incisive foramina	Length of palatal bridge	Alveolar length of upper tooth-row
				N. florida campestris, Pendennis, Lane County				
♂	7	41.3	26.8	6.9	18.9	10.3	8.6	9.6
	min.	38.1	25.4	6.8	17.3	9.5	8.1	9.2
	max.	44.8	28.4	7.2	20.2	11.0	9.5	10.2
♀	14	39.6a	25.9a	6.9	18.2a	9.8	8.5	9.5
	min.	37.5	24.5	6.4	17.1	9.2	8.0	9.0
	max.	43.5	27.4	7.1	19.4	10.5	8.9	10.0
				N. floridana osagensis, Greenwood County				
♂	8838	47.0	25.5	6.5	18.8	9.7	8.5	9.9
♂	8839	46.0	24.8	6.3	18.1	9.5	7.5	9.0
?	8835	47.0	26.0	6.5	18.1	9.8	8.3	9.4
♀	8836	48.2	27.2	6.3	19.5	10.5	8.7	9.4
♀	8837	50.0	27.4	6.1	20.5	10.2	8.8	9.8
♀	8840	44.8	25.3	6.3	17.9	10.0	8.1	9.5
				N. micropus canescens, Morton County				
♂	5369	47.1	26.4	6.1	19.1	11.6	8.5	9.0
♂	5244	46.7	25.7	6.0	19.7	11.4	8.5	9.1
♂	5242	47.0	26.1	5.9	18.8	11.1	8.3	9.2
♀	5367	46.7	25.9	6.5	17.7	10.5	8.4	9.6
				N. m. micropus, Kiowa County				
♂	13312	50.0	28.8	6.5	21.3	12.3	7.8	9.0
♀	13183	48.2	27.1	6.4	20.4	11.7	7.8	8.9
♀	13187	47.0	26.4	6.0	20.2	11.2	8.3	9.5
♀	13185	48.2	27.9	6.7	20.0	11.3	8.8	9.3
♀	13184	46.9	26.2	7.0	21.2	11.7	7.5	9.3

a. 13 averaged.

Genus Synaptomys Baird

Lemming Mice

One species of this genus occurs in Kansas. It can be distinguished from other Kansas rodents by its short tail which is little if any longer than the hind foot, by the longitudinal groove on the anterior face of each upper incisor, and by the enamel pattern of the cheek teeth. The enamel pattern consists of tracts of dentine surrounded by enamel; the tracts are more or less separated from one another by re-entrant angles.

Synaptomys cooperi

Cooper Lemming Mouse

Two subspecies of this species occur in Kansas. These animals are approximately six inches in length, the tail comprising less than one inch of the total.

This mouse has been found in several counties in the eastern part of the state and in Stafford County in central Kansas and in Meade County in western Kansas. In Stafford and Meade counties the animals were in bogs and marshes. Probably these mice are relict populations, remaining in these local situations which meet

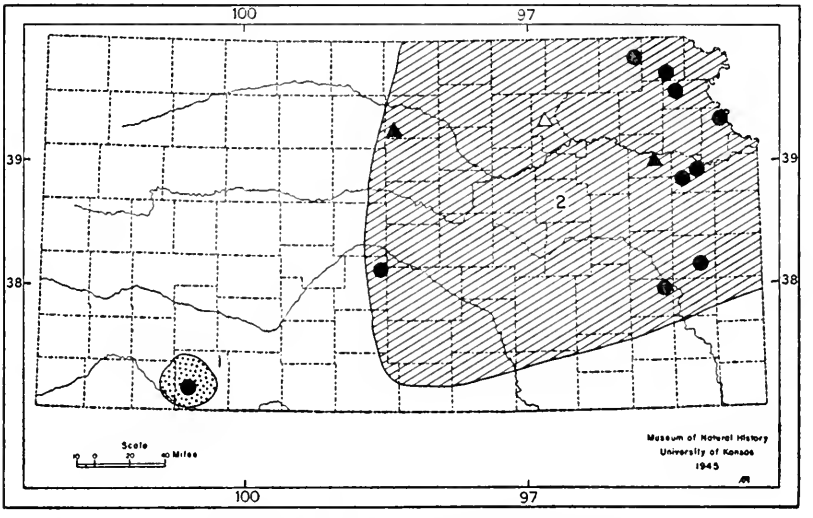

FIG. 52. Distribution of *Synaptomys cooperi* in Kansas. 1. *S. c. paludis.* 2. *S. c. gossii.* See figure 5 for explanation of symbols.

their habitat requirements. In Meade County this mouse is known only from marsh areas found in Meade County State Park. Hibbard and Rinker (1942:33) state: "The range of *Synaptomys* in Meade, Seward and Beaver Counties [Beaver County, Oklahoma] must have been widespread along the stream valleys when the country was first settled, for larger meadows existed along the flood plains of the Beaver and Cimarron Rivers, and along Crooked Creek. Many parts of the meadows were marshy and supported a large number of muskrats. The area between the true marsh and meadow would be the ideal area for *Synaptomys.*" Hibbard and Rinker (*loc. cit.*) think that with the arrival of the settlers, some of

the meadows were mowed for hay, others were burned to furnish pasture, and many were drained and plowed.

In eastern Kansas the bog lemming was common, at least locally, only to disappear at a later time. In Douglas County 89 specimens have been taken, which, by year of capture, are distributed as follows: 1894, 1 specimen; 1924, 8; 1925, 31; 1926, 36; 1927, 6; 1928, 5; 1929, 1; 1937, 1.

The number of mice caught may, in part, reflect the number of traps set. However, trapping (at times intensive) has been done at various localities in Douglas County from 1892 to the present. Many other kinds of small mammals have been taken in the county in this time, but none showed such an unusual fluctuation when plotted by years of collection. Further the only specimens of the Cooper lemming mouse in the collection of the Museum of Natural History from Woodson County were taken in 1926; from Anderson County in 1925 and Stafford County in 1927—years in which several specimens were taken in Douglas County. The population of *Synaptomys* seems to have been relatively high over most of eastern Kansas from 1924 through 1928.

The presence of *Synaptomys* in such numbers in eastern Kansas led Linsdale (1927) and Burt (1928) to publish some notes on the life history and occurrence of these animals in Kansas. Linsdale (1927:51) reported that: "In the winter of 1924-1925 this mouse was found by myself and others at several places in Douglas County, Kansas, within seven miles of the University of Kansas. Mice had been collected in that vicinity, and even in the same fields in which *Synaptomys* was subsequently found, for many years without finding this particular species."

Leo Brown (*in litt.*) examined a series of barn owl pellets taken on August 10, 1933, from a barn one-fourth of a mile south of Hunter. This barn was near Bacon Creek, a wooded tributary of the Saline River. Fifteen of the 376 skulls of small mammals found in these pellets were of the lemming mouse.

Since this period intensive trapping has yielded only one additional specimen from Douglas County (1937); all recent records have been secured in northeastern Kansas: Nemaha, Brown, and Atchison counties.

In fields of blue grass, runways are constructed above ground, criss-crossing one another. In many respects these runways are like the runways constructed by *Microtus* and *Pitymys*. Positive identification can be made only after the capture and identification of the mouse itself but a fairly certain determination can be made

from an examination of the fresh droppings in the runway. The fresh droppings are light green in color if from *Synaptomys,* and brown or blackish if from *Microtus* and *Pitymys.*

These mice remain active throughout the year. Burt (1928:214) reported that: "During the four days, January 21 to 24, 1925, eleven mice were caught despite the fact that this was an extremely cold period. The ground was covered with sleet and the temperature was four degrees below zero Fahrenheit on the morning of January 22." In winter the nest is built four to six inches below the surface of the ground, but in summer the nest is often above ground. Burt (1928:213-214) described the nest as: ". . . from six to eight inches in diameter, . . . made of dry grass with, sometimes a lining of fur. . . . There are usually three or four exits from the nest, but it is not uncommon to find only two."

Asdell (1946:252) reports that the breeding season of this species is from February through November and that the litter size is from one to five young, with an average of 3.2. This does not agree with data available from eastern Kansas. Burt (1928:214) reported finding five young in a nest on October 30th. Embryo counts from nine females taken in eastern Kansas range from one to seven and average 3.5. These are distributed by months as follows: January, 1; March, 1; April, 1; October, 1; November, 2; and December, 3. In eastern Kansas, at least, this species seems to breed all winter. Burt (1928:214) reported that: "The number of embryos found at different seasons of the year indicate that the number per litter is less in cold than in warm weather."

Synaptomys cooperi gossii (Coues)

Arvicola (*Synaptomys*) *gossii* Coues, Monog. N. Amer. Rodentia, p. 235, 1877, type from Neosho Falls, Woodson County, Kansas.

Synaptomys cooperi gossii, Howell, N. Amer. Fauna, 50:18, 1927; Burt, Jour. Mamm., 9:212, 1928; Hibbard, Trans. Kansas Acad. Sci., 33:244, 1933; Hibbard, Trans. Kansas Acad. Sci., 47:81, 1944; Fichter and Hanson, Bull. Univ. Nebraska State Mus., 3(8):2, 1947; Brumwell, Amer. Midland Nat., 45:213, 1951.

Synaptomys cooperi gossi, Rhoads, Proc. Acad. Nat. Sci., Philadelphia, 1897:307, 1897; Black, Kansas State Board Agric., 30th Biennial Rept. p. 200, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):45, 1940.

Synaptomys cooperi, Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:137, 1947.

Synaptomys helaletes gossii, Merriam, Proc. Biol. Soc. Washington, 10:60, 1896; Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:132, 1901; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Dice, Ecology, 4:48, 1923; Dice, Jour. Mamm., 4:110, 1923; Linsdale, Jour. Mamm., 8:51, 1927.

Sunaptomys cooperii [*sic*], Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Distribution.—Formerly in the northeastern part of the state, west to Mitchell County and south to Woodson County. Probably an isolated population occurs in Stafford County. Recent records of occurrence are from Nemaha, Brown, and Atchison counties. See map, figure 52.

Remarks.—External measurements of two males and four females from one and one-half to four miles south of Muscotah, are: ♂ 132, 138, ♀ 131.5 (127-135); 24, 24, 22.0 (18-33); 20, 20, 18.5 (17-20); 11, 11.5, 10.4 (10-11). Weight, in grams, of two males and one female from four miles south of Muscotah, Atchison County, are: males 42, 49, female 39.

Specimens examined.—Total, 118, distributed as follows: *Nemaha County:* ¾ mi. E, 3½ mi. S Sabetha, 3; 4 mi. S Sabetha, 3. *Brown County:* 1 mi. N Horton, 1. *Atchison County:* 1½ mi. S Muscotah, 4; 4 mi. S Muscotah, 9. *Leavenworth County:* Fort Leavenworth, 6 (USBS). *Douglas County:* 3 mi. NW Lawrence, 1; 2½ mi. W. Lawrence, 1; 2 mi. W Lawrence, 5; 1¾ mi. W Lawrence, 1; 1½ mi. W Lawrence, 1; 1 mi. W Lawrence, 16; ½ mi. W Lawrence, 2; Lawrence 1; U. of Kansas Campus, Lawrence, 10; 2 mi. SW Univ. Kansas Campus, 4; 7 and 7½ mi. SW Lawrence, 31; Unspecified, 9. *Anderson County:* 6 mi. S Garnett, 5; Unspecified, 1. *Woodson County:* 1 mi. SE Neosho Falls, 1; Neosho Falls, 2 (USNM). *Stafford County:* Little Salt Marsh, 15 mi. N, 3 mi. E Stafford, 1.

Additional records.—*Mitchell County:* ¼ mi. S Hunter, see text *Riley County:* Unspecified, Dice (1923:110). *Shawnee County:* Topeka, Lantz (1905A:175).

Synaptomys cooperi paludis Hibbard and Rinker

Synaptomys cooperi paludis Hibbard and Rinker, Univ. Kansas Sci. Bull., 28(pt. 1, no. 2):26, 1942, type from Bog area surrounding brooder Pond No. 1, Meade County State Park, 14 miles southwest of Meade, Meade County, Kansas; Hibbard and Rinker, Univ. Kansas Sci. Bull., 29(pt. 2, no. 4):255, 1943; Hibbard, Trans. Kansas Acad. Sci., 47:82, 1944.

Distribution.—Known only from the type locality. See map, figure 52.

Remarks.—External measurements of ten males and six females from 14 miles southwest of Meade, are: ♂ 142.7 (133-154), ♀ 135.5 (122-142); 21.6 (18-24), 21.5 (21-22); 21.4 (20-22), 21.0 (20-22); 12.8 (12-14), 12.5 (11-14).

Specimens examined.—Total, 32, from the following locality: *Meade County:* 14 mi. SW Meade, 32 (4, GCR).

Genus **Ondatra** Link

Muskrats

This genus, a native of North America, is found from Northern Alaska and Canada southward through most of the United States. It has recently been introduced into Europe and Asia. The large size and the scaly, laterally compressed tail serve to distinguish the muskrat from other rodents found in Kansas.

Ondatra zibethicus

Muskrat

The muskrat is found over the entire state but is much more common in the eastern, more humid half. Although typically a semiaquatic mammal, the muskrat is often seen far from the nearest water.

In swamps and marshes the muskrat builds a house of cattails and other vegetation available in the water. These houses are usually constructed in water not more than two feet deep. A snug, dry chamber, slightly above the water level, serves as a sleeping chamber.

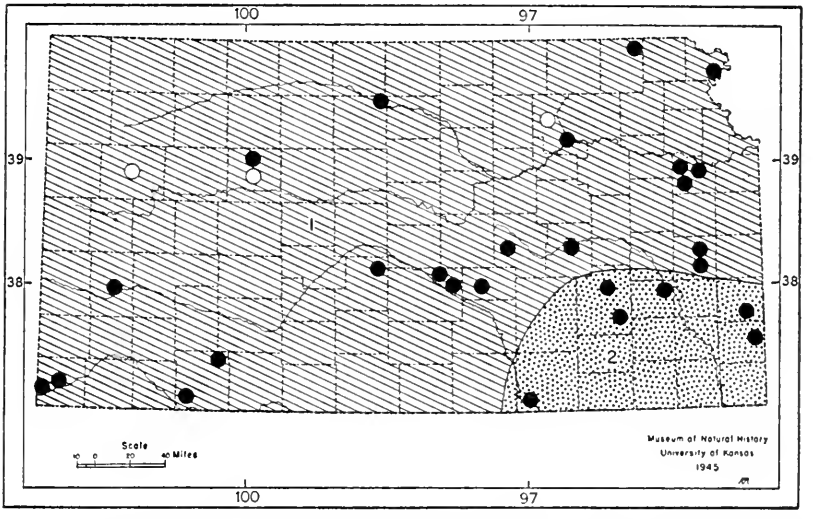

FIG. 53. Distribution of *Ondatra zibethicus* in Kansas. 1. *O. z. cinnamominus.* 2. *O. z. zibethicus.* See figure 5 for explanation of symbols.

Where conditions are unsatisfactory for the construction of a house, the muskrat digs a tunnel in the bank, usually below the surface of the water. This tunnel leads to an enlarged chamber well above the high water level, where a nest of grasses is constructed. A second entrance may open on the bank.

According to Asdell (1946:248-9) the muskrat, at the latitude of Iowa, breeds from April to August, or later. The litter size varies from one to 11 and averages 6.5 young per litter. The period of gestation is probably 29 to 30 days.

TABLE 23. NUMBER OF MUSKRAT PELTS TAKEN IN KANSAS IN VARIOUS RECENT YEARS.

THESE FIGURES WERE COMPILED FROM THE SOURCES GIVEN IN TABLE 2.

1928	1929	1930	1931	1932	1933	1934	1938	1940
239,174	280,719	276,338	225,487	203,144	210,387	198,652	77,923	119,918
1941	1942	1943	1944	1945	1946	1947-48	1948-49	1949-50
121,256	116,758	121,256	116,287	119,387	103,209	104,537	93,472	81,611

The muskrat is one of the most important fur bearing mammals in the state. Table 23 shows the number of muskrats taken in Kansas for their furs, in the last several years. Muskrats rank third in number of individuals taken, being exceeded in Kansas by the opossum and skunks.

Ondatra zibethicus cinnamominus (Hollister)

Fiber zibethicus cinnamominus Hollister, Proc. Biol. Soc. Washington, 23:125, 1910, type from Wakeeney, Trego County, Kansas; Hollister, N. Amer. Fauna, 32:31, 1911.

Ondatra zibethicus cinnamominus, Hibbard, Trans. Kansas Acad. Sci., 47:83, 1944; Brumwell, Amer. Midland Nat., 45:214, 1951.

Ondatra zibethica cinnamomina, Dice, Ecology, 4:43, 1923; Dice, Jour. Mamm., 4:110, 1923; Hibbard, Trans. Kansas Acad. Sci., 36:244, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 203, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:508, 1939; Hibbard and Rinker, Univ. Kansas Sci. Bull., 29 (pt. 2, no. 4):255, 1943.

Fiber zibethicus, J. A. Allen, Bull. Essex Inst., 6:49, 1874; Baker, Trans. Kansas Acad. Sci., 11:58, 1889; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905.

Fiber Zibethicus, Knox, Trans, Kansas Acad. Sci., 4:21, 1875.

Ondatra zibethica zibethica, Linsdale, Jour. Mamm., 9:145, 1928.

Distribution.—Throughout all but the southeastern part of the state. See map, figure 53.

Remarks.—External measurements of three males from Wakeeney, are: 470, 456, 533; 213, 200, 254; 72, 65, – –; 21, 20, – –.

Specimens examined.—Total, 297, distributed as follows: *Nemaha County:* Sabetha, 4. *Doniphan County:* Doniphan Lake, 3; 1½ mi. W Doniphan, 1. *Osborne County:* 1 mi. E Downs, 1. *Riley County:* Manhattan, 1 (USNM); Unspecified, 3. *Logan County:* S of Smokey, 1; Unspecified, 1. *Trego Co.:* Wakeeney, 3; Unspecified, 7 (USNM). *Douglas County:* ½ mi. N Lawrence, 1; Wakarusa River, 10 mi. W KU, 1; in creek of Kaw River, Lawrence, 1; Kaw River, 4; 2 mi. W Lawrence, 2; 1 mi. W Lawrence, 6; Lawrence, 4; Wakarusa Creek, Haskell Farm, 1; 3 mi. SW Lawrence, 5; 4½ mi. SW Lawrence, 3; 7 mi. SW Lawrence, 27; 7½ mi. SW Lawrence, 31; Wakarusa Creek, 11 mi. SW Lawrence, 2; Unspecified, 79. *Marion County:* S Cottonwood Creek, 2 mi. W, 3 mi. S Hillsboro, 1. *Chase County:* 3 mi. E court house, Cottonwood Falls, 1. *Anderson Co.:* Garnett, 1 (USNM); 6 mi. SW Garnett, 1. *Kearny County:* Lakin, 3; Unspecified, 1. *Stafford County:* Little Salt Marsh, 3. *Reno County:* 1 mi. N, 2 mi. W Medora, 1; 2 mi. W, ½ mi. S Medora, 1; 2 mi. N, 2 mi. E Hutchinson, 3. *Harvey County:* Halstead, 7. *Morton County:* Spring Creek, 12 mi. NW Elkhart, 1; 9 mi. N, 3 mi. E Elkhart, 3. *Meade County:* 1½ mi. N Fowler, 1; 13 mi. SW Meade, 1; 14 mi. SW Meade, 3; 17 mi. SW Meade, 1; Unspecified, 1. *Eastern Kansas:* no other locality specified, 71.

Ondatra zibethicus zibethicus (Linnaeus)

[*Castor*] *Zibethicus* Linnaeus, Syst. Nat., ed. 12, 1:79, 1866, type from eastern Canada.

Ondatra zibethicus zibethicus, Davis and Lowery, Jour. Mamm., 21:212, 1940.

Ondatra zibethica zibethica, Hibbard, Trans. Kansas Acad. Sci., 36:244, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 203, 1937.

Distribution.—Southeastern Kansas, west to Cowley County and north to Greenwood, Woodson, and Bourbon counties. See map, figure 53.

Remarks.—External measurements of one male from three miles southeast of Arkansas City, are: 520; 217; 78, 20.

Specimens examined.—Total, 12, distributed as follows: *Greenwood County:* Hamilton, 1 (GCR); 1 mi. E Hamilton, 1 (GCR); 3 mi. SE Hamilton, 1 (GCR); 8 mi. SW Toronto, 3; Unspecified, 1. *Woodson County:* Neosho Falls, 1. *Bourbon County:* 1 mi. W Anna, 1. *Crawford County:* Mulberry, 1. *Cowley County:* Arkansas City, 1; 3 mi. SE Arkansas City, 1.

Genus **Pitymys** McMurtrie

Pine Mice

This genus occurs in North America, Europe, and Asia. In North America it is confined mainly to eastern United States and some mountains in eastern Mexico. Members of this genus have five plantar tubercles, four mammae, lateral glands on the hips of adult males, small ears, short tail, and short, dense and glossy fur. One species of this genus occurs in Kansas, and that is restricted to the eastern part of the state.

Pitymys pinetorum

Woodland Pine Mouse

This species may be distinguished from *Synaptomys cooperi* by the longer tail (slightly longer than the hind foot) and absence of grooves on the upper incisors. From *Microtus, Pitymys* differs in glossy, rich chestnut, instead of gray or blackish, dorsum. The pine mouse is approximately six inches in length, the tail comprising approximately one inch of this total.

The pine mouse usually lives in moist woodlands where it makes runways under the fallen trees and leaves and in soft soil. Occasionally it has been taken in grassy areas. G. C. Rinker took a total of 90 individuals of this species over a period of years from a brushy railroad embankment one-half mile south of Hamilton, Greenwood County.

Asdell (1946:252) reports only one record of the number of young for this species; that being two. Data given on the label of a female taken on April 8, 1923, at Geary, Doniphan County,

indicates that the female was associated with three young. Three females in the collection contained two embryos each. Two of these gravid females were taken on March 7th and one on December 26th.

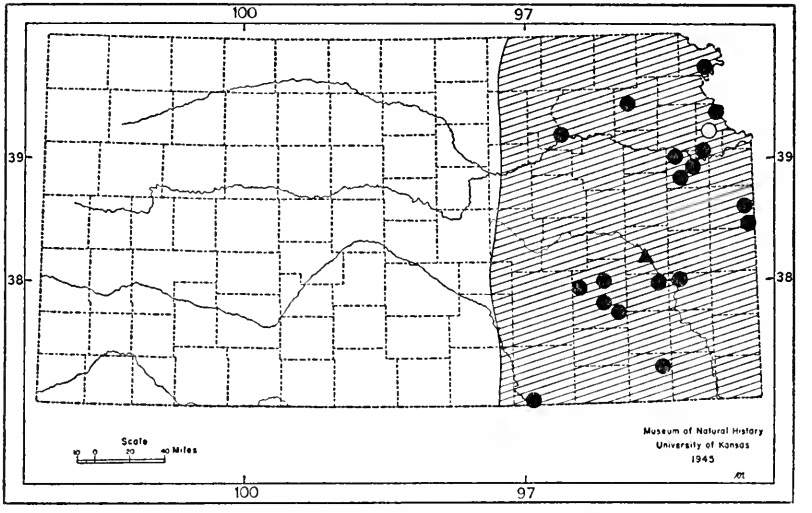

FIG. 54. Distribution of *Pitymys pinetorum nemoralis* in Kansas. See figure 5 for explanation of symbols.

Pitymys pinetorum nemoralis (Bailey)

Microtus pinetorum nemoralis Bailey, Proc. Biol. Soc. Washington, 12:89, 1898, type from Stilwell, Adair County, Oklahoma.

Pitymys pinetorum nemoralis, Jackson, Proc. Biol. Soc. Washington, 54:202, 1941.

Pitymys nemoralis, Miller, N. Amer. Land Mamm. 1911, p. 229, 1912; Linsdale, Jour. Mamm., 8:145, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:244, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 202, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:82, 1944; Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:137, 1947; Brumwell, Amer. Midland Nat., 45:213, 1951.

Microtus nemoralis, Bailey, N. Amer. Fauna, 17:66, 1900; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Dice, Ecology, 4:45, 1923; Dice, Jour. Mamm., 4:110, 1923.

M[icrotus] nemoralis, Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905.

Arvicola pinetorum, Knox, Trans. Kansas Acad., Sci., 5:65, 1877.

Arvicola (*Pitymys*) *pinetorum*, Coues, Monograph N. Amer. Rodentia, p. 225, 1877.

Distribution.—Eastern part of the state, west certainly to Riley, Greenwood, and Cowley counties. See map, figure 54.

Remarks.—External measurements of three males and two females from two miles west-northwest of Lawrence, are: ♂ 127,

132, 141, ♀ 122, 134; 24, 26, 26, 22, 24; 19, 18, 19, 18, 18; 12, 12, 12, 11, 12; weight in grams 28.6, 35.0, 44.3, 27.3, 39.6.

Specimens examined.—Total, 211, distributed as follows: *Doniphan County:* Geary, 16; Geary Lake, 5. *Riley Co.:* Manhattan, 2 (USBS). *Jackson County:* 10½ mi. WSW Holton, 1. *Leavenworth Co.:* Fort Leavenworth, upper one mile creek, 1; Fort Leavenworth, 2 (1, USBS); Stranger Creek, 2 mi. N Jarbalo, 1; Unspecified, 1. *Douglas County:* 1 mi. W Midland, 1; Lakeview, 2; 2 mi. WNW Lawrence, 5; 1 mi. W Lawrence, 1; Lawrence, 13; 7 mi. SW Lawrence, 10; 7½ mi. SW Lawrence, 15; 7½ mi. SW Lawrence (Washington Creek), 2; Rock Creek, 10 mi. SW Lawrence, 1; N end Lone Star "State" Lake, 9 mi. S, 7 mi. W Lawrence, 1; Unspecified, 4. *Miami County:* Pigeon Lake, 1; 11 mi. SSE Paola, 1. *Greenwood County:* Hamilton, 8; ½ mi. S Hamilton, 90 (GCR); ¾ mi. S Hamilton, 5; 1 mi. S Hamilton, 7; 4 mi. S, 14 mi. W Hamilton, 1; Fall River, 5 mi. S, 12 mi. W Hamilton, 3 (GCR); 14 mi. S Hamilton, 1; 8½ mi. SW Toronto, 4. *Woodson Co.:* Neosho Falls, 1 (USNM). *Allen County:* 5½ mi. N, 4½ mi. W Iola, 2. *Cowley County:* 3 mi. SE Arkansas City, 2. *Montgomery Co.:* Cherryvale, 1 (USNM).

Additional records.—*Coffey Co.:* Burlington, 1 (Coues, 1877:225).

Genus **Microtus** Schrank

Meadow Mice

This genus is characteristic of the north and high altitudes, and is found in Europe and Asia as well as North America. Meadow mice have long, loose pelage, a relative short tail, short, rounded ears nearly concealed by the pelage and smooth anterior faces of the incisor teeth. One species of this genus occurs in Kansas.

Microtus ochrogaster

Prairie vole

Three subspecies of the prairie vole occur in Kansas. They may be separated from *Synaptomys* by their longer tail (longer than length of hind foot) and by the absence of grooves on the upper incisors. From *Pitymys*, *Microtus ochrogaster* differs in that the dorsal color is gray or blackish, rarely with a brownish tinge, while *Pitymys* is usually a rich chestnut in dorsal coloration. The pelage is harsher than in *Pitymys*.

This species is active throughout the day all year. In eastern Kansas it is more common in damp situations; it has been found in the same runways as *Synaptomys*. Its habits closely resemble those of *Synaptomys*. The meadow mouse feeds on a large number of grasses, clovers, and weeds. Jameson (1947) made an intensive study of the natural history of this species at Lawrence. He found that, in summer, this vole inhabits areas of grass, clover, and alfalfa. In winter, habitats with some woody growth may be sought.

Jameson (1947:146-7) found that the breeding season is from February through November; that the size of the litter varied with

the age of the female and with the season of the year (litter size largest in old females and in March). The average number of embryos in 58 gravid females examined by him was 3.4 (range from one to seven), and these gravid females were distributed by months as follows: January, 0; February, 4; March, 10; April, 6; May, 8; June, 9; July, 5; August, 2; September (no examinations made); October, 5; November, 5; and December, 0.

In western Kansas this species was formerly found in most of the native prairies. In 1933 Wooster (1939A) made a census of this species on a prairie near Hays, and estimated that there were 2,500 individuals per square mile; 1933-1937, inclusive, was a period

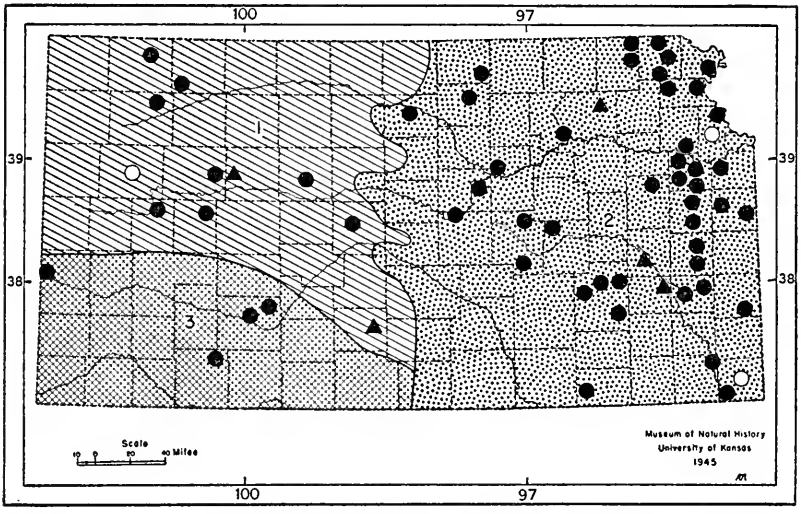

FIG. 55. Distribution of *Microtus ochrogaster* in Kansas. 1. *M. o. haydenii*. 2. *M. o. ochrogaster*. 3. *M. o. taylori*. See figure 5 for explanation of symbols.

of low rainfall throughout the state, especially so in the western part. By 1934 the grass cover of the prairies was gone and the prairie voles almost disappeared. Wooster also pointed out (1939): "Predatory birds evidently had to turn to other rodents for food. . . . A study of Barn Owl pellets in 1932 showed that meadow mice composed approximately half the total food of the owls at that time. In 1933 meadow mice composed one-third of the total food of the Barn Owls. . . . In 1935 the meadow mouse composed only one-fiftieth of the food of the Barn Owl."

Brown (1946:453) studied a mixed prairie two and one-half miles west of Hays in 1944, seven years after the drouth period in that area. He pointed out that although the meadow mouse

had been the most abundant rodent in much of the native prairie several years ago, it was found only in small areas in the ungrazed little bluestem. He estimated that there were approximately 22 meadow mice per square mile in 1944.

Microtus ochrogaster haydenii (Baird)

Arvicola (Pedomys) haydenii Baird, Mamm. N. Amer., p. 543, 1858, type from Fort Pierre, Stanley County, South Dakota.

Microtus ochrogaster haydenii, Black, Kansas State Board Agric., 30th Biennial Rept., p. 202, 1937; Hibbard and Rinker, Univ. Kansas Sci. Bull., 29 (pt. 2, no. 4):260, 1943; Hibbard, Trans. Kansas Acad. Sci., 47:82, 1944; Brown, Trans. Kansas Acad. Sci., 48:451, 1946.

Microtus ochrogaster haydeni, Osgood, Proc. Biol. Soc. Washington, 20:48, 1907.

Microtus haydenii, Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:244, 1933.

Microtus haydeni, Bailey, N. Amer. Fauna, 17:75, 1900; Burnett, Occas. Papers Mus. Zool. and Ent., Colorado Agric. College, 1:7, 1930; Wooster, Trans. Kansas Acad. Sci., 38:352, 1935; Wooster, Trans. Kansas Acad. Sci., 42:515, 1939; Wooster, Trans. Kansas Acad. Sci., 43:303, 1940; Webb, Trans. Kansas Acad. Sci., 43:479, 1940.

M[icrotus] haydenii, Lantz, Kansas State College Exp. Sta. Bull., 129: 335, 1905.

Pedomys haydenii, Ellerman, Families and Genera of living Rodents, volume 2, p. 621, 1941.

Pedomys ochrogaster haydenii, Anderson, Nat. Mus. Canada Bull., 102:200, 1947.

Distribution.—Northwestern part of the state, east certainly to Decatur and Ellis counties and south certainly to Barton, Pratt, Scott, and Lane counties. See map, figure 55.

Remarks.—External measurements of six males from 2 mi. NE Ludell, and one female from Logan County, are: ♂ ♂ 149.3 (137-172), ♀ 143.3; 34.8 (24-41), 36.8; 20.6 (19-22), 21.8; 12.6, – –.

I have not critically studied the geographic variation in this species because James Bee at present is doing so.

Specimens examined.—Total, 31, distributed as follows: *Rawlins County:* 2 mi. NE Ludell, 6. *Decatur County:* 10¾ mi. S, 4 mi. W Oberlin, 3. *Thomas County:* 10 mi. N, 6 mi. E Colby, 3. *Logan County:* Unspecified, 3. *Gove County:* Castle Rock, 2 (GCR). *Ellis Co.:* Hays, 2 (USBS); 4 mi. W, ½ mi. S Hays, 1. *Scott County:* State Park, 4 (GCR). *Lane County:* Pendennis, 1. *Barton County:* 3 mi. N, 2 mi. W Hoisington, 6.

Additional records.—Trego County: Banner, 15 (Bailey, 1900:75). *Lane Co.:* Pendennis, 10 (Bailey, 1900:75). *Pratt Co.:* Cairo, 4 (Bailey, 1900:74).

Microtus ochrogaster ochrogaster (Wagner)

Hypudaeus ochrogaster Wagner, Schreber's Saugethiere, Suppl., 3:592, 1842, type from New Harmony, Posey County, Indiana (See Bole and Moulthrop, 1942:157).

Microtus ochrogaster ochrogaster, Black, Kansas State Board Agric., 30th Biennial Rept., p. 200, 1937; Bole and Moulthrop, Sci. Publ. Cleveland Mus. Nat. Hist., 5(6):159, 1942; Hibbard, Trans. Kansas Acad. Sci., 47:82, 1944.

Microtus ochrogaster, Lantz, U. S. Dept. Agric., Biol. Surv. Bull., 31:18, 1907; Dice, Ecology, 4:44, 1923; Dice, Jour. Mamm., 4:110, 1923; Linsdale, Jour. Mamm., 8:52, 1927; Linsdale, Jour. Mamm., 9:144, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:244, 1933; Jameson, Univ. Kansas Publs., Mus. Nat. Hist., 1:128, 1947.

Microtus ochogaster ochogaster [*sic*], Brumwell, Amer. Midland Nat., 45:213, 1951.

Arvicola austerus, Baker, Trans. Kansas Acad. Sci., 11:58, 1889.

Arvicola (*Pedomys*) *austerus*, Coues, Monograph N. Amer. Rodentia, p. 214, 1877.

A[*rvicola*] *austerus*, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

A[*rvicola*] *austerus* var. *cutata*, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Microtus austerus, Bailey, N. Amer. Fauna, 17:74, 1900; Elliott, Field Columbian Mus. Publ. 115, Zool. Series, 8:300, 1907; Lantz, Trans. Kansas Acad. Sci., 19:175, 1905.

M[*icrotus*] *austerus*, Lantz, Kansas State College Exp. Sta. Bull., 129: 335, 1905; Lantz, U. S. Dept. Agric. Yearbook for 1905:373, 1905.

Microtus pennsylvanicus, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Beach, Trans. Kansas Acad. Sci., 34:125, 1931.

Arvicola riparia var. *longipilus*, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Distribution.—Eastern part of the state, west along stream valleys certainly to Republic, Mitchell, Saline, McPherson, and Chautauqua counties. See map, figure 55.

Remarks.—External measurements of 25 males and 20 females from one and one-half miles south of Muscotah, are: ♂ 154.7 (142-172), ♀ 153.8 (134-171); 34.0 (29-41), 32.5 (29-38); 20.4 (19-22), 20.2 (17-22); 13.4 (12-15), 13.2 (12-14).

Specimens examined.—Total, 583, distributed as follows: *Republic County:* Agenda, 3; ½ mi. SE Agenda, 2. *Nemaha County:* 6 mi. N Sabetha, 1; 2½ mi. S Sabetha, 2; ¾ mi. E, 3½ mi. S Sabetha, 2. *Brown County:* 1 mi. E Reserve, 2; 7 mi. N, ½ mi. E Hiawatha, 1; 3 mi. N Hiawatha, 1; 1 mi. N Horton, 1. *Doniphan County:* Geary, 19; 1½ mi. W Doniphan, 1. *Mitchell County:* 3½ mi. W, ½ mi. S Beloit, 6. *Cloud County:* 4 mi. E Concordia, 2. *Riley Co.:* Manhattan, 1 (USBS). *Atchison County:* 1½ mi. S Horton, 2; 1½ mi. S Muscotah, 47; 4 mi. S Muscotah, 9; 1.8 mi. N Atchison, 1. *Jefferson County:* 3½ mi. ENE Williamstown, 4. *Leavenworth County:* Ft. Leavenworth, 14; Unspecified, 4. *Saline County:* DeBolds Farm, 4 mi. E Salina, 8 (AJK); 10 mi. E Salina, 2. *Dickinson County:* 3½ mi. NW Solomon, 1 (AJK); 3 mi. NW Solomon, 1 (AJK); 6 mi. S Solomon, 2 (AJK). *Osage County:* 3 mi. SE Carbondale, 4. *Douglas County:* ½ mi. NW Lecompton, near Kaw R., 1; 4½ mi. N Lawrence, 1; 3 mi. NE Lawrence, 1; 1 mi. NW Midland, 6; 2 mi. N Lawrence, 3; 2 mi. NW Lawrence, 1; 1 mi. NW Lawrence, 2; U. P. tracks N of Lawrence, 13; 7 mi. W Lawrence, 1; 2½ mi. W Lawrence, 1; 2 mi. W Lawrence, 1; 1 mi. W Lawrence, 9; West of Fort Lake, 13; Lawrence, 44; Haskell Farm, Lawrence, 1; 2 mi. SW Lawrence, 2; 7 mi. SW Lawrence, 26; "around Clinton", 1; 3½ mi. SSW Pleasant Grove, 2; N end Lone Star State Lake, 9 mi. S, 7 mi. W Lawrence, 1; Rock Creek, 850 ft., 10 mi. SW Lawrence, 1; Unspecified, 34. *Johnson County:* Sunflower Village, 2 mi. SW DeSoto, 1. *McPherson County:* Smoky Hill River, 1 mi. S, ½ mi. W Lindsborg, 4; 1 mi. S Lindsborg, 2. *Marion Co.:* 4½ mi. E Peabody, 1; Lost Springs, 3 (USBS). *Chase County:* 9 mi. E Lincolnville, "101 Pasture", 2. *Franklin County:* Near Princeton, 2; 4 mi. N Ottawa, 2. *Anderson County:* 3 7/10 mi. S Garnett,

11; 4 3/10 mi. S Garnett, 5; 6 mi. S Garnett, 3; 7 mi. S Garnett, 3; Unspecified, 4. *Miami County:* 13 mi. SW Spring Hill, 1; 11 mi. SSE Paola, 2. *Greenwood County:* Hamilton, 181 (173, GCR); 1 mi. E Hamilton, 14; ¾ mi. S Hamilton, 1; 1 mi. S Hamilton, 2; 1½ mi. SE Hamilton, 4; 1 mi. W Virgil, 1 (GCR); 4 mi. S, 14 mi. W Hamilton, 1; 8½ mi. SW Toronto, 6; Unspecified, 2. *Allen County:* Moran, 8; 2½ mi. W Iola, 1. *Bourbon County:* 1 mi. W Anna, 1. *Chautauqua Co.:* Cherryvale, 2 (USNM). *Labette County:* 10 mi. E, 1½ mi. N Parsons, 3. *Cherokee County:* 18 mi. SW Columbus, 1; Unspecified, 1.

Additional records.—Doniphan County: Unspecified, 1 (Coues, 1877:214). *Pottawatomie Co.:* Onaga, 3 (Bailey, 1900:74). *Leavenworth Co.:* Fort Leavenworth, 22 (Bailey, 1900:74). *Coffey Co.:* Burlington, 1 (Coues, 1877:214). *Woodson Co.:* Neosho Falls, 3 (Coues, 1877:214).

Microtus ochrogaster taylori Hibbard and Rinker

Microtus ochrogaster taylori Hibbard and Rinker, Univ. Kansas Sci. Bull., 29 (pt. 2, no. 4):256, 1943; type from H. H. Hildebrand Farm, 1½ mi. N Fowler, Meade County, Kansas; Hibbard, Trans. Kansas Acad. Sci., 47:82, 1944.

Distribution.—Occurs locally in southwestern Kansas; known only from Hamilton, Ford, and Meade counties. See map, figure 55.

Remarks.—External measurements of 22 specimens from Meade County, as given by Hibbard and Rinker (1943:260) in the original description of this subspecies, are: 160.0 (141-180); 35.4 (30-42); 21.0 (20-22); 11.2 (10-13).

Hibbard and Rinker (1943:266) reported that: "The data at hand show clearly that *M. o. taylori* inhabits a much more moist habitat than *M. o. haydenii*." They further reported (*op. cit.*:264) that nine females of this subspecies collected in Meade County in the last part of June and the first part of July, contained embryos, ranging from one to five in number. The average number of embryos per female was 2.6.

According to Hibbard and Rinker (1944:257), the skull of this subspecies is similar to that of *M. o. haydenii,* but differs in being slightly shorter, narrower, and with lighter upper incisors. The temporal ridges of *M. o. taylori* meet posterior to the interorbital constriction and form a pronounced interorbital ridge, a character that is not common in *M. o. ochrogaster* nor in *M. o. haydenii.* The pelage of the dorsum is a snuff brown color, as contrasted to a gray coloration in *M. o. haydenii* and a grizzled color in *M. o. ochrogaster.*

Specimens examined.—Total, 55, distributed as follows: *Hamilton County:* Coolidge, 1. *Ford County:* 8 mi. E Dodge City, 1; ½ mi. NW Bellefont, 4. *Meade County:* 1½ mi. N Fowler, 29; 1 mi. N, 1 mi. E Fowler, 20 (GCR).

TABLE 24.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF SYNAPTOMYS, ONDATRA, PITYMYS, AND MICROTUS.

Sex	Number averaged or catalogue number	Condylobasal length	Zygomatic breadth	Nasal length	Diastema	Alveolar length of upper tooth-row	Alveolar length of lower tooth-row	Interorbital breadth
			S. cooperi gossii, Atchison County					
♂	16146	30.6	17.8	8.1	9.0	7.8	7.0	3.3
♂	16147	28.8	17.1	7.3	8.0	7.5	6.7	3.7
♂	16148	26.9	15.9	7.1	7.6	7.0	6.5	3.6
			Nemaha County					
♀	16638	26.8	16.5	6.9	7.4	7.2	6.4	3.6
♀	16639	24.5	15.8	6.5	7.3	7.0	6.2	3.5
♀	16641	25.8	16.0	7.1	7.3	7.1	6.2	3.5
			S. c. paludis, 14 miles SW Meade, Meade County					
†	8	28.2	18.6	....	....	7.5	7.1	....
	min.	27.5	17.9	....	....	7.3	6.9	....
	max.	29.0	19.7	....	....	8.0	7.5	....

Sex	Catalogue number	Condylobasal length	Zygomatic breadth	Nasal length	Diastema	Alveolar length of upper tooth-row	Interorbital breadth
			Ondatra zibethicus cinnamominus, Trego County				
♂	5113	63.2	38.7	19.4	22.3	15.5	5.7
♂	5114	57.6	35.6	18.1	20.0	15.3	6.7
♂	1519	60.1	....	20.0	22.3	14.2	6.3
			Douglas County				
♀	2668	59.0	37.1	19.6	21.0	14.1	6.9
♀	4099	64.1	39.8	21.8	22.3	16.7	5.6
♀	1521	61.0	....	19.5	22.1	15.3	7.4
			O. z. zibethicus, Cowley County				
♂	12919	63.1	38.1	19.9	22.6	15.0	5.7
			Pitymys nemoralis, Greenwood County				
♂	13629	25.1	14.7	8.0	7.3	5.8	4.2
♂	13630	24.5	13.9	7.2	7.5	6.1	4.3
♂	13635	26.4	15.6	7.6	7.8	6.5	4.3
♀	13633	26.7	15.7	8.5	8.3	6.4	4.1
♀	13641	24.2	14.8	6.5	7.5	5.9	4.5
♀	8040	26.0	15.2	7.9	7.8	6.4	4.3

TABLE 24.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF SYNAPTOMYS, ONDATRA, PITYMYS, AND MICROTUS—*Concluded*

Sex	Number averaged or catalogue number	Condylobasal length	Zygomatic breadth	Nasal length	Diastema	Alveolar length of upper tooth-row	Alveolar length of lower molar series	Interorbital breadth
	Microtus ochrogaster haydenii, 2 mi. NE Ludell, Rawlins County							
♂	5	27.5	15.7	7.5	8.3	6.3	6.2	4.1
	min.	24.9	14.2	6.4	7.3	5.8	5.6	4.0
	max.	29.2	17.6	8.4	8.9	6.8	6.7	4.3
	Logan County							
♀	1066	27.0	15.1	7.5	7.7	6.4	6.3	3.9
	M. o. ochrogaster, 1½ mi. S Muscotah, Atchison County							
♂	16	27.6	15.9a	7.5	8.3	5.9	5.7	4.1
	min.	25.7	14.8	6.7	7.6	5.1	5.1	3.7
	max.	29.3	16.8	8.5	9.1	6.5	6.1	4.5
♀	13	27.2	15.9	7.3	8.1	5.9	5.9	3.9
	min.	25.7	14.7	6.8	7.3	5.7	5.7	3.8
	max.	29.5	16.8	8.0	9.0	6.4	6.2	4.3
	M. o. taylori, 1½ mi. N Fowler, Meade County							
**	22	28.0	16.4	7.1	8.2	6.5	6.5	....
	min.	24.2	14.5	6.5	6.6	6.0	5.9	....
	max.	30.7	17.3	8.4	9.1	7.1	7.0	....

** Average of eight males and 14 females as given by Hibbard and Rinker (1943:259).
a. 15 averaged.
† Average of seven males and one female as given by Hibbard and Rinker (1942:29).

Family Muridae

Old World Rats and Mice

Two genera, including three species, of this family occur in Kansas. The barn rat and the house mouse are introduced commensals of man. They are distinguished from the native rats and mice by their thinly haired and scaly tails and by the presence of three rows of tubercles on the molars. The dental formula for this family is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{0}{0}$, m. $\frac{3}{3}$.

The following key will aid in the separation of species known to occur in Kansas.

1. Hind foot less than 22 mm.; greatest length of skull less than 30 mm.; no heavy ridges on skull.....*Mus musculus*, p. 211
1'. Hind foot more than 22 mm.; greatest length of skull more than 30 mm.; heavy ridges over orbit and posteriorly on skull.....2

2.(1′) Tail shorter than head and body; ears small, half buried in fur; no distinct notches on anterior row of cusps on first molar tooth, *Rattus norvegicus*, p. 209

2′. Tail longer than head and body; ears large, standing out from the fur; distinct outer notches on anterior row of cusps on first molar tooth ..... *Rattus rattus*, p. 208

Genus **Rattus** G. Fischer

Old World Rats

Rats of this genus have scaly, naked tails, nearly naked ears, and much coarser pelage than the native rats of the genus *Neotoma*. The upper molars differ from those of native rats in having three longitudinal rows of tubercles on the cheek teeth, instead of two rows of tubercles or a flat occlusal area. According to Hamilton (1943:349), rats of the genus *Rattus* have been in the New World since the American Revolution.

The general destructiveness of these rats as well as their activity as disease carriers and their role in increasing the fire hazard have all been emphasized time and again. The United States Department of Agriculture has available a free publication on rat control and methods of rat-proofing of buildings.

Rattus rattus

Rats

Two subspecies of this rat seem to occur, or to have occurred, in Kansas. This species can be distinguished from *Rattus norvegicus* by the longer tail (longer than the head and body in *R. rattus*) and more prominent ears (small and half buried in the fur in *R. norvegicus*).

Hibbard (1933:245) reported that the black rat [*Rattus rattus rattus*] was once common throughout the eastern United States but that it had been replaced in Kansas by the house rat, *Rattus norvegicus*, and mentioned one skin, in the University of Kansas Museum, taken near Lawrence in Douglas County. I have failed to locate any specimen of *Rattus rattus rattus*, or other record of one from Kansas.

Last year (1950) J. W. Hunt of the United States Public Health Service presented to the University of Kansas Museum of Natural History one specimen of *Rattus rattus alexandrinus* from Wichita and reported that several individuals of this subspecies have been killed in Wichita by various employees of the United States Public Health Service.

Hayden (1875:94) reported that: "*Mus rattus,* or common Rat," had been introduced at fur-trading posts along the Missouri River as early as 1855.

Rattus rattus rattus (Linnaeus)

[*Mus*] *rattus* Linnaeus, Syst. Nat., 1 (ed. 10):61, 1758, type from Upsala, Sweden.

Rattus rattus rattus, Miller, Bull. U. S. Nat. Mus., 128:428, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:245, 1933; Hibbard, Trans. Kansas Acad. Sci., 47:83, 1944.

Distribution.—Not known to be present in the state at present but may have formerly occurred in at least the eastern third of the state.

Remarks.—Measurements of 12 adults from Alabama, Florida, Georgia, Massachusetts, New Hampshire, and Virginia (as given by Hamilton, 1943:355) are: 369 (327-430); 193 (160-220); 35.5 (33-39).

Specimens examined.—None.

Rattus rattus alexandrinus (Geoffroy)

Roof Rat

Mus alexandrinus Geoffroy, Catal. Mam. du Mus. Nat. d'Hist. Nat. Paris, p. 192, 1803, type from Alexandrina, Egypt.

R[attus] rattus alexandrinus, Hinton, Jour. Bombay Nat. Hist. Soc., 26:63, 1918.

Distribution.—At present known only from Wichita, Sedgwick County.

Remarks.—The measurements of the specimen, an adult male, taken on June 29, 1950, at Wichita, are: 15″ [381 mm.]; 8″ [203 mm.]; 1½″ [38 mm.]; ¾″ [19 mm.].

Specimens examined.—Total, one, from the following locality: *Sedgwick County:* Wichita 1.

Rattus norvegicus

Norway Rat

Only one subspecies of the Norway rat occurs in Kansas but it is state-wide in distribution and is common around many warehouses, barns, and city garbage dumps. The Norway rat is a much larger and heavier-bodied rat than either the black rat, *R. r. rattus,* or the roof rat, *R. r. alexandrinus.*

Hamilton (1943:352) reports this species as introduced into the United States in the latter part of the eighteenth century, and of its reproductive habits states (p. 354) that: "Much has been written on the reproductive potentialities of the rat, a great deal of which has been grossly exaggerated. Nevertheless, rats are among the most prolific of all mammals. If food is abundant and shelter adequate, rats will breed throughout the year, although fewer

litters are produced in the winter." The litter size varies from one to 14 (the female has 12 mammae) with an average of six to eight young per litter. The average litter size varies in different parts of the world and, to my knowledge, has not been worked out for animals from Kansas.

O. M. King (1950) published the results of his study of this species in Lawrence.

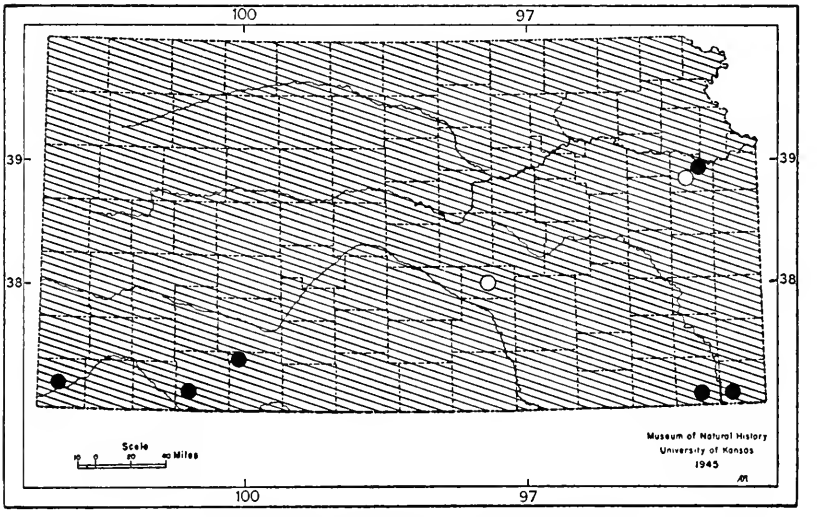

FIG. 56. Distribution of *Rattus norvegicus norvegicus* in Kansas. See figure 5 for explanation of symbols.

Rattus norvegicus norvegicus (Berkenhout)

Mus norvegicus Berkenhout, Outlines Nat. Hist. Great Britain and Ireland, 1:5, 1769, type from Norway; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:194, 1907.

Rattus norvegicus norvegicus, Hibbard, Trans. Kansas Acad. Sci., 47:83, 1944; Brumwell, Amer. Midland Nat., 45:214, 1951.

Rattus norvegicus, Dice, Ecology, 4:44, 1923; Dice, Jour. Mamm., 4:110, 1923; Linsdale, Jour. Mamm., 9:145, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:245, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 205, 1937; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; King, Trans. Kansas Acad. Sci., 53:500, 1950.

Mus decumanus, J. A. Allen, Bull. Essex Inst., 6:49, 1874; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:270, 1895.

M[us] decumanus, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Distribution.—State-wide, rarely found far from buildings. See map, figure 56.

Remarks.—Measurements of six females, from Lawrence, are: 357.6 (294-425); 161.0 (125-190); 37.8 (35-42); 22 (one specimen only).

Specimens examined.—Total, 29, distributed as follows: *Douglas County:* 1 mi. N Lawrence, 6; Lawrence, 7; Unspecified, 9. *Harvey County:* Unspecified, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 1. *Meade County:* Meade County State Game Farm, 1; 17 mi. SW Meade, 1. *Clark County:* Minneola, 2400 ft., 1. *Labette Co.:* 10 mi. SW Oswego, 1. *Cherokee Co.:* 18 mi. SW Columbus, 1.

Genus Mus Linnaeus

This genus is a native of the Old World but has been introduced all over the world. Although not as destructive as the Old World rats, genus *Rattus,* the house mouse causes untold thousands of dollars damage to stored foods each year, in Kansas alone.

Mus musculus

House Mice

House mice can be distinguished from the native mice by the characteristics pointed out in the discussion of this family: thinly haired and scaly tails and three rows of tubercles on the occlusal surfaces of the cheek teeth. A third distinguishing feature of the house mice is the notched occlusal surface of the upper incisors.

Hayden (1875:94) reported the house mouse as abundant at all fur-trading posts on the Missouri River as early as 1855.

Mus musculus subspecies

[*Mus*] *musculus* Linnaeus, Systema Naturae, 10 ed., 1:58, 1758, type probably from southern Sweden.

Mus musculus, Baird, Mamm. N. Amer., p. 444, 1858; J. A. Allen, Bull. Essex Inst., 6:48, 1874; Knox, Trans. Kansas Acad. Sci., 4:21, 1875; Baker, Trans. Kansas Acad. Sci., 11:58, 1889; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:270, 1895; Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:334, 1905; Linsdale, Jour. Mamm., 8:52, 1927; Wooster, Trans. Kansas Acad. Sci., 43:303, 1940; King, Trans. Kansas Acad. Sci., 53:500, 1950.

Mus musculus subsp. ?, Brumwell, Amer. Midland Nat., 45:214, 1951.

Mus. musculus musculus, Dice, Ecology, 4:44, 1923; Dice, Jour. Mamm., 4:110, 1923; Linsdale, Jour. Mamm., 9:146, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:245, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 204, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:508, 1939; Webb, Trans. Kansas Acad. Sci., 43:479, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:83, 1944.

Remarks.—External measurements of ten males and ten females from Douglas County, are: males 148.5 (130-178), females 167.3 (145-198); 73.9 (63-91), 81.5 (66-102); 17.7 (16-20), 18.3 (17-21); 13.3 (11-18, 9 specimens), 13.3 (12-14, 3 specimens).

The subspecific status of the house mice in Kansas is unknown. Schwartz and Schwartz (1943:59-72) made an intensive study of the wild and commensal stocks of the house mice, and concluded that, in wild stocks, four different subspecies can be distinguished.

Each of these subspecies is found in a different part of Eurasia and from three of these wild stocks (subspecies) commensal stocks (designated also as subspecies) have developed. They further concluded that only two of these commensal stocks have been introduced and established in the western hemisphere; *Mus musculus domesticus* introduced into North America, from Alaska southward to the northern part of the central states of the United States, and *Mus musculus brevirostris,* which has been introduced " . . .

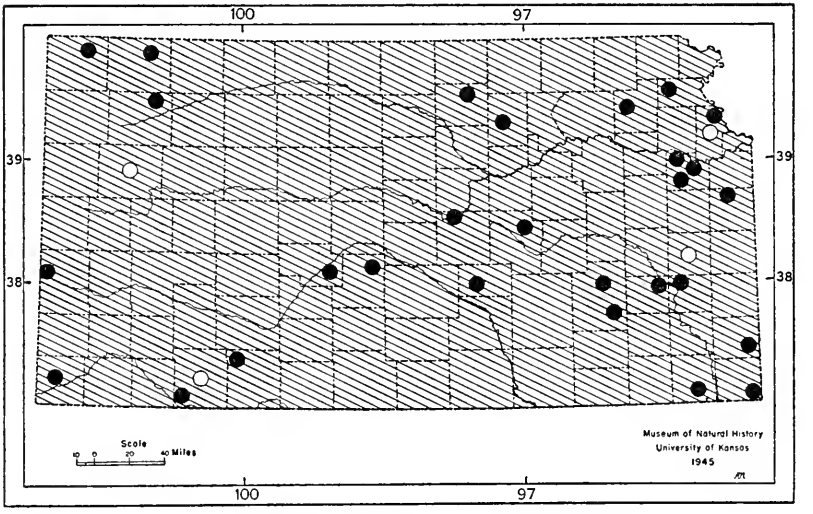

FIG. 57. Distribution of *Mus musculus* subspecies in Kansas. See figure 5 for explanation of symbols.

into South and Central America, and the southern part of the United States where its range passes into and overlaps with that of *M. m. domesticus.*" (Schwartz and Schwartz, 1943:65).

I have wondered if the house mice in Kansas are the result of crosses between two or more of the various named subspecies of this species. I have made no attempt to assign a subspecific name to the available specimens.

Specimens examined.—Total, 110, distributed as follows: *Cheyenne County:* 14 mi. NE St. Francis, 1. *Rawlins County:* 2 mi. NE Ludell, 5. *Thomas County:* 10 mi. N, 6 mi. E Colby, 3100 ft., 3. *Cloud County:* 3 mi. E Concordia, 9. *Clay County:* 6 mi. SW Clay Center, 1. *Jackson County:* 10½ mi. WSW Holton, 1. *Atchison County:* 1½ mi. S Muscotah, 1. *Leavenworth County:* Fort Leavenworth, 2; Unspecified, 3. *Logan County:* Unspecified, 1. *Douglas County:* Kansas R., ½ mi. NW LeCompton, 1; 2 mi. N Lawrence, 2; 1 mi. N Lawrence, 1; 1 mi. W Lawrence, 1; Lawrence, 16; 7½ mi. SW

Lawrence, 17; Unspecified, 6. *McPherson County:* Smoky Hill R., 1 mi. S, ½ mi. W Lindsborg, 1. *Marion County:* 1½ mi. NE Lincolnville, 1. *Anderson County:* Unspecified, 1. *Miami County:* 3 mi. SW Springhill, 1. *Hamilton County:* 1 mi. E Coolidge, 3. *Pawnee County:* 3 mi. S, 1½ mi. W Larned, 1. *Stafford County:* Little Salt Marsh, 1. *Harvey County:* 1 mi. E, ½ mi. N Halstead, 1; "E of Halstead", 1; 1½ mi. E, 1 mi. S Halstead, 1. *Greenwood County:* Hamilton, 9 (8, GCR)); ½ mi. S Hamilton, 2; 8 mi. SW Toronto, 1. *Woodson County:* Neosho Falls, 1. *Allen County:* 5½ mi. N, 4½ mi. W Iola, 1. *Crawford County:* Pittsburg, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 1. *Meade County:* State Lake, 1; 17 mi. SW Meade, 4; Unspecified, 1. *Clark County:* Minneola, 2400 ft., 2. *Labette Co.:* 8 mi. SW Oswego, 2. *Cherokee County:* 1 mi. S, 4¾ mi. E Baxter Springs, 900 ft., 1.

TABLE 25.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF RATTUS AND MUS.

Sex	Catalogue number	Occipitonasal length	Basilar length	Palatilar length	Length of nasals	Zygomatic breadth	Mastoidal breadth	Width across upper molars	Alveolar length of upper cheek teeth
				R. norvegicus norvegicus, Cherokee County					
♂	2614	50.5	42.6	24.5	18.5	23.9	18.1	9.4	7.7
				Douglas County					
♀	3785	38.2	31.9	18.2	14.0	19.1	15.8	7.8	6.6
♀	3787	41.5	35.4	20.2	14.8	21.0	16.1	8.7	6.8
♀	689	45.9	38.5	21.9	16.1	....	17.9	9.5	7.0
				R. rattus alexandrinus, Wichita					
♂	38099	39.7	32.3	18.2	14.7	18.9	16.4	7.8	6.5
				M. musculus, Douglas County					
♂	18553	21.8	17.9	10.3	7.8	11.3	9.7	4.5	3.2
♂	730	20.1	16.5	9.5	7.1	10.7	9.6	4.4	3.1
♂	3796	21.3	17.2	9.6	7.6	10.8	9.3	4.4	3.2
♀	3793	20.9	17.3	9.7	7.3	....	9.6	4.5	3.1
♀	3795	21.5	17.8	10.2	7.8	10.9	9.5	4.5	3.5
♀	4519	22.0	17.3	9.7	8.1	12.1	10.2	4.8	3.3

Family Zapodiadae

Jumping Mice

Only one genus of this family, *Zapus*, occurs in Kansas. The jumping mouse is a small, saltatorial mouse with a very long tail, elongated hind legs, and small ears and eyes. The upper incisors are grooved. The dental formula is: i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{0}$, m. $\frac{3}{3}$.

Genus **Zapus** Coues

Jumping Mice

Mice of this genus occur in Asia and in North America from Alaska across Canada to the Atlantic Ocean and southward into the United States. In the eastern United States this genus extends southward, in the mountains to South Carolina and in the western United States, it extends southward, in the mountains, to Central New Mexico.

Zapus hudsonius

Hudsonian Jumping Mouse

One subspecies of this species occurs in Kansas. From the other rodents in the state it can be distinguished by the long tail (longer by one-fifth than the head and body), the long, slender hind legs

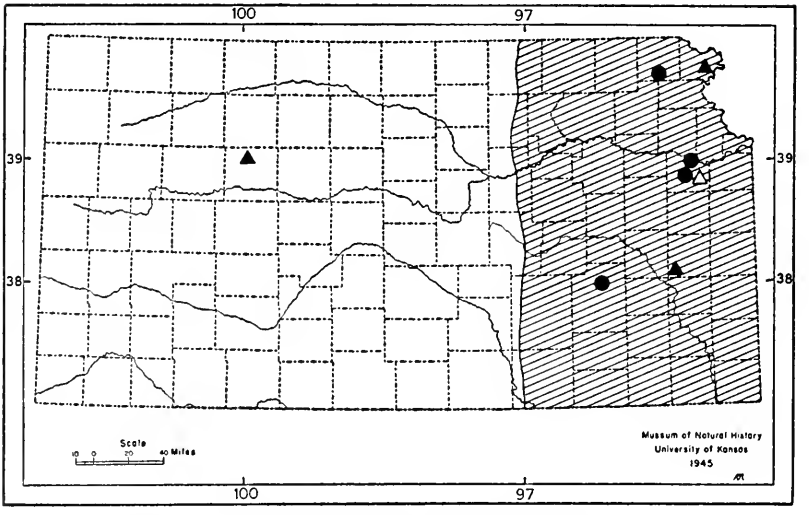

FIG. 58. Distribution of *Zapus hudsonius pallidus* in Kansas. See figure 5 for explanation of symbols.

and feet and small front feet, the grooves on the upper incisors and the dental formula.

Prior to 1948, fewer than ten specimens of *Zapus hudsonius* were known from Kansas, although considerable collecting had been done in the state in the past 70 years by personnel of the University of Kansas Museum of Natural History as well as by the personnel of the Bureau of Biological Survey (U. S. Fish and Wildlife Service) and other institutions. During and since 1948 a total of 12 specimens have been taken in Douglas County. Although of apparent

widespread distribution within the state, this species may be one of the rarest of small mammals in Kansas and, certainly, is one of the least known. Probably it will be found principally in relatively undisturbed marginal situations between grasslands and woodlands in the more humid parts of eastern Kansas.

Asdell (1946:291-2) reported that this species, *Zapus hudsonius,* has one litter per year in New York and probably in North Dakota, but in the south it has more. In the north the mating season is in May and the young are born in June. The litter size is five to eight and the mean is 7.0. Of ten females, in the University of Kansas Museum of Natural History, taken in the first part of July, 1947, three miles northwest of Sundance, Crook County, Wyoming, eight contained embryos. The number of embryos ranged from five to seven and averaged 6.0. No information is available on the reproductive habits of this species in Kansas.

Jumping mice are nocturnal and live in globular nests made of dried grasses placed on the surface of the ground in tall grasses. In winter they hibernate and, like other mammals that hibernate, they accumulate a large supply of fat in late summer and autumn. Neither the dates of hibernation nor actual hibernation has been observed in Kansas jumping mice.

Zapus hudsonius pallidus Cockrum and Baker

Zapus hudsonius pallidus Cockrum and Baker, Proc. Biol. Soc. Washington, 63:1, 1950, type from NW corner sect. 4, T12S, R20E, 5½ mi. N, 1¾ mi. E Lawrence, Douglas County, Kansas.

Zapus hudsonius hudsonius, Linsdale, Jour. Mamm., 9:146, 1928.

Zapus hudsonius campestris, Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:245, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 205, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:83, 1944; Brumwell, Amer. Midland Nat., 45:214, 1951.

Zapus hudsonius, Baker, Trans. Kansas Acad. Sci., 11:56, 1889.

Jaculus Hudsonius, Knox, Trans. Kansas Acad. Sci., 4:21, 1875.

Distribution.—Probably of rare occurrence throughout the eastern one-third of the state. See map, figure 58.

Remarks.—External measurements of four adult males and four adult females from the type locality are: ♂ 199.2 (193-204), ♀ 189.5 (178-197); 114.5 (107-121), 113.2 (106-119); 28 (28-28), 27.2 (26-29); 12.5 (11-14), 13.8 (13-15); weight in grams 17.0 (15.2-20.0), 14.4 (11.7-16.2).

Baker (1889:57) reports one specimen of this species from near Wakeeney. Of this specimen he wrote: "Rare, one individual was taken among willow brush on the bank of a stream."

TABLE 26.—CRANIAL MEASUREMENTS (IN MILIMETERS) OF ZAPUS.

Sex	Number averaged	Greatest length of skull	Zygomatic breadth	Mastoid breadth	Least interorbital constriction	Length of palatal bridge	Alveolar length of upper molariform tooth-row	Greatest height of skull	Length of nasals
	Z. hudsonius pallidus, 5½ mi. N, 1¾ mi. E Lawrence, Douglas County								
♂	4	22.4	11.5	9.7	4.3	3.4	3.4	9.2	8.5
	min.	22.1	10.9	9.5	4.1	3.3	3.2	9.0	8.2
	max.	22.7	11.8	10.0	4.6	3.5	3.5	9.8	8.7
♀	4	21.6	10.9	9.5	4.4	3.3	3.2	8.6	8.2
	min.	21.0	10.5	9.1	3.9	3.2	3.0	8.4	7.9
	max.	22.6	11.1	9.7	4.8	3.4	3.6	8.7	8.4

Specimens examined.—Total, 17, distributed as follows: *Brown County:* Horton, 1. *Douglas County:* NW corner Sect. 4, T12S, R20E, 5½ mi. N, 1¾ mi. E Lawrence, 8; 5 mi. N, 1½ mi. E Lawrence, 3; Sect. 8, T12S, R20E, 4 mi. N, 1¾ mi. E Lawrence, 1; Lakeview, 1; 7½ mi. SW Lawrence, 2. *Greenwood County:* ½ mi. S Hamilton, 1 (GCR).

Additional records.—Doniphan County: Geary (Linsdale, 1928:146). *Douglas Co.:* Baldwin City, 1 (Knox, 1875:21). *Trego Co.:* near Wakeeney: ". . . along the hundredth meridian between N latitude 38.30 and 39.30", 1 (Baker, 1889:57). *Anderson County:* Colony, 1 (Baker Univ. Collection, R. Kellogg, 1915: unpublished thesis).

Family Erethizontidae

Porcupines

This family occurs in North America and South America. It is distinguished from other families of rodents in Kansas by its highly developed spines or quills. These are pointed, barbed, and loosely attached in the skin. The cheek teeth are complex and flat crowned.

One genus, *Erethizon*, of this family occurs in Kansas.

Genus **Erethizon** F. Cuvier

Porcupines

This genus occurs from the northern portions of North America, south, in the mountains, to Arizona. There are four toes on the front foot and five on the hind foot; each toe bears a strong, sharp, curved claw—an adaptation to arboreal habits. The tail is broad, bushy, and densely covered with quills.

The pelage is of three different types: a woolly under fur, a coarse guard hair, and highly specialized spines or quills. One species of this genus occurs in Kansas.

Erethizon dorsatum

Porcupine

But one subspecies of the porcupine occurs in Kansas. Probably it has never been common in the state. In general the porcupine is an arboreal animal and trees are rare in the western part of the state, where specimens of the porcupine have been reported or taken. The porcupine seems never to have occurred regularly in the eastern wooded part of the state. Professor E. Raymond Hall has told me that his father, Wilbur Downs Hall, remembers

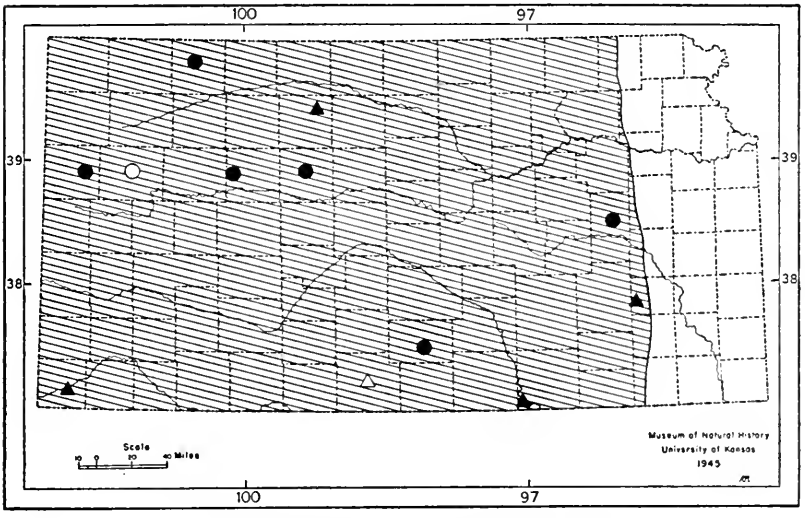

FIG. 59. Distribution of *Erethizon dorsatum bruneri* in Kansas. See figure 5 for explanation of symbols.

one porcupine killed in a large apple orchard approximately four miles south and one mile east of Gardner, Johnson County, in the 1890's. W. D. Hall lived at the place mentioned from 1876 until 1901 and this was the only porcupine seen or heard of in that area.

Black (1937:206) reported that: "The one Barber County specimen in the K. U. collection is rather small and decidedly different in coloration from typical *bruneri;* additional material may prove the presence of an undescribed race of porcupine in that region." A thorough search of the collections at the University of Kansas Museum of Natural History at the present time (1951) has failed to yield any trace of this specimen.

Scattered reports of the occurrence of the porcupine in the state within recent years are available. W. C. Justice (*in litt.*) reported

that a large porcupine was taken six miles west of Arkansas City, near the Arkansas River, in the summer of 1942. Justice is of the opinion that this porcupine had floated down the river on drift in the spring floods. In July, 1950, natives of Morton County told me of various sight records of the porcupine in that region within the past year. One porcupine was killed in the winter of 1949-50 near the Cimarron River north of Rolla.

On July 17, 1950, an adult male was found in a hedgerow near Reading State Lake, ten miles north and eight miles east of Emporia. The animal was shot by O. W. Haywood and through the co-operation of Ted Andrews and John Breukelman of the Department of Zoology of Emporia State Teachers College, was saved for the collections of the University of Kansas Museum of Natural History.

According to Asdell (1946:294) the porcupine mates in November and after a gestation period of 16 weeks, one or occasionally two young are born.

Mead (1899:280) reported that in 1859 "Hedgehogs, locally called porcupines, were very common on the streams between the Saline and Solomon. They subsisted on the bark and buds of trees, climbing with ease. . . . They nested under the shelving rocks where such could be found and brought forth two at a litter."

Erethizon dorsatum bruneri Swenk

Erethizon epixanthum bruneri Swenk, Univ. Studies Nebr., 16:117, 1916, type from three miles east of Mitchell, Scottsbluff County, Nebraska; Hibbard, Trans. Kansas Acad. Sci., 36:245, 1933; Hibbard, Jour. Mamm., 15:70, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 206, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:508, 1939; Hibbard, Trans. Kansas Acad. Sci., 47:84, 1944.

Erethizon dorsatum bruneri, Anderson and Rand, Canadian Jour. Research, 21:293, 1943.

Erethizon dorsatus var. *epizanthus*, J. A. Allen, Bull. Essex Inst., 6:52, 1874; Knox, Trans. Kansas Acad. Sci., 4:22, 1875.

Erethizon dorsatus epixanthus, Baker, Trans. Kansas Acad. Sci., 11:58, 1889.

Erethizon epixanthus, Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Erethizon epixanthum, Lantz, Trans. Kansas Acad. Sci., 19:176, 1905; Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:358, 1907.

Distribution.—Formerly perhaps throughout the western two-thirds of the state or, less likely, state wide. At present, of rare occurrence throughout the western two-thirds of the state. See map, figure 59.

Remarks.—External measurements of two males, one from Decatur County and one from Lyon County, and one female from Kingman County are: ♂ 785, 760, ♀ 630; 210, 215, 180; 102, 105, 70; 30, 30, 34. The male from Lyon County weighed 18 pounds.

Cranial measurements of one male from Decatur County and one female from Kingman County, are, respectively: Basal length, 91.2, 90.1; basilar length, 85.2, 84.4; occipitonasal length, 94.6, 90.5; palatilar length, 45.4, 47.3; length of nasals, 40.7, 35.6; zygomatic breadth, 70.5, 64.3; mastoidal breadth, 45.5, 43.9; interorbital breadth, 24.3, 30.8; and alveolar length of upper cheek-teeth, 23.7, 24.9.

Specimens examined.—Total, 8, distributed as follows (the date in the parenthesis is the date of collection): *Decatur County:* Oberlin, 1 (1932). *Wallace Co.:* Wallace, 1 (USBS, 1872). *Logan County:* Unspecified, 2 (1894, 1912). *Trego County:* 20 mi. SW Wakeeney, 1 (1924). *Lyon County:* 10 mi. N, 8 mi. E Emporia, 1 (1950). *Kingman County:* 1 mi. W Rago on Chikaska R., (1933).

Additional records.—Rooks Co.: Northeast of Stockton on Bow Creek (winter, 1930-31) (Wooster, 1931:112). *Ellis Co.:* 10 mi. N Hays (1929) (Wooster, 1931:112). *Woodson County:* Along Verdigris River SW of Toronto (late 1870's) (Hibbard, 1944:84). *Morton County:* Cimarron R., north of Rolla (winter, 1949-50) (see text). *Barber County:* Unspecified, 2 (one in 1931) (Black, 1937:206). *Cowley County:* 6 mi. W Arkansas City, (1942) (see text).

Order CARNIVORA

Carnivores

The carnivores, or flesh eating mammals, are mainly terrestrial and are nearly world-wide in distribution. Their dentition is adapted for a flesh diet, two teeth in each jaw being modified, usually, into carnassials or cutting teeth. The incisors are small but the canines are well developed, being longer than the other teeth, and thus are adapted for seizing prey.

Members of this order vary greatly in size. Among the smallest is the least weasel which is scarcely larger than a chipmunk. Among the largest is the huge Alaskan bear which is reported to weigh more than half a ton. Five families of terrestrial carnivores occur in North America, each of which either formerly occurred, or at present occurs, in Kansas.

The following key will aid in the separation of the various families of carnivores known to occur in the state within historic times.

1. Total length more than 1225 mm. (48 inches) and tail less than 14% of total length; M2 (always present) at least 1½ times as long as wide ..... URSIDAE, p. 237
1'. Total length less than 1200 mm. (47 inches) and tail more than 15% of total length; M2 (may be absent) less than 1½ times as long as wide 2
2.(1') Five toes on hind foot; 34 to 40 teeth 3
2'. Four toes on hind foot; 30, 32, or 42 teeth 4
3.(2) Pelage of tail with conspicuous rings; 40 teeth, PROCYONIDAE, p. 241
3'. Pelage of tail without rings; less than 40 teeth .. MUSTELIDAE, p. 243

4.(2′) Muzzle long and narrow; claws not retractile; 42 teeth including 2 upper molars on each side.....CANIDAE, p. 220
4′. Muzzle short and wide; claws retractile; 30 or 32 teeth with only one upper molar on each side.....FELIDAE, p. 261

Family Canidae

Wolves, Coyotes, and Foxes

This family, which includes the domestic dog, is composed of several genera of medium-sized, dog-like carnivores. The feet are digitigrade. There are four toes on each of the hind feet and five on each of the front feet. The claws are non-retractile. There are 42 teeth in all North American members of this family; the dental formula is i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{4}{4}$, m. $\frac{2}{3}$. It is world wide in distribution and has three genera represented in Kansas.

The following key will aid in the separation of the species of this family known to occur in Kansas within historic times.

1. Weights of adults less than 18 pounds; length less than 1050 mm.; greatest length of skull less than 175 mm.....2
1′. Weights of adults more than 18 pounds; length more than 1050 mm.; greatest length of skull more than 175 mm...Genus *Canis*, p. 220
2.(1) Total length less than 735 mm.; upper parts buffy-yellow, *Vulpes velox*, p. 234
2′. Total length more than 735 mm.; upper parts reddish or grizzled gray 3
3.(2′) Upper parts grizzled-grayish; tail with dorsal black stripe and prominently tipped with black; lyre-shaped temporal ridges; P2 approximately as long as wide.....*Urocyon cinereoargenteus*, p. 236
3′. Upper parts yellowish-red; tail without dorsal black stripe and not tipped with black; temporal ridges not lyre-shaped; P2 approximately three times as long as wide.....*Vulpes fulva*, p. 232

Genus Canis Linnaeus

Wolves and Coyotes

Three species of this genus either occur, or have occurred, in the state within historic times. These are the wolf, the red wolf, and the coyote. Members of this genus can be distinguished from the foxes by greater weight, adult specimens of *Canis* weighing more than 18 pounds.

Canis latrans

Coyotes

The taxonomic relationships of the various populations of coyotes has long been obscure, because the number of specimens studied were too few, too few localities were represented clearly to show

geographic variation, and too few specimens were available from a given locality to show the degree of individual variation. However, H. H. T. Jackson recently has brought all available material together and made a careful study of the individual and geographic variation of this species, although the results of his studies are not yet published and thus, are not available to me at this time.

Since Kansas was first settled, almost continuous "warfare" was waged against the wolf until it was exterminated and this warfare has been continued against the coyote which still thrives. In the minds of most people, the coyote and wolf are one and the same animal; therefore, many of the references to wolves in the state pertain to the coyote rather than the wolf.

On March 6, 1877, the Legislature of the State of Kansas passed a law providing a bounty of one dollar for each coyote and wolf scalp presented to the county commissioner. Twenty-four counties, mainly in the eastern part of the state, offered bounties in 1877-78. Table 27 gives a summary of the numbers and amounts of bounties paid. This table is based on information found in the first Biennial

TABLE 27.—NUMBER OF WOLVES AND COYOTES PRESENTED TO VARIOUS COUNTY CLERKS FOR BOUNTIES IN 1877-78.

COUNTY	Coyotes	Wolves	Cost
Butler	0	150	$150.00
Chautauqua	0	59	59.00
Chase	134	0	134.00
Cherokee	0	48	48.00
Douglas	0	28	28.00
Ellsworth	107	1	108.00
Harvey	0	50	50.00
Jackson	0	192	192.00
Jefferson	0	14	14.00
Labette	4	40	44.00
Leavenworth	0	41	41.00
Linn	8	0	8.00
Lyon	0	103	103.00
Marion	1	57	58.00
McPherson	101	11	112.00
Mitchell	0	17	17.00
Morris	0	27	27.00
Neosho	18	0	18.00
Osage	0	41	41.00
Pawnee	0	23	23.00
Riley	0	25	25.00
Wabaunsee	0	109	109.00
Wilson	70	0	70.00
Woodson	42	0	42.00
Totals	485	1,036	$1,521.00

Report of the state Board of Agriculture to the Legislature of the State of Kansas for the years 1877-78 (pp. 584-589).

The table above reveals that most county clerks reported all animals presented as either coyotes or wolves. Chase County, for example, reported paying bounties on 134 coyotes and no wolves, while each of the adjacent counties, Morris to the north, Lyon to the east, and Butler to the south, reported paying bounties on a total of 310 wolves but no coyotes. McPherson County, to the west of Chase County, reported paying bounties on 11 wolves and 101 coyotes.

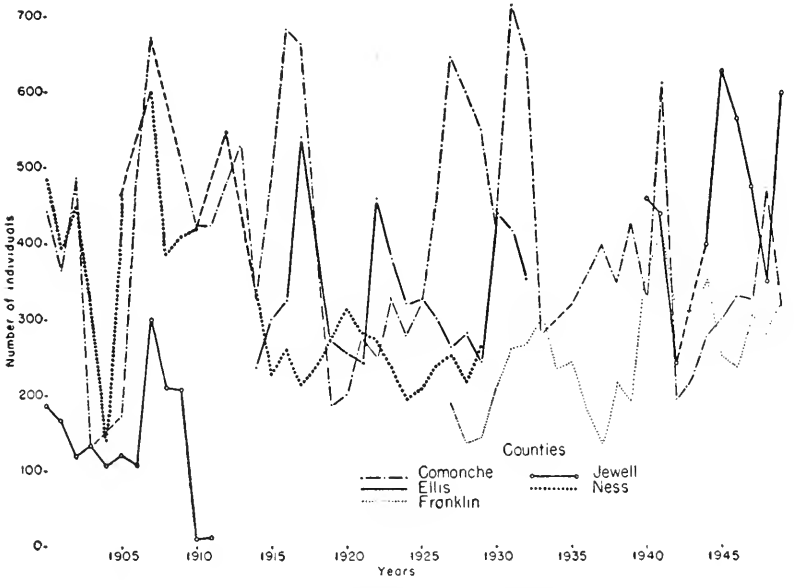

FIG. 60. Graph showing the number of coyotes presented for bounty payments in five counties.

The payment of bounties on coyote scalps has been continued, in Kansas, from 1877 to date. Lantz (1905C:10) listed 94 counties in the state which paid bounties on coyotes from July 1, 1903 to June 30, 1904. Of the 11 counties not listed he determined that ten had paid no bounties and one, Doniphan, had made no report. He found that a total of 19,514 coyote scalps had been presented for bounty payments in the one year period. This is an average of 207.6 annual payments in each of the 94 counties.

Wooster (1938:389) listed the number of bounties paid on coyotes in Ellis County, by year, from 1914 through 1932. He also

listed (1931:112) similar information for Ness County for the years 1889 through 1929. This information, together with similar information that I have received from the county clerks of Comanche, Jewell, and Franklin counties, is presented in figure 60. An inspection of this chart reveals that although many fluctuations in bounty payments have occurred from year to year, there is a surprising amount of correlation among the various counties. If the number of coyotes presented for bounty payment can be taken as a measure of the relative abundance of the animals in the county, then it is obvious that the population levels of the coyotes is in a state of continuous flux. Such fluctuations of population levels among carnivores is well known in more northern latitudes, where it is cyclic in nature and has been correlated with the cyclic behavior of the population levels of the rodents and rabbits. This correlation is not perfect; the peaks of the carnivore population cycles are usually one or two years later than the peaks of the rodent population cycles.

TABLE 28.—NUMBER OF COYOTES PRESENTED TO COUNTY CLERKS OF VARIOUS COUNTIES FOR BOUNTY PAYMENTS IN THE YEARS 1941-1949.

COUNTY	1941	1942	1943	1944	1945	1946	1947	1948	1949
Atchison	.....	.....	167	344	233	271	290	223	143
Bourbon	246	127	234	266	217	316	270	203	139
Comanche	614	192	220	275	300	330	325	470	315
Crawford	94	88	153	184	176	131	294	177	129
Doniphan	155	115	209	196	248	247	269	340	214
Ellsworth	380	367	371	503	399	518	514	340	583
Franklin	412	308	309	355	250	236	305	280	320
Hamilton	.....	.....	.....	.....	.....	.....	232	226	235
Harper	265	225	279	313	282	491	332	174	302
Hodgeman	.....	.....	.....	354	279	362	179	169	181
Jewell	439	241	.....	398	628	563	476	348	597
Johnson	141	91	197	200	194	210	157	154	171
Labette	.....	.....	.....	.....	156	108	90	61	87
Leavenworth	209	37	156	495	261	212	326	449	265
Marion	191	254	297	288	193	256	282	293	301
Marshall	.....	.....	.....	.....	.....	383	695	581	164
McPherson	172	125	210	256	229	409	307	260	140
Neosho	.....	.....	.....	.....	.....	259	357	209	314
Osage	.....	.....	.....	.....	714	333	475	363	244
Osborne	245	353	480	564	502	722	518	220	403
Rawlins	.....	92	869	905	249	560	431	382	472
Sedgwick	.....	.....	33	.....	121	179	221	104	161
Smith	64	42	285	581	591	498	464	341	333
Sumner	.....	51	53	64	146	157	143	230	141
Washington	434	374	550	594	656	460	636	389	251
Wichita	30	165	148	212	492	254	168	95	53
Totals	4,091	3,147	5,220	7,679	7,512	8,465	8,756	7,081	6,658
Average	255.7	174.8	274.7	383.9	327.0	338.6	336.7	272.3	256.0

However, the population fluctuations shown above, for the coyote in Kansas, are not cyclic in nature, but rather reach peaks at various intervals of five to eleven years. Hall (1946:57) proposed the term "multiannual fluctuation" to describe fluctuations of this nature. When the peaks and low points of multiannual fluctuations are spaced regularly, the fluctuation is properly spoken of as cyclic. The multiannual fluctuations in Kansas differ from the cyclic fluctuations not only in the lack of periodicity but also in that trends toward peaks are frequently abortive.

In the summer of 1950 I sent a questionnaire to each of the county clerks of the 105 counties in Kansas, requesting information on the numbers of animals that had been presented to their office for bounty payments. Twenty-six of these questionnaires were returned with sufficient information on coyote bounties to be of use here. Table 28 summarizes the number of coyotes presented for bounty payments in these various counties.

The following tabulation shows the average number of bounties paid on coyotes in each county in various years between 1877 and 1950. The number of such averages available is inadequate to use as a basis for valid conclusions. The number of coyotes presented for bounties in 1903-04 is fewer than the number presented in recent years—this fact indicates that, in spite of the bounty system, the coyote has held its own, or even increased, in competition with man.

Year	Average	Number of counties
1877-78*	63.3	24
1903-04	207.6	94
1940	333.1	8
1941	255.7	16
1942	174.8	18
1943	274.7	19
1944	383.9	20
1945	327.0	23
1946	338.6	25
1947	336.7	26
1948	272.3	26
1949	256.0	26

* Includes animals reported as "wolves."

Wooster (1938:389), in analyzing the records of coyote bounties in Ellis County for the years 1914 through 1932, found "that the arithmetic mean of bounties paid per year on coyotes in the ten-year period from 1923 to 1932, inclusive, is 333. From preceding nine years (the tenth year back is incomplete) the arithmetic mean is 338." He further pointed out (*loc. cit.*) that: "It will be seen from the above data that the average for each of the two periods is practically the same. This would indicate that coyotes have held

their own in numbers through a period of almost twenty years. If coyotes were either decidedly on the increase or decidedly on the decrease the fact would, over a considerable period of time, be manifest in the numbers killed for bounty. Neither seems to be the case. It is of interest to note that the common impression among old settlers, farmers, and hunters is to the effect that coyotes are maintaining their numbers in spite of the numbers killed for the bounty. This impression corresponds to the indications of the bounty record."

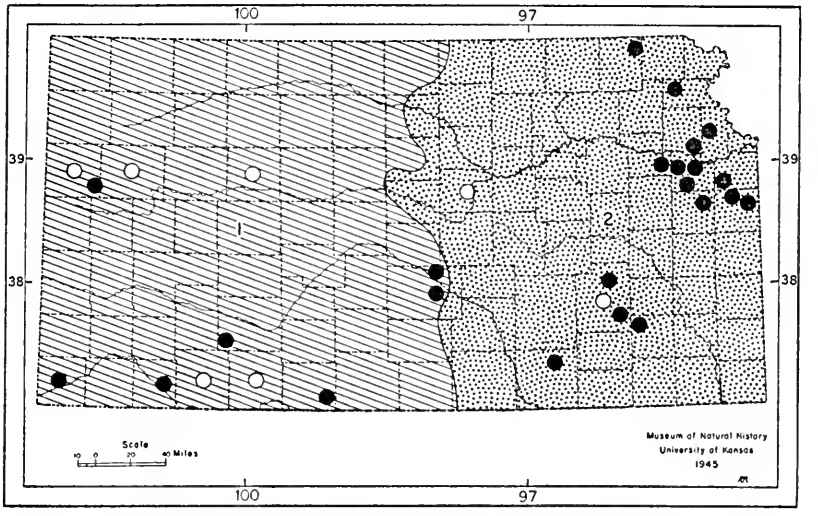

FIG. 61. Distribution of *Canis latrans* in Kansas. 1. *C. l. nebracensis.* 2. *C. l. latrans.* See figure 5 for explanation of symbols.

Wooster's comments just quoted seem to me to apply equally well to the data that I have presented above. In spite of their competition with man, coyotes are maintaining their numbers.

Bennitt (1948:321) studied the bounty system of coyote "control" in Missouri. He found: (1) the number and cost of coyote bounties in Missouri increased rapidly in the 12 years from 1936 through 1947. (2) In this same time complaints of damage continued to increase; so did the population of coyotes. (3) "There is reason to believe that bounty figures furnish a reliable index of population." (4) "It is virtually certain that there is no relation between total number of coyotes and amount of damage. Damage is caused by a relatively few members of the species." (5) "The bounty system cost the counties about $50,000 in 1947. . . ."

Many coyotes are sold for their furs. In many cases the animal

is first presented for bounty payment, then skinned and the pelt sold in the fur trade. Table 29 shows the numbers sold for fur in Kansas in various recent years.

According to Asdell (1946:156) the breeding season of the coyote is between February and April; the gestation period is 60 to 65 days. In 1,330 cases the average number of embryos was 6.23 and in 1,582 cases the average number of den young was 5.70. Wooster (1938:390) reported that 28 litters of coyotes were presented for bounties in Ellis County in the spring of 1931. These litters ranged in number from three to 12 and averaged 6.21. Wooster thought that perhaps the one litter of 12 actually represented two litters—as well may have been the case. If this be true, then the litters ranged in number from three to nine and averaged 6.00

TABLE 29.—NUMBER OF PELTS OF "WOLVES" AND COYOTES SOLD IN KANSAS IN RECENT YEARS. THE "WOLVES" LISTED IN THIS TABLE ARE ALMOST CERTAINLY COYOTES. THESE FIGURES WERE COMPILED FROM THE SOURCES GIVEN IN TABLE 2.

YEAR	Coyotes	"Wolves"	Total
1928	6,169	1,416	7,585
1938	10,957	2,492	13,449
1940	14,022	1,047	15,069
1941	18,392	983	19,375
1942	16,758	1,153	17,911
1943	22,953	1,558	24,511
1944	23,987	.....	23,987
1945	26,853	.....	26,853
1946	19,263	.....	19,263
1947–48	2,716	338	3,054
1948–49	672	85	757
1949–50	798	.....	798

Canis latrans nebracensis Merriam

Canis nebracensis Merriam, Science, N. S., 8:792, 1898 (Substitute for *pallidus* Merriam, Proc. Biol. Soc. Washington, 11:24, 1897), type from Johnstown, Brown County, Nebraska.

Canis latrans nebracensis, Nelson, Proc. Biol. Soc. Washington, 45:223, 1932; Hibbard, Trans. Kansas Acad. Sci., 47:70, 1944.

Canis nebrascensis [sic], Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Canis nebrascensis subsp. *[sic],* Tihen and Sprague, Trans. Kansas Acad. Sci., 42:506, 1939.

Canis nebrascensis nebrascensis [sic], Dice, Ecology, 4:48, 1923; Dice, Jour. Mamm., 4:108, 1923; Wooster, Trans. Kansas Acad. Sci., 41:387, 1938.

Canis nebracensis nebracensis, Hibbard, Trans. Kansas Acad. Sci., 36:237, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 168, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):29, 1940.

Canis latrans, J. A. Allen, Bull. Essex Inst., 6:45, 1874; Baker, Trans. Kansas Acad. Sci., 11:57, 1889.

Canis latrans texensis, Hibbard, Trans. Kansas Acad. Sci., 47:70, 1944.

Distribution.—Western part of the state, east certainly to Reno County. See map, figure 61.

Remarks.—No external measurements of specimens of this subspecies are available to me. According to Black (1937:168) individuals of this subspecies average slightly smaller than those of the subspecies *C. latrans latrans.* Diagnostic characteristics of *C. latrans nebracensis* include the pale coloration and buffy instead of fulvous color on the back of the ears.

Specimens examined.—Total, 46, distributed as follows: *Wallace County:* 7 mi. SE Wallace, 5; Unspecified, 1. *Logan County:* Unspecified, 8. *Trego County:* Unspecified, 1. *Reno County:* 3 mi. SW Hutchinson, 1; 7 mi. NNW Hutchinson, 1; 11 mi. NW Hutchinson, 1. *Ford County:* 7 mi. N Fowler, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 9; 12 mi. NE Elkhart, 1. *Seward County:* 1 mi. E Arkalon, 1. *Meade County:* Unspecified, 2. *Clark County:* Unspecified, 1. *Comanche County:* Cave Creek, 4½ mi. SW Aetna, 13.

Canis latrans latrans Say

Canis latrans Say, Long's Exped. Rocky Mts., 1:168, 1823, type from Engineer Cantonment, near present town of Blair, Washington County, Nebraska; Baird, Mamm. N. Amer., p. 120, 1858; Knox, Trans. Kansas Acad. Sci., 4:19, 1875; Merriam, Proc. Biol. Soc. Washington, 11:23, 1897; Lantz, Trans. Kansas Acad. Sci., 19:176, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905; Elliot, Field Columbian Mus. Publ. 115, Zool. Ser., 8:409, 1907; Linsdale, Jour. Mamm., 9:142, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:236, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 167, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):29, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:70, 1944.

Canis latrans latrans, Nelson, Proc. Biol. Soc. Washington, 45:223, 1932; Brumwell, Amer. Midland Nat., 45:210, 1951.

Distribution.—Eastern part of the state, west to Saline and Cowley counties. See map, figure 61.

Remarks.—External measurements of six males and four females from eight miles west of Lawrence, are: ♂ 1229.1 (1192-1260), ♀ 1165.0 (1140-1190); 351.3 (320-370), 343.7 (335-350); 204.5 (193-212), 194.5 (191-200); 111.0 (104-120), 107.7 (102-116).

Specimens examined.—Total, 94, distributed as follows: *Nemaha County:* Sabetha, 3. *Atchison County:* 4 mi. NE Muscotah, 1. *Jefferson County:* 1 mi. N Midland, 1. *Leavenworth County:* 3 mi. E McLouth, 1. *Saline County:* Unspecified, 1. *Shawnee County:* Watson, 5; 1 mi. SE Watson, 1; 2 mi. NW Richland, 5; 2 mi. SE Barryton, 4. *Douglas County:* 2 mi. S LeCompton, 1; 2 mi. E Midland, 2; 8 mi. W Lawrence, 10; 3 mi. W Lawrence, 1; Lawrence, 3; Wakarusa bottoms near Haskell, 1; 2 mi. SE Stull, 1; 3 mi. NE Overbrook, 1; 2 mi. NW Eudora, 2; 2 mi. S Eudora, 1; 10 mi. W, 2 mi. S Lawrence, 1; 3 mi. SW Lawrence, 1; 3 mi. S Lawrence, 1; 5 mi. S, 1 mi. W Eudora, 4; 7½ mi. SW Lawrence, 1; Unspecified, 16. *Johnson County:* Edgerton, 2. *Franklin County:* 2 mi. S LeLoup, 3. *Miami County:* 1 mi. N, 8 mi. E Hillsdale, 5;

9 mi. N Paola, 4. *Greenwood County:* Hamilton, 3; 3 mi. S, 2 mi. W Toronto, 1; 6 mi. SW Toronto, 1; 8 mi. SW Toronto, 1; 1 mi. E, 4 mi. S Hamilton, 1; Unspecified, 1. *Wilson County:* West of Coyville, 1. *Cowley County:* 2 mi. S, 2¼ mi. E Atlanta, 2.

Canis lupus

Wolf

The wolf was once common in Kansas but now is extinct within the limits of the state. J. R. Mead, an early hunter, trapper, and resident of Kansas, in recording some natural history notes of 1859, wrote (1899:280) that: "Lobo, the mountain wolf, locally known on the plains as 'big gray,' were congeners and associates of the buffalo, and lived almost exclusively upon them. Each wolf would kill in the course of a year, it is fair to assume, a dozen buffalo, many of them calves; but they, with equal facility, could kill the strongest bull, and did, whenever appetite and circumstances made it most convenient. Hunters with strychnia finally exterminated the wolves, myself and men killing some 5000 of them. They never molested people."

Allen (1874:45) reported that, in middle and western Kansas, in 1871, the wolf was: "Formerly very abundant, but during the last few years their numbers have greatly diminished, thousands having been killed for their skins every winter by means of strychnine. Comparatively few now remain." Knox (1875:10) reported that the wolf was: ". . . not uncommon in all parts of the state. Many are taken on the plains every winter for their splendid fur that is used for muffling robes. . . . *C. Lupus* seems to be getting more common in older parts of the state."

By 1889, however, the number of wolves had greatly diminished. Baker (1889:56) reported that near Wakeeney, Trego County, the wolf was ". . . formerly quite numerous; now uncommon, and found only in rough country along streams."

In 1905 Lantz (1905A:176) reported the wolf was ". . . still found in a few scattered sections of the state. There is a bounty of five dollars on the large wolves in most of the counties. Last year only three counties were called upon to pay such bounties—Chautauqua, Republic, and Sherman."

Bailey (1907:11), in reporting the status of the wolf in Kansas, stated: "Gray wolves were reported as not uncommon in the region of Colby in 1893, and later reports show that bounties were paid in 1905 on 29 wolves in the five counties of Brown, Labette, Lyon, Sedgwick, and Sherman."

Bailey (1907:23) stated that the young of the wolf in Wyoming were usually born in March or early in April. He found that the

litter size varied from five to 13, the usual size being between eight and 11. He further reported (1907:24) that: "The young are usually born in caves, among rocks, in washed-out cavities in bad lands, or in old badger holes in banks that had been enlarged by the wolves."

Canis lupus nubilus Say

Canis nubilus Say, Long's Expedition Rocky Mountains 1:169, 1823, type from Engineer Cantonment, near present town of Blair, Washington County, Nebraska; Miller, Smithsonian Misc. Coll., 59(15):4, 1912; Dice, Jour. Mamm., 4:108, 1923; Hibbard, Trans. Kansas Acad. Sci., 36:237, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 169, 1937.

C[anis] nubilus, Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Canis lupus nubilus, Pocock, Proc. Zool. Soc. London, 1935, p. 45, 1935; Goldman, Jour. Mamm., 18:37, 1937; Goldman, The wolves of North America, American Wildlife Inst., p. 441, 1944; Hibbard, Trans. Kansas Acad. Sci., 47:71, 1944; Brumwell, Amer. Midland Nat., 45:210, 1951.

Canis lupus, J. A. Allen, Bull. Essex Inst., 6:45, 1874; Knox, Trans. Kansas Acad. Sci., 4:19, 1875; Bailey, Forest Serv. Bull., 72:11, 1907.

Canis ater, Lantz, Trans. Kansas Acad. Sci., 19:176, 1905.

Canis griseus, Lantz, Trans. Kansas Acad. Sci., 19:176, 1905.

Canis occidentalis, Baker, Trans. Kansas Acad. Sci., 11:56, 1889; Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Distribution.—Formerly statewide, now extinct.

Remarks.—No external measurements of specimens taken in Kansas are available to me. Young and Goldman (1944:443) gave the length of an adult male of this subspecies from Douglas, Wyoming, as 1982 mm.

Specimens examined.—Total, 3, distributed as follows: *Sherman County:* Unspecified, 1. *Gove County:* 3 mi. W Castle Rock, 1. *Trego County:* Near Castle Rock, 1.

Additional records.—Ellsworth Co.: Fort Harker, 1 (Young and Goldman, 1944:444). *Gove County:* Unspecified, 1 (Young and Goldman, 1944:444).

Canis niger

Red Wolf

One subspecies of the red wolf probably formerly occurred in the southeastern corner of the state. Unfortunately, however, no specimens of this species have been preserved from the state.

Remington Kellogg and Victor Householder investigated the mammalian fauna of Cherokee County in December, 1915, and January, 1916. Kellogg wrote of the red wolf (unpublished notes): "Bill Benham saw seven in his feed ring south of Columbus in 1892. Clyde Boyd killed a male in 1909. The trappers in this

county speak of this wolf as having longer legs and a more reddish color than the coyote." Householder's notes, also unpublished, concerning this same trip, record that: "The prairie wolf is rare. One was heard on the night of December 31 [1915]. They were formerly numerous. Clyde Boyd killed one in 1908. Frank Larson has noticed a pair around his place for a couple of years."

No information is available on the natural history of this species in the state.

The red wolf formerly ranged throughout the southeastern United States, westward to central Texas and northward, in the Mississippi Valley, to central Illinois. It is now restricted mainly to the Ozark Mountain region in Missouri, Arkansas, and southeastern Oklahoma and to a few restricted sections of Louisiana and Texas. The red wolf is rather small and is of slender build. Its color is usually near tawny, especially on the muzzle, ears, and outer surfaces of the limbs.

The food habits of the red wolf resemble those of the timber wolf. Young (1944:211) reported that an examination of the stomachs of 31 red wolves revealed that cottontails and jackrabbits were the most important food items, comprising 56 per cent of the total food, while carrion constituted an additional 18 per cent.

Canis niger rufus Audubon and Bachman

Canis lupus var. *rufus* Audubon and Bachman, Quadr. North Amer. 2:240, 1851, type locality restricted (see Goldman, 1937:38) to 15 miles west of Austin, Texas.

Canis niger rufus, Harper, Jour. Mamm., 23:339, 1942; Hibbard, Trans. Kansas Acad. Sci., 47:70, 1944.

Canis frustror, Hibbard, Trans. Kansas Acad. Sci., 36:237, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 169, 1937.

Distribution.—Formerly in the southeastern part of the state, now extinct.

Remarks.—No external measurements of specimens taken in Kansas are available. Young and Goldman (1944:487) gave the external measurements of two adult males from Redfork, Oklahoma, as: 1403, 1454; 381, 420; 210, 221; and the weight of an adult male from Noble, Cleveland County, Oklahoma, as 55 lbs.

Specimens examined.—None.

Additional records.—*Cherokee County:* "south of Columbus" (see text).

TABLE 30.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF CANIS.

Sex	Catalogue number	Greatest length	Maxillary tooth-row, crown length	Interorbital breadth	Zygomatic breadth	Postorbital constriction	First upper molar, antero-posterior diameter	Upper carnassial crown length (outer side)
			C. latrans nebracensis, Wallace County					
♂	2100	174.5	65.1	26.7	81.4	30.4	12.2	19.6
			Meade County					
♂	14367	203.7	71.0	34.6	99.5	33.8	14.4	20.9
			C. latrans latrans, Douglas County					
♂	21991	197.5	69.7	33.0	97.0	35.0	13.6	20.1
♂	16223	202.2	72.4	33.4	99.3	35.1	13.5	19.6
♂	21993	196.9	75.3	32.8	100.8	34.5	13.2	19.7
♀	30800	188.1	68.8	29.9	91.3	33.8	13.3	19.0
♀	22059	188.6	71.9	29.6	....	34.6	12.2	18.5
♀	22066	182.6	66.4	28.8	88.0	31.2	12.4	18.5
			C. lupus nubilus,* Gove County, Kansas					
♂	139156	254.4	105.6	45.7	135.7	39.3	16.3	26.1
			Platte River, Nebraska					
♀	3575	231.0	96.2	40.3	130.5	38.0	15.5	24.2
♀	2611	233.5	....	37.3	126.2	35.3	14.8	23.4
			Canis niger rufus,* Redfork, Oklahoma					
♂	133233	228.5	97.8	39.3	120.0	36.1	15.3	21.8
♂	135748	217.2	92.1	34.9	111.1	36.2	13.8	20.3
			Tahlequah, Oklahoma					
♀	251059	210.5	89.9	34.7	105.0	36.0	13.5	20.5

* Measurements given by Young and Goldman (1944:490-506). Catalogue numbers are those of the United States National Museum.

Genus **Vulpes** Oken

Foxes

Two species, the red fox and the swift fox either occur or have occurred in Kansas. The swift fox is probably extinct in the state. Generic characteristics of these foxes include the large ears, the large cylindrical and bushy tail, small size (weight less than 15 pounds), temporal ridges closely paralleling one another or uniting to form a saggital crest, and inferior margin of mandible without the "step" seen in *Urocyon*.

Vulpes fulva

Red Fox

The red fox ranges normally from the limit of trees in the far north to the northern edge of the cotton belt in the southern United States. According to Bailey (1928:272): "A few scattered records over Texas, Louisiana, Alabama, Arkansas, Oklahoma, and Kansas are probably of wanderers, or the progeny of stocks introduced for fox hunting." One subspecies of the red fox occurs in Kansas. It is distinguished from the swift fox, *Vulpes velox,* which formerly occurred in western Kansas, by its reddish color, larger size, and the white tip on the tail.

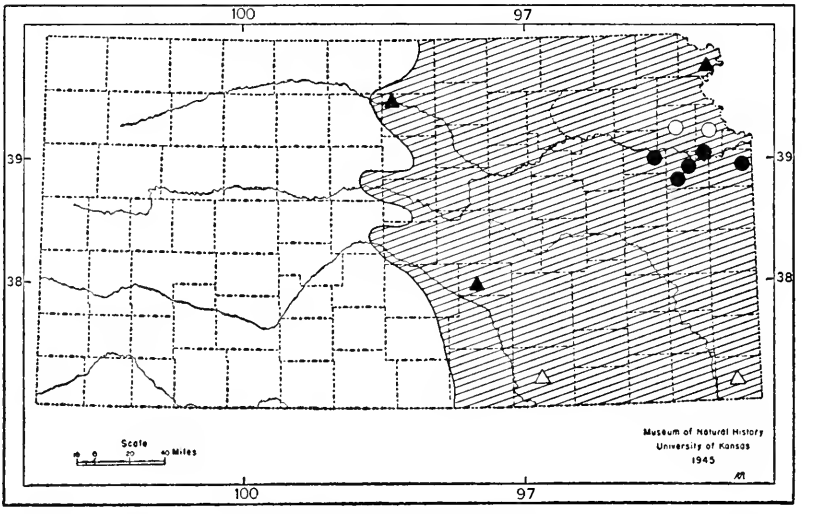

FIG. 62. Distribution of *Vulpes fulva fulva* in Kansas. See figure 5 for explanation of symbols.

According to Asdell (1946:157-158) this species mates in late January or February and the gestation period is 49 to 55 days. The litters range in number from one to eight; and the numerical average is 4.52 young per litter.

This shy animal is not common anywhere in the state. Remington Kellogg and V. Householder reported in 1916 (unpublished notes) that a few red foxes had been killed in Cherokee County but that they ". . . were never plentiful". Charles D. Kennedy (personal communication, 1949) reported trappers have taken some red foxes near Halstead in recent years. W. C. Justice (*in litt.*) reported to me that the red fox was introduced into Cowley County in 1935 and is now common there.

According to reports of the United States Fish and Wildlife Service a few foxes are taken in the state each year for their fur. No distinction is made in these reports between the gray fox and the red fox. Table 31 shows the number of pelts of foxes sold in the state in recent years for their furs.

TABLE 31.—NUMBERS OF PELTS OF FOXES SOLD IN KANSAS IN VARIOUS RECENT YEARS. THESE FIGURES WERE COMPILED FROM THE SOURCES GIVEN IN TABLE 2.

1938	1940	1941	1942	1943	1944	1945	1946	1947-48	1948-49	1949-50
501	1,965	1,387	1,574	1,792	1,252	971	738	1,341	302	0

Vulpes fulva fulva (Desmarest)

Canis fulvus Desmarest, Mammalogie, 1:203, 1820, type from Virginia.

Vulpes fulva fulva, Soper, Jour. Mamm., 4:251, 1923; Hibbard, Trans. Kansas Acad. Sci., 47:69, 1944.

Vulpes fulvus fulvus, P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):28, 1940.

Vulpes fulvus, Knox, Trans. Kansas Acad. Sci., 4:19, 1875; Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905; Lantz, Trans. Kansas Acad. Sci., 19:177, 1905.

Vulpes fulva, Linsdale, Jour. Mamm., 9:142, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:236, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 163, 1937; Brumwell, Amer. Midland Nat., 45:210, 1951.

Vulpes fulva regalis, Bailey, Nature Magazine, 28:317, 1928.

Distribution.—Eastern part of the state, west certainly to Mitchell County and probably to Harvey County. See map, figure 62.

Remarks.—Measurements of two males and one female from Douglas County, are: ♂ 1000, 910, ♀ 965; 358, 310, 357; 162, 150, 145; --, 90, --. One male from ten and one-half miles south of Tonganoxie, Leavenworth Co., weighed 10½ pounds.

Bailey (1936:317) includes Kansas in the range of *Vulpes fulva regalis*. Comparisons of specimens from Kansas with *V. f. regalis* from Cavalier County, North Dakota and with *V. f. fulva* from New York, Illinois, and Georgia show that Kansas specimens are referable to the latter subspecies, *Vulpes fulva fulva*.

Specimens examined.—Total, 29, distributed as follows: *Jefferson County:* Unspecified, 1. *Leavenworth County:* 3 mi. W, ½ mi. S Linwood, 1; 10½ mi. S Tonganoxie, 2; Unspecified, 2. *Shawnee County:* Tecumseh, 3. *Douglas County:* First Island N on Kaw River from Lawrence, 1; 2 mi. N Courthouse, Lawrence, 1; 1½ mi. W Union Pac. Depot, Lawrence, 1; Lawrence, 1; 2½ mi. E KU, 1; "E of Lawrence", 3; 1½ mi. SE Lawrence, 1; 8 mi. SW Lawrence, 1; Near Clinton, 1; Unspecified, 8. *Johnson County:* 3 mi. S, 1 mi. W Overland Park, 1.

Additional records.—Doniphan County: Geary (Linsdale, 1928:142). *Mitchell County:* Waconda Springs, 1 (Hibbard, 1944:69). *Harvey County:* Near Halstead (see text). *Cowley County:* Unspecified (see text). *Cherokee County:* Unspecified (see text).

Vulpes velox

Swift Fox

The swift fox is small, lightly built and much paler than the red fox, *Vulpes fulva,* and is buffy yellow in general dorsal color. The tail is buffy gray above and tipped with black. The swift fox is approximately 26 inches in total length; the tail comprises approximately nine inches of this total.

The swift fox is extinct in Kansas at the present time and appears to be on the verge of extinction throughout its range.

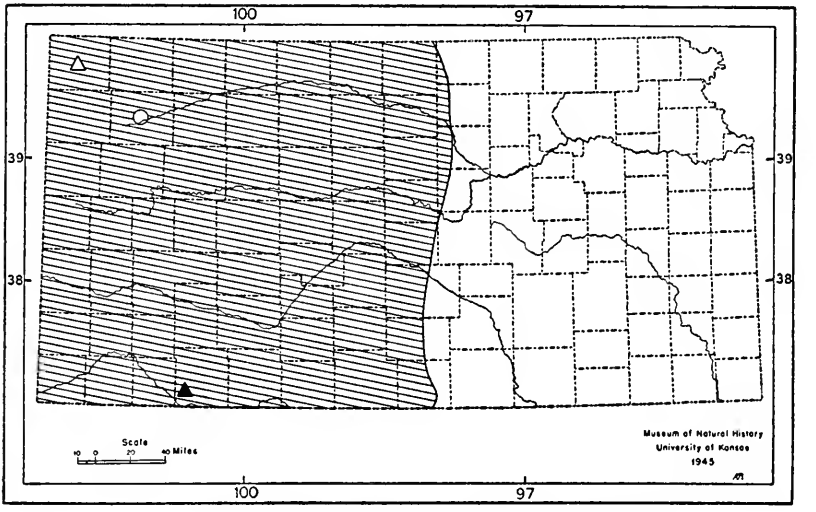

FIG. 63. Distribution of *Vulpes velox velox* in Kansas. See figure 5 for explanation of symbols.

Mead (1899:280) reported that in 1859: "There were red foxes living on the plains with the wolves, called "swifts" from their remarkable speed. They lived in pairs; not more than two found together. No other foxes were found on the plains." Allen, in writing of the swift fox in central and western Kansas in 1871, reported (1874:45) that: "These graceful little animals are still more or less abundant." Baker, in 1889, reported (1889:57) that near Wakeeney, Trego County, the swift fox was: ". . . very numerous until within the past five or six years; now rarely seen. It lives in shallow burrows on the open prairie."

Bunker (1940:35-36) reported that: "In the summer of 1911, T. A. Rocklund and I were camped for one month on the Pennell Ranch in Wallace County, Kansas, adjoining the George A. Allman Ranch. Mr. Allman was an early settler in the West, had been a

government guide, and had shipped tons of fossils to the Smithsonian Institution. He was a very observing man and spent hours recounting to me conditions of wildlife in the early West.

"He told me that it was the general custom of the early cattlemen to place poison at all the undevoured buffalo carcasses to destroy the wolves. It was his observation that the little swift foxes were always the first to take the poison. He stated that the gray wolf has not been seen in Kansas since 1879."

Vulpes velox velox (Say)

[Canis] velox Say, Long's exped. Rocky Mts., Vol. 1, p. 487, 1823, type from South Platte River, Colorado. (See Miller, 1924:146.)

Vulpes velox velox, Miller, Bull. U. S. Nat. Mus., 128:146, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:236, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 165, 1937; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:506, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):28, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:69, 1944.

Vulpes velox, J. A. Allen, Bull. Essex Inst., 6:45, 1874; Baker, Trans. Kansas Acad. Sci., 11:57, 1889; Lantz, Trans. Kansas Acad. Sci., 19:177, 1905.

V[ulpes] velox, Knox, Trans. Kansas Acad. Sci., 4:19, 1875; Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Distribution.—Formerly common in the western half of the state, but now extinct. See map, figure 63.

Remarks.—No external measurements of specimens taken in Kansas are available. External measurements of an adult male from First View, Cheyenne County, Colorado (KU no. 1601) are: 838; 228.

One specimen in the collection of the University of Kansas Museum of Natural History (no. 1602), supposedly taken on December 8th, 1900, in Douglas County, must have been a captive animal. Other than this one specimen no evidence is available to indicate that the swift fox ever occurred as far east as Douglas County.

Specimens examined.—Total, 1, from the following locality: *Logan County:* "Monument", 1.

Additional records.—Cheyenne County: Unspecified (Black, 1937:165). *County unspecified:* Mehita, 1 (no. 16609, AMNH, Jan. 22, 1901). *Meade County:* S of State Park, 1 (Tihen and Sprague, 1939:506); Big Springs Ranch, 1 (Tihen and Sprague, 1939:506).

Genus **Urocyon** Baird

Gray Foxes

One species of this genus occurs in Kansas. Generic characteristics include: ears large, tail large, tipped with black and triangular in cross section; size small (less than 14 lbs.); line of long, stiff

black hairs along middle of upper side of tail for its entire length; temporal ridges of skull far apart, forming lyrate pattern on top of skull; inferior margin of mandible with distinct "step" midway between tip of angular process and anterior border of coronoid process.

This genus occurs from southern Canada southward through most of the United States, Mexico, Central America, into northern South America.

Urocyon cinereoargenteus

Gray Fox

One subspecies of the gray fox occurs in Kansas. It is nowhere common in the state at the present time. Knox reported in 1875 (p. 19) that the gray fox was rarer than the red fox at that time. Remington Kellogg and V. Householder (unpublished notes) re-

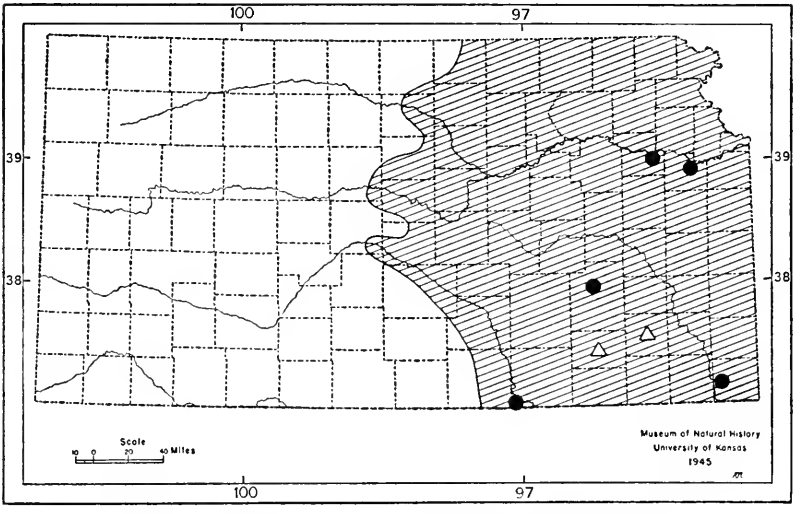

FIG. 64. Distribution of *Urocyon cinereoargenteus ocythous* in Kansas. See figure 5 for explanation of symbols.

ported that in Cherokee County two gray foxes were killed at the mouth of Cherry Creek in 1870. Kellogg (1915, unpublished thesis) reported that: "The Gray Fox was forced away from eastern Kansas when the timber was cleared off and the land settled by pioneers."

Only three records of the gray fox being taken in Kansas since 1900 are available, one specimen taken in Greenwood County in 1914, one in Cherokee County in 1949, and one in Shawnee County

in 1950. Black (1937:166) reported specimens of the gray fox from Douglas, Greenwood, Elk, and Wilson counties were available in the University of Kansas Museum of Natural History. A thorough search of the collections and records of the museum have failed to yield any trace of specimens from Elk and Wilson counties.

Asdell (1946:162) reports that after a gestation period of approximately 63 days the gray fox gives birth to litters ranging in size from two to seven young. The average litter size is approximately four young per litter.

Urocyon cinereoargenteus ocythous Bangs

Urocyon cinereoargenteus ocythous Bangs, Proc. New England Zool. Club, 1:43, 1889, type from Platteville, Grant County, Wisconsin; Hibbard, Trans. Kansas Acad. Sci., 36:236, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 166, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:70, 1944; Brumwell, Amer. Midland Nat., 45:210, 1951.

Urocyon cinereoargenteus, Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905.

V[ulpes] Virginianus, Knox, Trans. Kansas Acad. Sci., 4:19, 1875.

Distribution.—Rare in the eastern wooded portion of the state and west certainly to Greenwood and Cowley counties. See map, figure 64.

Remarks.—The total length and length of tail of one male from Lawrence, are: 1080; 382. Measurements of a female from 5 miles west and 3 miles south of Arkansas City, are: 889; 336; 133; 66; weight 7½ pounds.

A comparison of the few specimens available from Kansas with typical *U. c. ocythous* and *U. c. cinereoargenteus* reveals that the specimens from Kansas are referable to the race *U. c. ocythous.*

Specimens examined.—Total, 10, distributed as follows: *Shawnee County:* 8 mi. E State Capitol Bldg., Topeka, 1. *Douglas County:* Lawrence, 6. *Greenwood County:* 8 mi. NW Hamilton, 1. *Cowley County:* 5 mi. W, 3 mi. S Arkansas City, 1. *Cherokee County:* 2 mi. S, ½ mi. W Hollowell, 1.

Additional records.—Elk County: Unspecified (Black, 1937:166). *Wilson County:* Unspecified (Black 1937:166).

Family Ursidae

Bears

Bears are found in North and South America, Europe, and Asia. Native North American bears are characterized by large size, rudimentary tail, and plantigrade feet. The dental formula for the bears is: i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{4}{4}$, m. $\frac{2}{3}$. Actually, few adult bears have as many as sixteen premolars; the anterior teeth of this series are small and are frequently lost with advancing age.

Genus Ursus Linnaeus

Bears

This genus, as here employed (see Simpson, 1945:111) includes the black bear and the grizzly bear, both of which formerly occurred in the state. The black bear and the grizzly bear were exterminated in Kansas soon after it was settled.

Ursus horribilis

Grizzly Bear

Although few records remain, the grizzly bear probably formerly roamed over most of the western two-thirds of the state. Almost nothing of the occurrence and habits of this bear in Kansas has been recorded in literature.

J. O. Pattie (1831) was an early traveller in many of the western states and, although his accounts have been shown to be unreliable in several aspects [see M. M. Quaife's remarks (Pattie, 1831 [1930 ed., p. xxxv]) in the historical introduction to his reprint of Pattie's account], he apparently was in western Kansas in the autumn of 1824. He later recounted (1831:34-35): "Our encampment for the evening of this day, was near a small spring, at the head of which we found a great natural curiosity. A rock sixteen yards in circumference, rises from eighty to ninety feet in height, according to our best judgment, from a surface upon which, in all directions, not the smallest particle of rock, not even a pebble can be found. . . . We gave the spring the name of Rock Castle spring." Perhaps this and other information fixes Pattie's location as being at what is now called Castle Rock in Gove County. Two days following this, after crossing a ridge presumed to be the dividing ridge between the Republican and Smoky Hill drainages, he reported (*loc. cit.*): "Here we killed a white bear, which occupied several of us at least an hour. It was constantly in chase of one or another of us, thus withholding us from shooting it, through fear of wounding each other. This was the first I had ever seen. His claws were four inches long and very sharp. He had killed a buffalo bull, eaten part of it, and buried the remainder. When we came upon him, he was watching the spot, where he had buried it, to keep off the wolves, which literally surrounded him. On the 11th we travelled over some hilly ground. In the course of the day, we killed three white bears, the claws of which I saved."

Kellogg (1915, unpublished thesis) reported that a druggist at Russell Springs, Logan County: ". . . at one time had a grizzly

bear skull in his collection which was picked up in one of the coulees along the Smoky Hill river. This skull cannot now be found."

Hibbard (1944:67) writes that: "One skull has been examined from Council Grove, Morris County, Kansas, in the mammal collection at the Kansas State Agricultural College, Manhattan, Kansas." In the spring of 1952, no grizzly skull could be found in the mammal collection at the College. Proof that mammal bones from Morris County were sent to the collection, however, is provided by the cranium and attached zygomata of a horse, labeled as "Black Bear. Excavated on E. A. Gruell farm July 1927. Dunlap, Kans. Sent in by D. Z. McCormick, Council Grove, Kans."

Ursus horribilis horribilis Ord

Ursus horribilis Ord, Guthrie's Geography, 2nd Amer. ed., Vol. 2, p. 291, described on p. 299, 1815, type from Missouri River, a little above mouth of Poplar River, northeastern Montana.

Ursus horribilis horribilis, Miller, Bull. U. S. Nat. Mus., 128:92, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:234, 1933; Hibbard, Trans. Kansas Acad. Sci., 47:67, 1944.

Distribution.—Probably once occurred in the western two-thirds of the state; now extinct.

Remarks.—No external measurements of specimens taken in Kansas are available to me. Bailey (1926:194) gives total lengths of this bear that range from six feet and two inches to nine feet.

Specimens examined.—None.

Additional records.—*Logan County:* (see text). *Trego County:* (see text).

Ursus americanus

Black Bears

Probably two subspecies of the black bear formerly occurred in Kansas. However, to my knowledge, no specimens were saved from anywhere within the limits of the state. Seton (1929:vol. II, p. 125) indicated that the black bear formerly occurred from the northern tree limit in Canada, southward through most of the United States into Mexico. The black bear has probably been extinct within the state at least since 1880.

Mead (1899:280), in recording some observations made in 1859, reported that a few black bears had been found in Comanche County where they lived in the gypsum caves. Kellogg (1915:unpublished thesis) added: "J. R. Mead, in a letter to the museum, gives the following information. 'In 1864-5-6 we killed Black Bears in Comanche County, Kansas. They had dens in the Gypsum caves,

which were numerous in the broken canyons, and raised their young there. We smoked them out and shot them as they ran.'".

Knox (1875:19) reported that the black bear was then still found in timber in the central part of the state. No records are available to show that the black bear has been taken in the state after this date.

Ursus americanus americanus Pallas

Ursus americanus Pallas, Spicilegia Zoologica, Fasc. 14, p. 5, type from eastern North America, 1780; Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905.

Ursus americanus americanus, Hall, Univ. California Publ. Zool., 30(10):232, 1928.

Ursus arctos var. *Americanus*, Allen, Bull. Essex Inst., 6:46, 1874.

Ursus Americanus, Knox, Trans. Kansas Acad. Sci., 4:19, 1875.

Euarctos americanus americanus, Miller, Bull. U. S. Nat. Mus., 128:90, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:234, 1933; Hibbard, Trans. Kansas Acad. Sci., 47:66, 1944; Brumwell, Amer. Midland Nat., 45:209, 1951.

Distribution.—Probably formerly found in the eastern, wooded portions of the state; now extinct.

Remarks.—No measurements are available for specimens taken in Kansas. Bailey (1926:191) gave the external measurements of an adult male of this subspecies from Montana, as: 1680; 105; 275.

Specimens examined.—None.

Ursus americanus amblyceps Baird

Ursus amblyceps Baird, Rep. U. S. and Mex. Bound. Surv., 2(2):29, 1859, type from Fort Webster, on the Gila River, lat. 32° 47′ N. long. 108° 4′ W, Grant County, New Mexico.

Ursus americanus amblyceps, Bailey, N. Amer. Fauna, 25:187, 1905.

Euarctos americanus amblyceps, Miller, Bull. U. S. Nat. Mus., 128:91; 1924; Hibbard, Trans. Kansas Acad. Sci., 36:234, 1933; Hibbard, Trans. Kansas Acad. Sci., 47:66, 1944.

Distribution.—Probably formerly occurred in at least the southwestern part of the state; now extinct.

Remarks.—No measurements of specimens taken in Kansas are available. Bailey (1931:350) indicated that the general characters of this subspecies included: "Size large for a black bear of the *americanus* group. . . ." He did not give any external measurements.

Specimens examined.—None.

Additional records.—Kiowa County: Unspecified (Hibbard, 1944:66). *Meade Co.:* ". . . small canyon just south of Meade" (Hibbard, 1944:67). *Comanche County:* Unspecified (Mead, 1899:280).

Family Procyonidae

Raccoons and Allies

The American species are medium- to small-sized carnivores with plantigrade or semi-plantigrade feet, all of which have five toes. The carnassial teeth are not typically developed; the molars are broad and tuberculate. One genus, *Procyon*, of this family occurs in Kansas.

Genus **Procyon** Storr

Raccoons

Raccoons occur from southern Canada southward through most of the United States, Mexico, Central America, and into South America to southern Brazil and northern Argentina. Generic characteristics include: head broad, with short, pointed muzzle; upper lip hairy across median line; soles of feet naked, smooth, without well-developed digital pads; claws non-retractile; tail shorter than body; cylindrical, distinctly annulated; and skull broad and massive. The dental formula is: i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{4}{4}$, m. $\frac{2}{2}$. One species of this genus occurs in Kansas.

Procyon lotor

Raccoon

Members of this species range from southern Canada southward to Panama. This genus has been divided into 27 geographic races or subspecies, only one of which occurs in Kansas. The raccoon is statewide in distribution, but is usually more common in the eastern part than in the more arid western part of the state. I personally observed tracks of the raccoon in the mud along Bear Creek, on the Colorado-Kansas state line, two and one-half miles south and eight and one-half miles west of Manter, on July 22, 1950. Local residents reported that a few raccoons have been seen in that region in the past ten years.

Raccoons are strictly nocturnal, rarely being seen during the day. In Kansas they are hunted and trapped for their fur as well as for sport. Because of the great interest in "coon hunts" many sportsmen have imported raccoons to release within the state. One release of this nature was reported in an Associated Press release on page 35 of the Kansas City [Missouri] *Star* for March 16, 1949. This dispatch stated in part: "Pittsburg, Kas., March 15. The Crawford County Coon Hunters' Association has thirty-five im-

ported coons it plans to release in Crawford County to bolster the coon hunting sport in coming years.

"L. C. Stevenson, Frontenac, president of the group, said it had been planned to release them yesterday, but the sudden cold wave postponed the ceremony, since twenty-five of the coons are from Florida and not yet accustomed to present Kansas temperatures. He is not worried about the other eight purchased in Wisconsin."

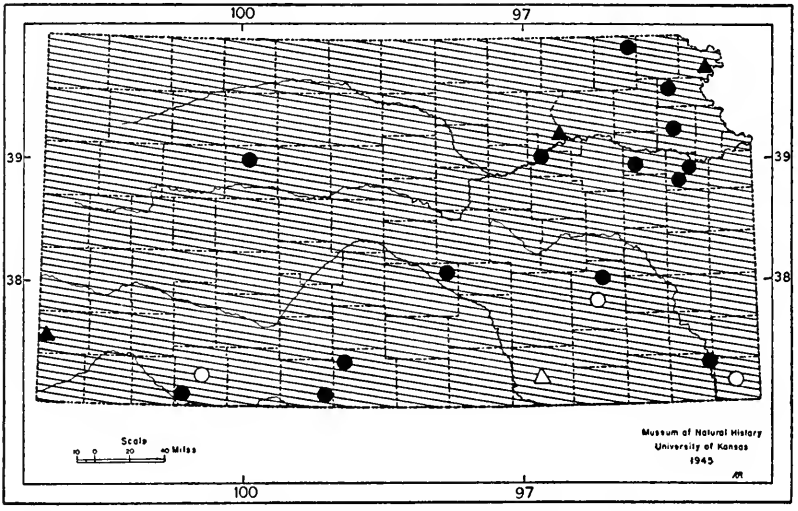

FIG. 65. Distribution of *Procyon lotor hirtus* in Kansas. See figure 5 for explanation of symbols.

W. C. Justice (*in litt.*) reported to me that "Wisconsin black coon" were introduced into Cowley County in 1935.

Table 32 shows the number of raccoon pelts sold in Kansas in various recent years. The population levels of raccoons have increased generally throughout the state in the past few years.

TABLE 32.—NUMBER OF RACCOON PELTS SOLD IN KANSAS IN VARIOUS RECENT YEARS. THESE FIGURES WERE COMPILED FROM THE SOURCES GIVEN IN TABLE 2.

1928	1929	1930	1931	1932	1933	1934	1938	1940	1941
5,789	24,447	22,666	21,742	18,698	18,000	17,350	9,375	8,374	9,744

1942	1943	1944	1945	1946	1947-48	1948-49	1949-50
11,215	16,774	15,666	16,899	13,224	44,259	58,980	62,002

Procyon lotor hirtus Nelson and Goldman

Procyon lotor hirtus Nelson and Goldman, Jour. Mamm., 11:455, 1930, type from Elk River, Sherbourne County, Minnesota; Hibbard, Trans. Kansas Acad. Sci., 36:235, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 154, 1937; Tihen and Sprague,

Trans. Kansas Acad. Sci., 42:506, 1939; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):24, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:67, 1944; Goldman, N. Amer. Fauna, 60:37, 1950; Brumwell, Amer. Midland Nat., 45:209, 1951.

Procyon lotor, Baird, Mamm. N. Amer., p. 212, 1858; J. A. Allen, Bull. Essex Inst., 6:46, 1874; Knox, Trans. Kansas Acad. Sci., 4:19, 1875; Baker, Trans. Kansas Acad. Sci., 11:57, 1889; Gowell, Univ. Kansas quarterly, 6:121, 1897; Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:339, 1905; Rinker, Jour. Mamm., 23:439, 1944.

Procyon lotor lotor, Dice, Ecology, 4:45, 1923; Dice, Jour. Mamm., 4:108, 1923; Linsdale, Jour. Mamm., 9:141, 1928.

Distribution.—Statewide; more numerous in the eastern, than western, part of the state. See map, figure 65.

Remarks.—External measurements of four males and four females from Douglas County, are: males 812.4 (800-839), females 750, 810, 820, 850; 209.5 (233-288), 240, – –, 270, 282; 121.7 (118-126), 110, 105, 115, 115; 53.0 (30-69), 50, 60, – –, – –.

Specimens examined.—Total, 105, distributed as follows: *Nemaha County:* Sabetha, 1. *Atchison County:* 21 mi. NE Muscotah, 3; 6 mi. NE Muscotah, 4. *Jefferson County:* Unspecified, 2; Fish Pond Creek, 2½ mi. E Ozawakie, 1. *Trego County:* Wakeeney, 1. *Geary County:* Junction City, 5. *Shawnee County:* Auburn, 1. *Douglas County:* Lawrence, 20; 4½ mi. SW KU, 1; Near Clinton, 8; 7-8 mi. SW Lawrence, 12; 10-11 mi. SW Lawrence, 2, Unspecified, 20. *Reno County:* 3 mi. N, 5½ mi. E Hutchinson, 3; 2 mi. N, 2 mi. E Hutchinson, 1. *Greenwood County:* 3 mi. N Hamilton, 1 (GCR); Unspecified, 1. *Meade County:* 14 mi. SW Meade, 3; Meade County State Park, 2; Unspecified, 3. *Comanche County:* Cave Creek, 4½ mi. SW Aetna, 1. *Barber County:* 2 mi. E, ¾ mi. S Sun City, 1. *Labette County:* 10 mi. E, 1½ mi. N Parsons, 1. *Cherokee County:* Unspecified, 1. *Eastern Kansas:* Unspecified, 6.

Additional records.—Doniphan County: Geary (Linsdale, 1928:141). *Riley Co.:* Manhattan, 1 (Goldman, 1950:38). *Stanton County:* 2½ mi. S, 8½ mi. W Manter (see text). *Cowley County:* Unspecified (see text).

Family Mustelidae

Weasels, Skunks, and Allies

This family occurs in North and South America, Europe and Asia. Much variation is shown among the various members. They range in size from the tiny least weasel, approximately the size of a chipmunk, to the sea otter, nearly four feet in length. Depending on the genus, they are terrestrial, arboreal, semi-aquatic, or aquatic. Anal scent glands are well-developed in these animals.

The following key will aid in separating the five genera and seven species that occur in Kansas.

1. General color of upper parts some shade of brown, buffy yellow, or silvery, never predominantly black and white; posterior border of hard palate extending appreciably beyond posterior edges of last upper molars 2

1′. General color of upper parts black and white; posterior border of hard palate not extending appreciably beyond posterior edges of last upper molars 6

2.(1) Size small, total length of adults less than 840 mm. (33 inches); hair on tail longer than on back; 34 teeth; P4 with a simple deuterocone, not expanded into a basined structure.....3

2′. Size large, total length of adults more than 840 mm. (33 inches); hair on tail approximately same length as on back; 36 teeth; P4 with deuterocone expanded into a basined structure, *Lutra canadensis*, p. 260

3.(2) Color of upper parts some shade of brown or buffy yellow; basilar length of skull less than 80 mm.....4

3′. Color of upper parts silvery, with a single white stripe on middle of head extending a varying distance toward the tail; basilar length of skull more than 80 mm.....*Taxidea taxus*, p. 251

4.(3) Color of upper parts some shade of brown; least interorbital breadth less than 16.5 mm.....5

4′. Color of upper parts yellow; hands, feet, mask, and tip of tail black; least interorbital breadth more than 16.5 mm., *Mustela nigripes*, p. 249

5.(4) Underparts with broad, light-colored area, amounting to at least a fourth of circumference of body; basilar length of skull less than 54 mm. .....*Mustela frenata*, p. 247

5′. Underparts with small or no light-colored areas; basilar length of skull more than 54 mm.....*Mustela vison*, p. 244

6.(1′) Back with two white stripes; length of upper tooth-row more than 23.5 mm.; M1 more than 8 mm. in length....*Mephitis mephitis*, p. 255

6′. Back with four or more lines of broken stripes or spots; length of upper tooth-row less than 23.5 mm.; M1 less than 8 mm. in length, *Spilogale interrupta*, p. 258

Genus Mustela Linnaeus

Weasels, Ferrets, and Minks

Members of this genus are slender-bodied and small, with the diameter of the head only slightly exceeding that of the neck. The tail is long and usually tipped with black. The pelage is short but dense. In the skull the rostrum is relatively short; the facial angle is slight; the palate terminates behind the upper molars; and the dental formula is: i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$ or $\frac{3}{2}$, m. $\frac{1}{2}$. Three species, the long-tailed weasel, the black-footed ferret, and the mink, occur in Kansas.

Mustela vison

Mink

This species occurs from northern Alaska and Canada southward throughout all but the semi-arid southwestern part of the United States. The mink is dark brown and some, but not all, individuals have white spots on the throat, chest, or belly. The total length

of the male is approximately 26 inches; the tail comprises approximately seven and one-half inches of this total. One subspecies of this species occurs in Kansas. Asdell (1946:147) reported that the mink breeds in March and the gestation period is 39 to 76 days. The litters range in size from four to ten young.

In general the mink is an animal of the waterways; rarely is one found far from permanent water of swamps, streams or lakes. For this reason the mink was never common in western Kansas, where few streams are permanent.

TABLE 33.—NUMBER OF MINK PELTS SOLD IN KANSAS IN VARIOUS RECENT YEARS. THESE FIGURES WERE COMPILED FROM THE SOURCES INDICATED IN TABLE 2.

1928	1929	1930	1931	1932	1933	1934	1938	1940	1941
5,527	7,587	5,867	2,565	2,687	1,239	1,368	1,398	2,271	1,529

1942	1943	1944	1945	1946	1947-48	1948-49	1949-50
1,239	1,618	1,381	852	590	13,724	18,422	12,773

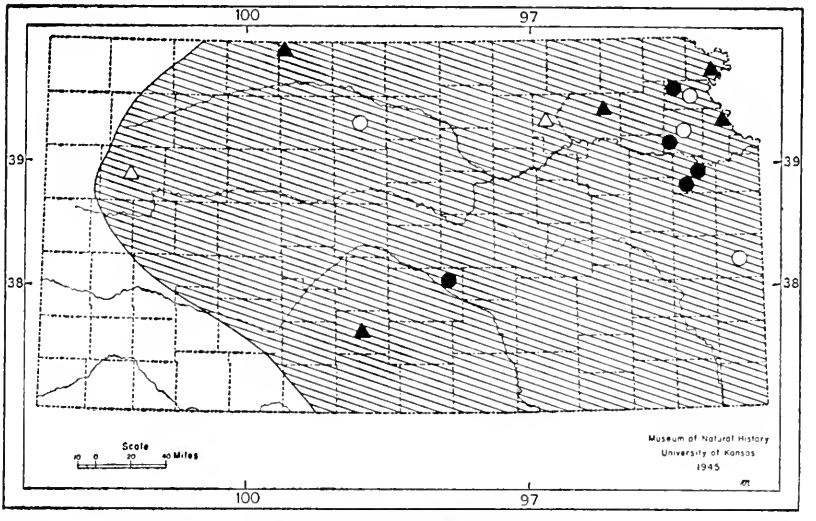

FIG. 66. Distribution of *Mustela vison letifera* in Kansas. See figure 5 for explanation of symbols.

Table 33 shows the number of mink pelts sold in Kansas in several recent years. There are several mink ranches in the state and part of the numbers reported in table 57 represent animals raised in captivity.

Mustela vison letifera Hollister

Mustela vison letifera Hollister, Proc. U. S. Nat. Mus., 44:475, 1913, type from Elk River, Sherburne County, Minnesota; Dice, Ecology, 4:45, 1923; Dice, Jour. Mamm., 4:109, 1923; Miller, Bull. U. S. Nat. Mus., 128:126, 1924; Linsdale, Jour. Mamm., 9:142, 1928; Hibbard,

Trans. Kansas Acad. Sci., 36:235, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 157, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:68, 1944; Brumwell, Amer. Midland Nat. 45:209, 1951.

Putorius nigrescens, Baird, Mamm. N. Amer., p. 180, 1858; Cragin, Bull. Washburn College Lab. Nat. Hist., 1:43, 1885.

P[utorius] nigrescens, Knox, Trans. Kansas Acad. Sci., 4:19, 1875.

P[utorius] vison, Knox, Trans. Kansas. Acad. Sci., 4:19, 1875.

Putorius (Lutreola) vison, Coues, Fur-bearing Animals of North America, p. 160, 1877.

Putorius vison, Cragin, Bull. Washburn College Lab. Nat. Hist., 1:43, 1885.

Putorius vison lutreocephalus, Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905.

Lutreola vison, Allen, Bull. Amer. Mus. Nat. Hist., 7:274, 1895.

Distribution.—Eastern Kansas, west along the main streams perhaps as far as Logan County. See map, figure 66.

Remarks.—External measurements of two males from Douglas County, are: 666, 597; 241, 171; 72, 70.

Specimens examined.—Total, 29, distributed as follows: *Osborne County:* Unspecified, 1. *Atchison County:* 6 mi. NE Muscotah, 4; Unspecified, 1. *Jefferson County:* 2 mi. S Meriden, 1; Unspecified, 2. *Douglas County:* 2 mi. W Lawrence, on Kaw River, 1; Lawrence, 3; 7½ mi. SW KU, 1; Unspecified, 11. *Linn County:* Unspecified, 2. *Reno County:* 2 mi. N, 2 mi. E Hutchinson, 1. *Eastern Kansas:* Unspecified, 1.

Additional records.—Phillips Co.: Long Island, 2 (Allen, 1895:274). *Doniphan County:* Geary (Linsdale, 1928:142). *Riley County:* Unspecified (Dice, 1923:109). *Pottawatomie County:* Onaga, 1 (USNM). *Leavenworth Co.:* Fort Leavenworth, 1 (USNM). *Logan County:* Unspecified (Black, 1937:157). *Pratt Co.:* Cairo, 2 (USNM).

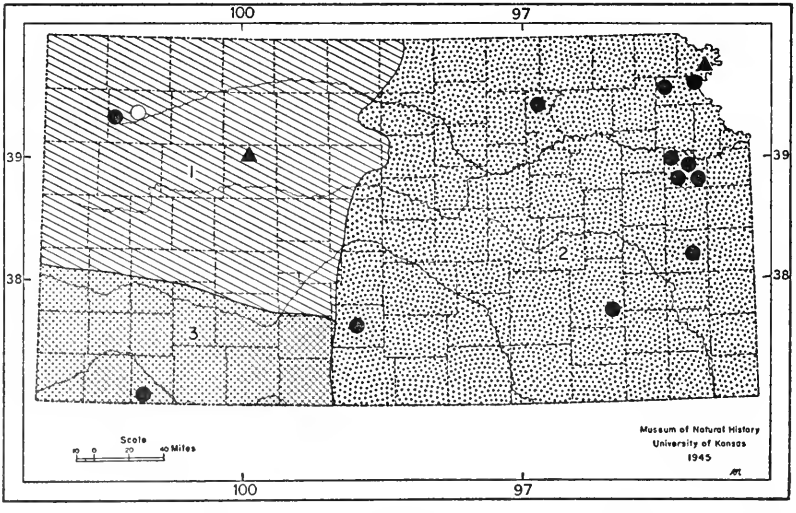

FIG. 67. Distribution of *Mustela frenata* in Kansas. 1. *M. f. longicauda.* 2. *M. f. primulina.* 3. *M. f. neomexicana.* See figure 5 for explanation of symbols.

Mustela frenata

Long-tailed Weasel

This species occurs from southern Canada southward to northern Bolivia in South America. Three subspecies occur in Kansas. *M. frenata* is strictly carnivorous.

Asdell (1946:149) reports that in mid-April females of this species give birth to their young. The litter size ranges from four to eight young.

TABLE 34.—NUMBERS OF PELTS OF WEASELS SOLD IN KANSAS IN VARIOUS RECENT YEARS. THESE FIGURES WERE COMPILED FROM THE SOURCES INDICATED IN TABLE 2.

1928	1938	1940	1941	1942	1943	1944	1945	1946	1947-48	1948-49
3,392	170	170	0	0	0	0	0	0	225	128

A few weasels are taken in Kansas for their furs, and Table 34 shows the number of pelts sold in several recent years.

Mustela frenata longicauda Bonaparte

Mustela longicauda Bonaparte, Charlesworth's Mag. Nat. Hist., 2:38, January, 1838, type from Carlton House, on North Saskatchewan River, Saskatchewan, Canada.

Mustela frenata longicauda, Hall, Carnegie Inst. Washington Publ., 473:105, 1936; Hibbard, Trans. Kansas Acad. Sci., 47:67, 1944.

Mustela longicauda longicauda, Miller, Bull. U. S. Nat. Mus., 128:121, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:235, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 155, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):25, 1940.

Putorius longicauda, Coues, Fur-bearing Animals N. Amer., p. 136, 1877; Baker, Trans. Kansas Acad. Sci., 11:56, 1889; Merriam, N Amer. Fauna, 11:19, 1896.

Putorius noveboracensis, Knox, Trans. Kansas Acad. Sci., 4:19, 1875.

Distribution.—Northwestern part of the state. See map, figure 67.

Remarks.—External measurements of two males and one female from Thomas County, are: ♂ 415, 410, ♀ 380; 138, 145, 130; 48, 43, 40; 22, 25, 17.

Specimens examined: Total, 6, distributed as follows: *Thomas County:* 6 mi. W Brewster, 2; Brewster (near), 2; Unspecified, 2.

Additional records.—Trego Co.: Near Wakeeney (?) (Baker, 1889:56).

Mustela frenata primulina Jackson

Mustela primulina Jackson, Proc. Biol. Soc. Washington, 26:123, 1913, type from 5 miles northeast of Avilla, Jasper County, Missouri, Miller, Bull. U. S. Nat. Mus., 128:121, 1924; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):25, 1940.

Mustela frenata primulina, Hall, Carnegie Inst. Washington Publ., 473:104, 1936; Hibbard, Trans. Kansas Acad. Sci., 47:68, 1944; Brumwell, Amer. Midland Nat., 45:209, 1951.

Mustela longicauda primulina, Linsdale, Jour. Mamm., 9:141, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:235, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 156, 1937.

Mustela longicauda longicauda, Dice, Jour. Mamm., 4:108, 1923; Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):25, 1940 (part from Pratt County).

Putorius longicauda, Lantz, Trans. Kansas Acad. Sci., 19:177, 1905.

P[utorius] longicauda, Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905.

Distribution.—Eastern Kansas, west certainly to Riley and Pratt counties. See map, figure 67.

Remarks.—External measurements of four males and one female from Douglas County, are: ♂ 392.7 (350-428), ♀ 355; 129.7 (110-147), 120; 42.9 (40-45.7), 41; 18.0 (12-21), 20.

Specimens examined.—Total, 103, distributed as follows: *Riley County:* Winkler (near), 1. *Atchison County:* Doniphan Lake, 1; 5 mi. NE Muscotah, 1; Unspecified, 1. *Douglas County:* 10 mi. W (KU) Lawrence, 1; 1½ mi. W Lawrence, 1; Lawrence, 8; 2 mi. SW Lawrence, 1; Clinton (near), 5; 7 mi. SW Lawrence, 7; 7½ mi. SW Lawrence, 5; 6 mi. S Lawrence, 3; 10 mi. SW Lawrence, 1; Baldwin, 1; Unspecified, 51. *Anderson County:* 4 mi. S Garnett, 1. *Greenwood County:* 8 mi. SW Toronto, 4. *Pratt County:* Pratt, 1. *Eastern Kansas:* Unspecified, 9.

Additional records.—Doniphan County: Geary (Linsdale, 1928:141).

Mustela frenata neomexicana (Barber and Cockerell)

Putorius frenatus neomexicanus Barber and Cockerell, Proc. Acad. Nat. Sci. Philadelphia, p. 188, 1898, type from Armstrong's Lake, Mesilla Valley, Donna Ana County, New Mexico; Lantz, Trans. Kansas Acad. Sci., 19:178, 1905.

Mustela frenata neomexicana, Miller, N. Amer. Land Mamm., 1911, p. 100, 1912; Hibbard, Trans. Kansas Acad. Sci., 36:235, 1933; Hall, Carnegie Inst. Washington Publ., 473:108, 1936; Black, Kansas State Board Agric., 30th Biennial Rept., p. 156, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):25, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:67, 1944.

P[utorius] frenatus neomexicanus, Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905.

Distribution.—Probably the southwestern part of the state; known only from one specimen from Seward County. See map, figure 67.

Remarks.—No external measurements of specimens of this subspecies taken in Kansas are available.

Specimen examined.—One from *Seward County:* Liberal.

Mustela nigripes

Black-footed Ferret

The range of the black-footed ferret is the Great Plains from western North Dakota westward to the eastern base of the Rocky Mountains, and from southern Canada southward to New Mexico and Texas. Little is known about the animals and for years after Audubon and Bachman first described the black-footed ferret, its very existence was denied by many zoologists. Throughout its range this animal is intimately associated with the prairie—apparently using the prairie dog as food and the hole dug by the prairie dog as a home.

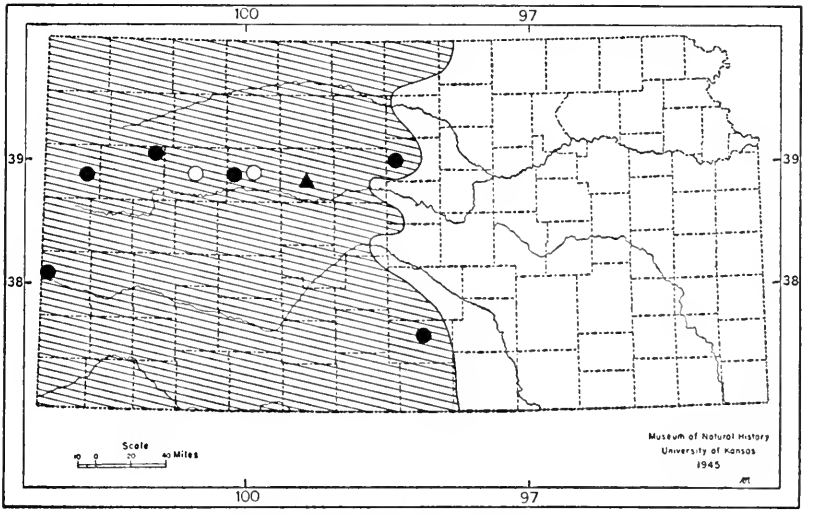

FIG. 68. Distribution of *Mustela nigripes* in Kansas. See figure 5 for explanation of symbols.

Baker (1889:56), in writing of this animal near Wakeeney, Trego County, stated: "Lives in prairie dogs' burrows, and preys upon these rodents; makes occasional inroads also upon poultry. It is generally to be found in the larger prairie-dog 'towns', but it is nowhere numerous." Weeks (1927:88) was probably describing the black-footed ferret when he wrote: "When we went to northwest Kansas in 1872 we found . . . once in a while an animal which

I called a pine martin, whose fur was rich lemon-yellow, except for a black-tipped tail. It had the boldness of a weasel. One of them would get into a prairie dog town and put the whole colony on the run. I ran one into a dog hole, and it came right up between my feet, and looked at me with the bold curiosity of the weasel. I got a trap, ran him into a hole, held to the end of the chain, and had him in less than ten seconds."

Mead (1885:92) reported the following observations on the black-footed ferret in Kansas: "Following the life of a hunter [from 1859 to 1869, in Kansas] . . . I saw one, and but one 'Black-footed Ferret'. It was in a Prairie Dog town, on Spillman Creek, north of the Saline River, in 1860. I was sitting down at the time waiting for a herd of buffalo to feed within range, when noticing a commotion among the Dogs, I looked and saw an animal closely resembling a Mink, of tawny yellowish color . . . running around in the Dog town, followed behind and on each side by the Dogs; who seemed greatly interested in his movements. The Ferret would occasionally go down a Dog hole; then the Dogs would gather closely around the hole and hold an animated discussion till he came out, when they would fall back and follow him around to the next hole he saw fit to enter. I did not see the Ferret attempt to catch or disturb the Dogs, or they to attack the Ferret."

Little is known of the reproductive habits or life history of this species. On July 10, 1929, Aldous (1940:23) found, in north-central New Mexico, an adult female with two young. One of the young was taken and raised in captivity. To my knowledge, this is the only instance where the number of young of the black-footed ferret has been recorded.

Mustela nigripes (Audubon and Bachman)

Putorius nigripes Audubon and Bachman, Quadrupeds N. Amer., 2:297, 1851, type from Fort Laramie, Laramie County, Wyoming; Coues, Fur-bearing Animals of North America, p. 151, 1877; Cragin, Bull. Washburn College Lab. Nat. Hist., 1:43, 1885; Baker, Trans. Kansas Acad. Sci., 11:56, 1889; Merriam, N. Amer. Fauna, 11:7, 1896; Lantz, Trans. Kansas Acad. Sci., 19:177, 1905.

Mustela nigripes, Miller, N. Amer. Land Mamm. 1911, p. 102, 1912; Hibbard, Trans. Kansas Acad. Sci., 36:235, 1933; Hibbard, Jour. Mamm., 15:70, 1934; Black, Kansas State Board Agric., 30th Biennial Rept., p. 157, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:68, 1944.

P[utorius] nigripes, Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905.

Distribution.—Formerly throughout the western half of the state, east certainly to Lincoln and Kingman counties. At present, probably extinct in the state. See map, figure 68.

Remarks.—External measurements of two males from near Coolidge, are: 500, 530; 125, – – –; 60, 64; 31, 31.

Specimens examined.—Total, 10, distributed as follows: *Wallace Co.:* Fort Wallace, 1 (USNM). *Logan Co.:* Oakley, 1 (USNM). *Gove County:* Unspecified, 2 (USNM). *Trego Co.:* Banner, 1 (USNM); Unspecified, 1 (USNM). *Lincoln County:* US highway No. 18, E of Lucas, 1. *Hamilton County:* Near Coolidge, 2. *Kingman County:* Kingman, 1.

Additional records.—Ellis County: Near Hays, 1 (Carnegie Museum).

Genus **Taxidea** Waterhouse

American Badger

This genus occurs only in North America. Only one species is recognized. Badgers are short-legged carnivores with strong forelimbs. The forefeet are armed with long, strong digging claws. The tail is short and the body is flattened. The dental formula is: i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{1}{2}$.

Taxidea taxus

American Badger

The badger occurs from the southern part of western Canada south, through the Great Plains and western United States into Mexico. The general color of the upper parts is grizzled gray with a prominent stripe arising on the forehead and continuing to or slightly beyond the shoulders. The face, prominently marked with dull black, has a whitish patch on each side before the eye and ear. The total length is approximately 29 inches; the tail comprises five to six inches of this total.

According to Asdell (1946:147-8) badgers give birth to one to five young between February and May. The time depends on the geographical locality; in Kansas the young are probably born in late May or early June.

The eastern limit of the range in Kansas apparently fluctuates over a period of years. Kellogg and Householder, in the winter of 1915-16, investigated the mammalian fauna of Cherokee County, in the southeastern corner of the state. Of the badger, they wrote (unpublished notes): "Doc Burgett killed a badger here in 1885. None occur here today. Old settlers say that they were never very plentiful." Lantz (1905:177), without mentioning localities or specimens, reported that the badger occurred throughout the state, ". . . but rarely in the eastern part."

In the southern part of the state I have no recent record of the badger farther eastward than Greenwood County. W. C. Justice (*in litt.*) reported to me that badgers are common in Cowley

County. In the northeastern part of the state I know of no records from points east of Riley County prior to 1940. Since 1940 the badger has been reported or taken in several counties east of Riley County. According to correspondence between R. A. Stirton and D. F. Hoffmeister in the files of the University of Kansas Museum of Natural History, a badger was killed in late May, 1945, by Clarence Keifer at a point two miles southwest of Muscotah. Specimens are in the collection of the University of Kansas Museum of Natural History which have been taken in the following counties

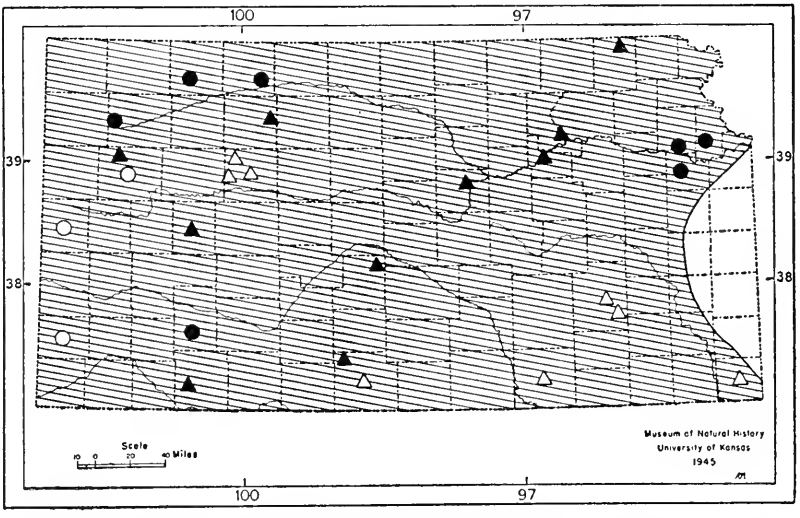

FIG. 69. Distribution of *Taxidea taxus taxus* in Kansas. See figure 5 for explanation of symbols.

in the years indicated: Nemaha, 1949; Jefferson, 1948; Leavenworth, 1947; and Douglas, 1946.

The badger from Jefferson County was brought to the University of Kansas Museum of Natural History on August 20, 1948, by Paul LeGer, state game warden. Mr. LeGer said at that time that he knew of six badgers having been taken within the preceding two years or less in his district (Jefferson and Leavenworth counties) but did not know of any taken earlier.

In December, 1950, a badger was taken "near Lawrence," Douglas County, and came into the hands of C. W. Ogle, a Lawrence fur buyer. The animal was discarded, pelt and all, before I learned of this; thus, this individual was not saved as a museum specimen.

The available evidence leads me to conclude that (1) The badger

may have been in eastern Kansas prior to 1890; (2) the badger probably did not occur in Kansas much east of Riley and Greenwood counties between 1890 and 1940; and (3) the badger has expanded its range into northeastern Kansas since 1940.

Although the pelt of the badger is not usually worth much on the fur market, a few badger pelts (see table 35) are sold in Kansas each year.

TABLE 35.—NUMBER OF BADGER PELTS SOLD IN KANSAS IN VARIOUS RECENT YEARS. THESE FIGURES WERE COMPILED FROM THE SOURCES GIVEN IN TABLE 2.

YEAR	Number	YEAR	Number
1928	9,789	1941	1,050
1929	9,389	1942	538
1930	8,344	1943	1,152
1931	5,987	1944	938
1932	5,103	1945	653
1933	4,283	1946	589
1934	4,756	1947–8	528
1938	205	1948–9	232
1940	2,911	1949–50	182

Taxidea taxus taxus (Schreber)

Ursus taxus Schreber, Säugethiere, 3:520, 1778, type said to be from "Labrador and Hudson Bay" but probably from southwest of Hudson Bay.

Taxidea taxus taxus, Dice, Jour. Mamm., 4:109, 1923; Hibbard, Trans. Kansas Acad. Sci., 36:236, 1933; Hall, Carnegie Inst. Washington Publ., 473:78, 1936; Black, Kansas State Board Agric., 30th Biennial Rept., p. 162, 1937.

Taxida taxus taxus [sic], Hibbard, Trans. Kansas Acad. Sci., 47:69, 1944.

Taxidea Americana, J. A. Allen, Bull. Essex Inst., 6:46, 1874; Knox, Trans. Kansas Acad. Sci., 4:19, 1875.

Taxidea americana, Coues, Fur-bearing animals of North America, p. 263, 1877; Baker, Trans. Kansas Acad. Sci., 11:56, 1889.

Taxidea Americana var. *Berlandieri,* Cragin, Bull. Washburn College Lab. Nat. Hist., 1:43, 1885.

Taxidea taxus, Lantz, Trans. Kansas Acad. Sci., 19:177, 1905.

Taxidea taxus berlandieri, Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:236, 1933.

Taxidea taxus montana Schantz, Jour. Mamm., 31:90, 1950, type from 35 miles south of Dillon, Beaverhead County, Montana (part from Greeley and Thomas counties, Kansas).

Taxidea taxus merriami Schantz, Jour. Washington Acad. Sci., 40:92, 1950, type from Banner, Trego County, Kansas (nine specimens from Trego, Lane, Harper, Meade, Stafford, and Logan counties).

Taxidea taxus kansensis Schantz, Jour. Mamm., 31:346, 1950, type from 4 miles southeast of McLouth, Leavenworth County, Kansas (eight specimens from Nemaha, Douglas, Riley, Leavenworth, Greenwood, and Jefferson counties).

Distribution.—Throughout all but the southeastern part of the state. See map, figure 69.

Remarks.—Measurements of a male from ½ mi. W Perry, and two females, one from 4 mi. SE McLouth, the other from 13 mi. W, 1 mi. S Lawrence, are: male 773, females 719, 710; 135, 111, 120; 104, 102, 115; 52, 49, 54; weight (lbs.) 21.6, – –, – –,

Schantz (1950A, 1950B, 1950C) has assigned the badgers in Kansas to at least three different subspecies. These subspecies are based primarily on differences in color of pelage, a feature which shows a wide range of variation in the few animals that I have seen. Most of the specimens of *Taxidea* in the collection of the University of Kansas Museum of Natural History have been on loan to Schantz since 1946 and I have not had the opportunity to study them. Perhaps, in the planned revision of the genus *Taxidea,* Schantz will point out additional diagnostic characteristics of sufficient constancy to warrant the recognition of three (or more) subspecies of badgers in Kansas.

Specimens examined.—Total, 17, distributed as follows: *Decatur County:* 8 mi. S Oberlin, 1. *Norton County:* 4 mi. W, 1 mi. S Logan, 1. *Thomas County:* Brewster, 8; Near Brewster, 11. *Jefferson County:* ½ mi. S Perry, 1. *Leavenworth County:* 4 mi. SE McLouth, 1. *Logan County:* Unspecified, 1. *Douglas County:* 13 mi. W, 1 mi. S Lawrence, 1. *Greeley County:* Unspecified, 1. *Stanton County:* Unspecified, 1. *Gray County:* 2 mi. S Montezuma, 1.

Additional records.—Nemaha County: Bern, 1 (KU, Schantz, 1950:347). *Graham County:* 22 mi. E Hill City, 1 (KU, Schantz, 1950:92); Bow Creek, 1 (Kellogg, 1915, unpublished thesis). *Riley Co.:* Manhattan, 1 (USNM, Schantz, 1950:347). *Logan County:* Winona, 1 (KU, Schantz, 1950:93). *Trego County:* Banner, 2 (USNM, Schantz, 1950:93); Collyers, 1 (USNM); Unspecified, 1 (USNM, Schantz, 1950:93). *Dickinson Co.:* Abilene, 1 (Cragin, 1885:44). *Geary Co.:* Junction City, 1 (Cragin, 1885:44). *Lane County:* Dighton, 1 (KU, Schantz, 1950:93). *Stafford County:* Little Salt Marsh, 2 (Schantz, 1950:93). *Greenwood County:* 4 mi. W Neal, 1 (KU, Schantz, 1950:347); 8 mi. SW Toronto, 1 (KU, Schantz, 1950:347). *Meade County:* 13 mi. SW Meade, 1 (KU, Schantz, 1950:93). *Barber County:* Sun City, 1 (Kellogg, 1915:unpublished thesis); Unspecified, (Cragin, 1885:44). *Harper County:* Unspecified, 1 (KU, Schantz, 1950:93). *Cowley County:* Unspecified (see text). *Cherokee County:* Unspecified (see text).

Genus **Mephitis** Geoffroy and Cuvier

Striped Skunks

This genus is restricted in distribution to North America where it ranges from northern Canada southward, through all of the United States, into Central America. There are two species, only one of which occurs in Kansas.

Generic characteristics include: highly arched skull ranging from 56 to 76 mm. in basal length; mastoid bullae not inflated; posterior margin of palate nearly on a line with posterior borders of upper

molars; long, bushy tails; conspicuous black and white color pattern; and anal scent glands well developed; dental formula: i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{1}{2}$.

Mephitis mephitis

Striped Skunk

The striped skunk, in Kansas, is divisible into three subspecies. The animal is notorius for the ill-smelling, volatile musk which it releases as a defense against enemies. The total length is approximately 23 inches; the tail comprises approximately nine inches of this total.

The skunk feeds upon almost any kind of small animal life as well as many fruits. Insects, mice, lizards, birds, birds' eggs, ground squirrels—all these and a host of others furnish food for the striped skunk.

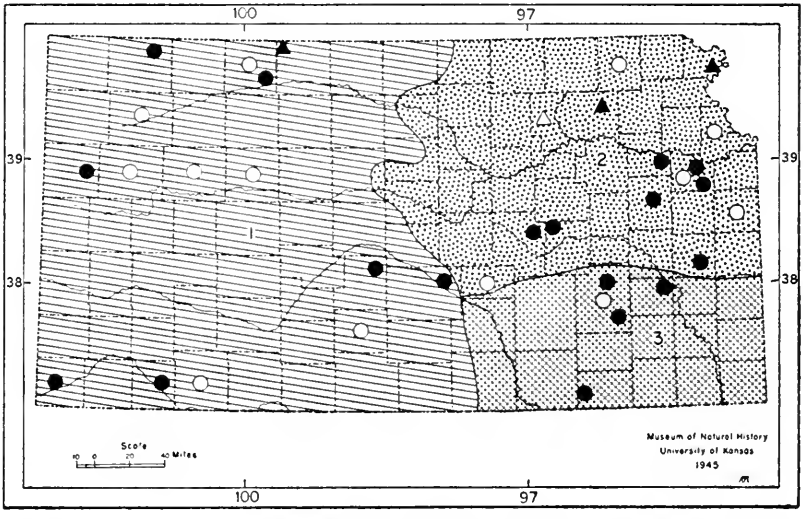

FIG. 70. Distribution of *Mephitis mephitis* in Kansas. 1. *M. m. varians.* 2. *M. m. avia.* 3. *M. m. mesomelas.* See figure 5 for explanation of symbols.

Asdell (1946:148-149) reported in effect that members of this species vary in time of breeding and size of litter in the various parts of its range. Probably, in Kansas, the young are born in late May or early June, and the litter size is thought to vary from four to seven, or more.

The skunks, both spotted and striped, furnish a large percentage of the furs sold in the state. The striped skunks, however, furnish a larger percentage of the total than do the spotted skunks. Table

TABLE 36.—NUMBER OF PELTS OF THE STRIPED AND THE SPOTTED SKUNKS SOLD IN KANSAS IN VARIOUS RECENT YEARS. THESE FIGURES WERE COMPILED FROM THE SOURCES INDICATED IN TABLE 2.

YEAR	Spotted	Striped	Total
1928	107,277	279,647	386,924
1929	116,334	269,940	386,274
1930	117,309	258,493	375,802
1931	101,431	215,633	317,064
1932	102,206	231,411	333,617
1933	93,216	186,328	279,544
1934	79,893	173,852	253,745
1938	21,604	110,245	131,849
1940	47,219	151,800	199,019
1941	48,874	153,216	202,090
1942	45,322	149,888	195,210
1943	48,337	151,758	200,095
1944	*	*	175,515
1945	*	*	171,807
1946	*	*	158,742
1947–8	*	*	189,303
1948–9	*	*	16,973
1949–50	*	*	17,887

* Separate totals not available.

36 shows the number of skunk pelts sold in Kansas in various recent years.

Mephitis mephitis varians Gray

Mephitis varians Gray, Charlesworth's Mag. Nat. Hist., 1:581, 1837, type from Texas.

Mephitis mephitis varians, Hall, Carnegie Inst. Washington Publ., 473:66, 1936; Hibbard, Trans. Kansas Acad. Sci., 47:69, 1944.

Mephitis mesomelas varians, Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:506, 1939.

Chincha mesomelas varians, Howell, N. Amer. Fauna, 20:32, 1901.

Distribution.—Western part of the state, east certainly to Phillips and Reno counties. See map, figure 70.

Remarks.—External measurements of four females from 12 miles northeast of Elkhart, are: 621.2 (610-640); 269.2 (255-293); 70.2 (63-76); 28.2 (25-30).

Specimens examined.—Total, 35, distributed as follows: *Rawlins County:* 2 mi. NE Ludell, 1. *Norton County:* 5 mi. W, 1 mi. N Logan, 1; Unspecified, 1. *Thomas County:* Unspecified, 1. *Wallace County:* 3 mi. S Wallace, 1. *Logan County:* Unspecified, 5. *Gove County:* Unspecified, 1. *Trego County:* Unspecified, 3. *Stafford County:* N of Salt Marsh, 1; Little Salt Marsh, 1. *Reno County:* 2 mi N, 2 mi. E Hutchinson, 3. *Pratt County:* Unspecified, 1. *Morton County:* 9 mi. N, 3 mi. E Elkhart, 3; Unspecified, 4. *Seward County:* 1 mi. E Arkalon, 1. *Meade County:* Unspecified, 7.

Additional records.—Phillips County: Long Island, 2 (Howell, 1901:32). *Trego County:* Unspecified, 5 (Howell, 1901:32).

Mephitis mephitis avia Bangs

Mephitis avia Bangs, Proc. Biol. Soc. Washington, 12:32, 1898, type from San Jose, Mason Co., Illinois.

Mephitis mephitis avia, Hall, Carnegie Inst. Washington Publ., 473:65, 1936; Hibbard, Trans. Kansas Acad. Sci., 47:68, 1944; Brumwell, Amer. Midland Nat., 45:210, 1951.

Mephitis mesomelas avia, Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:434, 1907; Hibbard, Trans. Kansas Acad. Sci., 36:236, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 160, 1937.

Mephitis mesomelas varians, Dice, Jour. Mamm., 4:109, 1923; Linsdale, Jour. Mamm., 9:142, 1928.

Distribution.—Northeastern part of the state, west certainly to Riley and Harvey counties and south certainly to Harvey, Chase, and Anderson counties. See map, figure 70.

Remarks.—External measurements of four males and four females from Douglas County, are: ♂ 633.0 (597-736.3), ♀ 612.4 (560-635); 236.7 (190.5-270), 240.3 (228.6-254); 77.7 (69.8-88.9), 65.7 (54.6-78.7).

Specimens examined.—Total, 284, distributed as follows: *Nemaha County:* Unspecified, 11. *Leavenworth County:* Unspecified, 1. *Shawnee County.* 1 mi. SE Watson, 1. *Douglas County:* 2½ mi. W Lawrence, 2; Lawrence, 13; 5 mi. S Lawrence, 2; 7-7½ mi. SW Lawrence, 22; 8 mi. SW Lawrence, 4; Lone Star Lake, 2; Baldwin, 1; Unspecified, 112. *Osage County:* Lyndon, 1. *Anderson County:* 6 mi. S Garnett, 2. *Miami County:* Unspecified, 1. *Marion County:* 1 mi. NE Lincolnville,1 . *Chase County:* 9 mi. NE Lincolnville, 11. *Harvey County:* Unspecified, 11. *Eastern Kansas:* Unspecified, 86.

Additional records.—Doniphan County: Geary (Linsdale, 1928:142). *Riley County:* Unspecified (Dice, 1923:109). *Pottawatomie Co.:* Onaga, 3 (Howell, 1901:32).

Mephitis mephitis mesomelas Lichtenstein

Mephitis mesomelas Lichtenstein, Darstellung neuer oder wenig bekannter Saugethiere, pl. 45, fig. 2, 1832, type from Louisiana.

Mephitis mephitis mesomelas, Hall, Carnegie Inst. Washington Publ., 473:66, 1936; Hibbard, Trans. Kansas Acad. Sci., 47:69, 1944.

Distribution.—Southeastern part of the state, north and west certainly to Greenwood County. See map, figure 70.

Remarks.—External measurements of one female from eight miles southwest of Toronto, are: 660; 295; 70; 40.

Additional material from central Kansas is necessary before the extent of the zones of intergradation between *M. m. varians* and *M. m. avia* and between *M. m. varians* and *M. m. mesomelas* can be more exactly determined.

Specimens examined.—Total, 13, distributed as follows: *Greenwood County:* Hamilton, 1 (GCR); 1 mi. SE Hamilton, 1 (GCR); 8 mi. SW Toronto, 2; Unspecified, 9.

Additional records.—Woodson Co.: Neosho Falls, 1 (Howell, 1901:32). *Chautauqua Co.:* "Cedarvale," 1 (Howell, 1901:32).

Genus Spilogale Gray

Spotted Skunks

This genus is restricted in distribution to North America; it occurs from extreme southern British Columbia and over most of the United States, south through Mexico, to Costa Rica. Only one species occurs in Kansas.

Generic characters include: skull flattened dorsally, ranging from 35 to 56 mm. in basilar length; mastoid bullae highly inflated; palate nearly on a line with posterior border of last upper molar; and color pattern consisting of white and black spots. The dental formula is: i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{1}{2}$.

Spilogale interrupta

Spotted Skunk

This nominal species of the Great Plains ranges from North Dakota south into east central Texas. The spotted skunk is much smaller and slenderer than the striped skunk. The total length is approximately 21 inches and the tail comprises approximately eight inches of this total. There is one annual litter of 2 to 7 young.

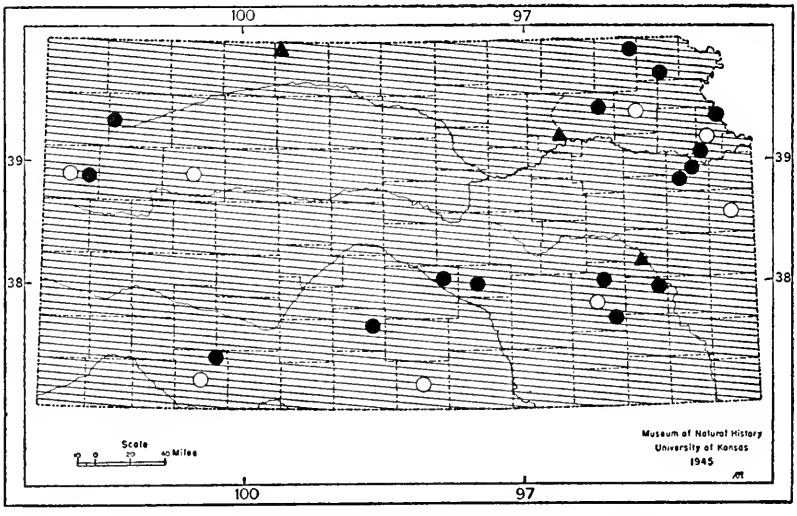

FIG. 71. Distribution of *Spilogale interrupta* in Kansas. See figure 5 for explanation of symbols.

Table 36 shows the number of spotted skunks sold for their fur in Kansas in various recent years.

The range of the spotted skunk may have changed since the

early settlers arrived in Kansas. Mead (1899:280), in recording some notes on conditions on the plains of Central Kansas in 1859, reported: "The large two-striped skunks [*Mephitis*] flourished everywhere; there were none of the small spotted variety." Baker (1889:56) in reporting the mammals near Wakeeney, Trego County, stated that the spotted skunk was: ". . . not seen here until the autumn of 1887. Of twenty skunks taken since that time, one-third were of this species." J. A. Allen visited Fort Hays, Kansas in the summer of 1871 and in the following winter spent two weeks in northwestern Kansas. Allen reported (1874:46) that the striped skunk was abundant but made no mention of the spotted skunk. Possibly the spotted skunk has expanded its range westward in Kansas in the past century.

Spilogale interrupta (Rafinesque)

Mephitis interrupta Rafinesque, Annals of Nature 1:3, 1820, type from upper Missouri River.

Spilogale interrupta, Baker, Trans. Kansas Acad. Sci., 11:56, 1889; Merriam, N. Amer. Fauna, 4:8, 1890; J. A. Allen, Bull. Amer. Mus. Nat. Hist., 7:274, 1895; Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905; Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Howell, N. Amer. Fauna, 26:19, 1906; Elliot, Field Columbian Mus., Publ. 115, Zool. Ser., 8:438, 1907; Scheffer, Trans. Kansas Acad. Sci., 23:111, 1911; Johnson, Jour. Mamm., 2:87, 1921; Dice, Jour. Mamm., 4:49, 1923; Dice, Ecology, 4:109, 1923; Linsdale, Jour. Mamm., 9:142, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:236, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 159, 1937; Hibbard, Trans. Kansas Acad. Sci., 47:68, 1944; Brumwell, Amer. Midland Nat., 45:209, 1951.

Mephitis (*Spilogale*) *putorius*, Coues, Fur-bearing animals of North America, p. 239, 1877.

M[*ephitis*] *bicolor*, Knox, Trans. Kansas Acad. Sci., 4:19, 1875.

Distribution.—State wide. See map, figure 71.

Remarks.—External measurements of three males and two females from Douglas County, are: ♂ 444.5, 567, 552.6, ♀ 426, 431; 196.8, 235, 190.5, 140, 165; 69.8, 53, 53.3, 47, 44.5.

Specimens examined.—Total, 183, distributed as follows: *Nemaha County:* Sabetha, 19. *Brown County:* Mission Lake, Horton, 1. *Thomas County:* Brewster, 1. *Pottawatomie Co.:* Onaga, 8 (USNM). *Jackson County:* Unspecified, 1. *Leavenworth Co.:* Fort Leavenworth, 1 (USNM); Botany Bluff, 2 mi. E, 6 mi. N Lawrence, 1; Unspecified, 1. *Wallace County:* 3 mi. SW Wallace, 1; Unspecified, 1. *Trego County:* Unspecified, 7 (USNM). *Douglas County:* Kaw River, 2; 3 mi. W KU Lawrence, 1; ½ mi. W Lawrence, 1; Lawrence, 4; 7½ mi. SW Lawrence, 9; 8 mi. SW Lawrence, 1; 11 mi. SW Lawrence, 2; Unspecified, 87. *Miami County:* Unspecified, 1. *Reno County:* 2 mi. N, 2 mi. E Hutchinson, 1. *Harvey County:* Halstead, 1. *Greenwood County:* ½ mi. NE Hamilton, 1; Hamilton, 10; 8 mi. SW Toronto, 4; 8½ mi. SW Toronto, 2; Unspecified, 3. *Woodson County:* Neosho Falls, 1. *Pratt Co.:* Cairo, 3 (USNM). *Meade County:* 2 mi. N Fowler, 2; ½ mi. N Fowler, 1; 1½ mi. N Fowler, 1; Unspecified, 1. *Harper County:* Unspecified, 2.

Additional records.—Phillips County: Long Island, 3 (Howell, 1906:19). *Riley County:* Manhattan, 2 (Howell, 1906:19); Fort Riley, 1 (Howell, 1906:19). *Coffey Co.:* Burlington, 1 (Howell, 1906:19).

Genus Lutra Brisson

Otter

This genus occurs in North and South America, Europe, Asia, and Africa. One species of this genus formerly occurred in Kansas. Generic characters include: skull flattened, ranging in basilar length from 50 to 135 mm.; tympanic bullae flattened and not in contact with paroccipital processes; palate terminates behind upper molars; toes entirely webbed; ears small; and fur short and dense. The dental formula is: i. $\frac{3}{3}$, c. $\frac{1}{1}$, p. $\frac{4}{3}$, m. $\frac{1}{2}$.

Lutra canadensis

River Otter

This species formerly ranged from northern Alaska and Canada southward, through most of the United States and on into South America. Probably only one subspecies of this species has occurred in Kansas within historic times.

When Kansas was first settled the otter was found along all the major streams in the state. There the otter was often found in a hole in the bank, the entrance of which was usually under the surface of the water. Various kinds of aquatic life including frogs, crayfish, fish, and mollusks, were utilized as food.

Mead reported (1899:280) that in 1859 otter were common in central Kansas. J. A. Allen spent the summer of 1871 in the vicinity of Fort Hays, Kansas, and two weeks of the following winter in northwestern Kansas. He reported (1874:46) that the otter occurred occasionally along the streams. Baker (1889:56) reported that the otter was found occasionally in western Kansas at that time.

Remington Kellogg and Victor Householder investigated the mammalian fauna of Cherokee County in the winter of 1915-1916. Of the occurrence of otter in that country, they reported (unpublished notes) that: "H. A. Scovell killed an otter on Brush Creek, 2 miles east of Columbus, in 1868. A few have been reported since then."

To my knowledge, the last record of the occurrence of the otter in Kansas is that reported by Lantz (1905A:178): "One was captured near Manhattan in September, 1904."

Lutra canadensis interior Swenk

Lutra canadensis interior Swenk, Univ. Studies, Univ. Nebraska, 18(1):2, 1918, type from Lincoln Creek, west of Seward, Seward County, Nebraska; Black, Kansas State Board Agric., 30th Biennial Rept., p. 158, 1937.

Lutra canadensis cf. interior, Hibbard, Trans. Kansas Acad. Sci., 47:68, 1944.

Lutra Canadensis, J. A. Allen, Bull. Essex Inst., 6:46, 1874; Knox, Trans. Kansas Acad. Sci., 4:19, 1875.

Lutra canadensis, Coues, Fur-bearing Animals N. Amer., 295, 1877; Baker, Trans. Kansas Acad. Sci., 11:56, 1889.

Lutra canadensis sonora, Lantz, Trans. Kansas Acad. Sci., 19:178, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905.

Lutra canadensis lataxina, Hibbard, Trans. Kansas Acad. Sci., 36:235, 1933; Brumwell, Amer. Midland Nat., 45:210, 1951.

Distribution.—Formerly state wide, now extinct in Kansas.

Remarks.—No reliable external measurements of specimens taken in Kansas are available to me. Bailey (1931:323) gave the external measurements of an adult female otter (*L. c. sonora*) from Montezuma Well, Arizona, as: 1300; 815; 146; weight 19½ lbs.

Specimens examined.—Total, 4, distributed as follows: *Wabaunsee County:* Unspecified, 1. *Douglas County:* Kaw River, near Lawrence, 1; Unspecified, 2.

Additional records.—Riley Co.: Manhattan, 1 (USNM). *Trego County:* Unspecified (Baker, 1889; 56). *Wabaunsee County:* Alma, 1 (Kellogg, 1915: unpublished thesis); Mill Creek, 1 (Kellogg, 1915:unpublished thesis). *Cherokee County:* 2 mi. E Columbus, 1 (see text).

Family Felidae

This family includes the cats and catlike carnivores. Members of this family are slender animals, have moderately long legs, and, in size, are medium to large. They occur in North and South America, Europe, Asia, and Africa. Two genera occur in Kansas.

The following key will aid in the separation of the species of this family known to occur in Kansas within historic times.

1. Tail more than 30 per cent of total length; P¾ . . . . . *Felis concolor*, p. 261
1'. Tail less than 30 per cent of total length; P⅞ . . . . . *Lynx rufus*, p. 263

Genus **Felis** Linnaeus

Cats

This genus occurs in North and South America, Europe, Asia, and Africa. One species has occurred in Kansas within historic times. The dental formula of this genus is: c. $\frac{3}{3}$, i. $\frac{1}{1}$, p. $\frac{3}{2}$, m. $\frac{1}{1}$.

Felis concolor

Puma

The puma, often called "mountain lion" or "panther" was once common throughout most of the state. Zebulon Pike (1811:177) found puma in what is now Chase County, Kansas.

Now the puma is extinct in Kansas. However, newspaper accounts as late as last year (1950) continue to report sight records of this cat in Kansas. Perhaps some pumas have strayed into the

state within recent years; however to my knowledge the last specimen taken in the state was one obtained on August 15, 1904, at Catherine (9 mi. N Hays). This animal is specimen no. 2193 in the collection of the University of Kansas Museum of Natural History. Dyche (1905:160-162) reported in detail on this animal. He reasoned that the animal was not to ". . . be considered as a native-born Kansan; it must rather be looked upon as a mere straggler."

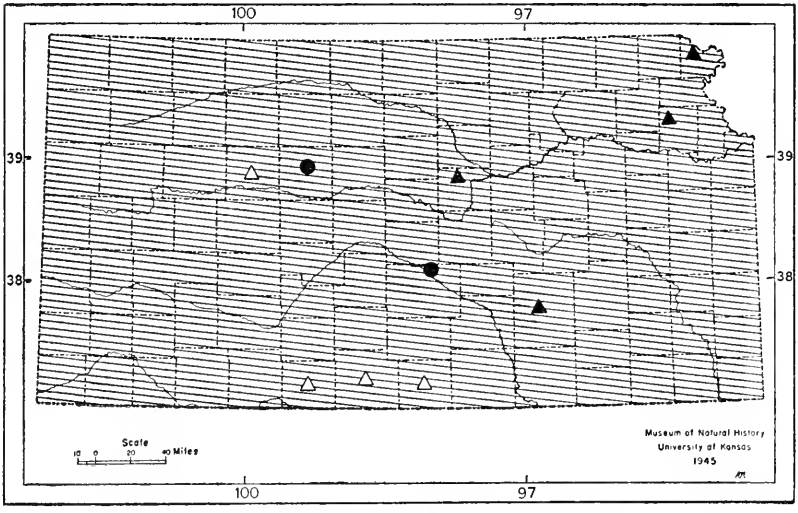

FIG. 72. Distribution of *Felis concolor hippolestes* in Kansas. See figure 5 for explanation of symbols.

Felis concolor hippolestes Merriam

Felis hippolestes Merriam, Proc. Biol. Soc. Washington, 11:219, 1897, type from Wind River Mountains, Fremont County, Wyoming.

Felis concolor hippolestes, Nelson and Goldman, Jour. Mamm., 10:347, 1929; Hibbard, Trans. Kansas Acad. Sci., 47:71, 1944; Goldman *in* Young and Goldman, The Puma, Amer. Wildlife Inst., p. 209, 1946.

Felis concolor, Knox, Trans. Kansas Acad. Sci., 4:19, 1875; Cragin, Bull. Washburn College Lab. Nat. Hist., 1:42, 1885; Dyche, Trans. Kansas Acad. Sci., 19:160, 1905.

Felis oregonensis hippolestes, Lantz, Trans. Kansas Acad. Sci., 19:176, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905; Hibbard, Trans. Kansas Acad. Sci., 36:237, 1933.

Felis cougar, Hibbard, Trans. Kansas Acad. Sci., 36:237, 1933.

Felis concolor couguar, Hibbard, Trans. Kansas Acad. Sci., 47:71, 1944.

Distribution.—Formerly state wide, now probably extinct in the state. See map, figure 72.

Remarks.—No reliable external measurements of specimens taken in Kansas are available to me. Young and Goldman (1946:210)

gave the total lengths of three adult males and three adult females from the vicinity of Meeker, Colorado, as: males 2438, 2336, 2286, females 2134, 2058, 2006; and their weights in pounds as: 227, 164, 160, 133, 124, 120.

Specimens examined.—Total, 2, distributed as follows: *Ellis County:* Catherine (9 mi. N Hays), 1. *Reno County:* Nickerson, 1.

Additional records.—Doniphan County: Sparks, 1 (Goldman, 1946:211). *Jefferson Co.:* Valley Falls (Knox, 1875:19). *Trego County:* Unspecified (Lantz, 1905A:176). *Saline Co.* (?): "a few miles above mouth of Solomon R." (Mead, 1899:278). *Butler County:* White Water [= Towanda] (Mead, 1899:278). *Comanche County:* Unspecified (Cragin, 1885:42). *Barber County:* Unspecified (Cragin, 1885:42). *Harper County:* Unspecified (Cragin, 1885:42).

Genus Lynx Kerr

Lynxes

This genus occurs in North America, Europe, Asia, and Africa. One species of this genus occurs in Kansas. The dental formula of this genus is: c. $\frac{3}{3}$, i. $\frac{1}{1}$, p. $\frac{3}{2}$, m. $\frac{1}{1}$.

Lynx rufus

Bobcat

This species occurs from the southern part of Canada south, through all of the United States, into Mexico. Two subspecies are recognized in Kansas. The bobcat is a medium sized, short-tailed cat with a total length of approximately 36 inches; the tail comprises approximately seven inches of this total.

According to Asdell (1946:174) the bobcat mates in late February and in April produce a litter of young ranging in size from one to four.

On March 6, 1877, the legislature of the State of Kansas passed a law authorizing a bounty of one dollar for each bobcat scalp presented to the county commissioner. Twenty-four counties, mainly in the eastern part of the state, offered bounties in 1877-78, and received a total of 356 bobcats. These were distributed by counties as follows: Butler, 56; Chautauqua, 68; Chase, 13; Cherokee, 4; Douglas, 0; Ellsworth, 41; Harvey, 6; Jackson, 27; Jefferson, 2; Labette, 8; Leavenworth, 1; Linn, 7; Lyon, 21; Marion, 0; McPherson, 10; Mitchell, 7; Morris, 0; Neosho, 1; Osage, 5; Pawnee, 1; Riley, 15; Wabaunsee, 23; Wilson, 35; and Woodson, 5. (See First Biennial Report of the State Board of Agriculture to the Legislature of the State of Kansas for the years 1877-78, pp. 584-589.)

Although not so abundant as formerly, the bobcat still occurs in many rough sections of the state. W. C. Justice, a taxidermist at

Arkansas City, Cowley County, reported (in letter dated April 1, 1950) that he had received three bobcats from Cowley County in 1950 and one from Chautauqua County.

In 1940 a total of 150 bobcat pelts were sold in Kansas and in 1947-48, 98 were sold in Kansas. No pelts were indicated as sold in Kansas in the years 1934, 1938, 1941-1946, 1948-49 and 1949-50. (For source of figures see references given in table 2.)

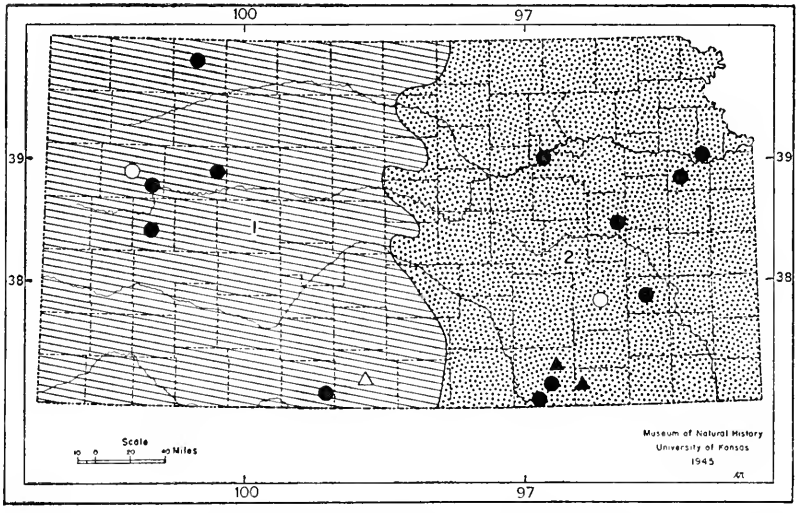

FIG. 73. Distribution of *Lynx rufus* in Kansas. 1. *L. r. baileyi.* 2. *L. r. rufus.* See figure 5 for explanation of symbols.

Lynx rufus baileyi Merriam

Lynx baileyi Merriam, N. Amer. Fauna, 3:79, 1890, type from Moccasin Spring, Coconino County, Arizona; Lantz Trans. Kansas Acad. Sci., 20(2):216, 1907; Hibbard, Trans. Kansas Acad. Sci., 36:237, 1933.

Lynx rufus baileyi, Bailey, N. Amer. Fauna, 53:291, 1931; Black, Kansas State Board Agric., 30th Biennial Rept., p. 170, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information Nat. Hist. Surv., 20(5):30, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:71, 1944.

Lynx rufus var. *maculatus,* Knox, Trans. Kansas Acad. Sci., 5:65, 1877.

Lynx rufus, J. A. Allen, Bull. Essex Inst., 6:45 1874; Knox, Trans. Kansas Acad. Sci., 4:19, 1875 (part); Baker, Trans. Kansas Acad. Sci., 11:56, 1889; Lantz, Trans. Kansas Acad. Sci., 19:176, 1905 (part).

Distribution.—Western Kansas, east certainly to Decatur and Comanche counties. See map, figure 73.

Remarks.—No external measurements of specimens of this subspecies, taken in Kansas, are available, but probably members of

this subspecies do not differ greatly in measurements from *L. rufus rufus.*

Specimens examined.—Total, 16, distributed as follows: *Decatur County:* Oberlin, 1. *Logan County:* 5 mi. W Elkader, 1; Unspecified, 11. *Gove County:* Bluffs near Castle Rock, 1. *Scott County:* Scott City, 1. *Comanche County:* 4 mi. SW Aetna, 1.

Additional records.—Barber County: Unspecified, 1 (Lantz, 1907A:216).

Lynx rufus rufus (Schreber)

Felis rufa Schreber, Saugethiere, plate 1096, 1777, type from New York.

Lynx rufus rufus, Miller, Bull. U. S. Nat. Mus., 128:161, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:237, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 170, 1937; P. B. Allen, Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):30, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:71, 1944; Brumwell, Amer. Midland Nat., 45:210, 1951.

Lynx ruffus, Lantz, Kansas State College Exp. Sta. Bull., 129:336, 1905.

Lynx rufus, J. A. Allen, Bull. Essex Inst., 6:45, 1874; Knox, Trans. Kansas Acad. Sci., 4:19, 1875 (part); Baker, Trans. Kansas Acad. Sci., 11:56, 1889; Lantz, Trans. Kansas Acad. Sci., 19:176, 1905.

Distribution.—Eastern Kansas, west certainly to Geary and Cowley counties. See map, figure 73.

Remarks.—Measurements of a male from two and one-half miles southwest of Dexter, are: 952; 160; 195; 80; weight 24 pounds. W. C. Justice (*in litt.*) reported measurements on specimens mounted by him in recent years. The localities of capture and measurements are as follows: Cowley County: City Services Lake, four miles northwest of Cambridge, a male weighing 34 pounds taken in 1938; one and one-half mile east of Vinton, a male weighing 25 pounds taken on Oct. 23, 1949; two miles west of Silverdale, a male trapped on December 11, 1949; two and one-half miles SW of Silverdale, a male, measuring 1010, 138, 181, 67, weight 23½ lbs., trapped on March 10, 1950; and Chautauqua County: two and one-half miles northeast of Cedar Vale, a male weighing 31½ lbs., trapped on January 28, 1950.

The material necessary to show the extent of the zone of intergradation between the eastern and western subspecies is not now in existence, nor, with the increased land use and decreased bobcat populations, is it likely to be in the future.

Specimens examined.—Total, 9, distributed as follows: *Leavenworth County:* 6 mi. N Lawrence, 1. *Geary County:* Junction City, 1. *Douglas County:* 17 mi. SW Lawrence, 2. *Lyon County:* Reading, 1. *Greenwood County:* Unspecified, 1. *Woodson County:* Yates Center, 1. *Cowley County:* 2½ mi. SW Dexter, 1; 2½ mi. SW Silverdale, 1.

Additional records.—Cowley County: City Services Lake, 4 mi. NW Cambridge (see text); 4 mi. E Cambridge (see text); 1½ mi. E Vinton (see text); 2 mi. W Silverdale (see text). *Chautauqua County:* 2½ mi. NE Cedar Vale (see text).

TABLE 37.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF CARNIVORES, EXCEPT CANIS.

Sex	Number averaged or catalogue number	Basilar length (of Hensel)	Length of tooth-rows	Least interorbital constriction	Orbitonasal length	Mastoidal breadth	Zygomatic breadth	Length of tympanic bullae	Length of nal	P4 Lateral	P4 Medial
					Vulpes fulva fulva, Douglas County						
♂	6	....	75.0	25.3	68.7	45.0a	72.4b	20.6b	14.7b	13.2	14.2
	min.	....	72.9	24.9	65.3	43.6	71.1	20.2	14.1	12.3	12.7
	max.	....	79.7	26.4	71.5	46.3	75.7	22.4	15.5	13.6	14.9
♀	6968	....	77.9	24.7	73.5	46.2	77.2	23.6	15.5	14.1	15.0
♀	11533	....	72.9	27.0	69.6	45.8	70.0	21.1	14.5	12.9	13.8
♀	7030	....	74.4	26.0	69.9	....	....	20.7	14.9	13.7	14.7
					V. velox velox, First View, Colorado						
♂	1601	99.7	58.5	23.7	55.2	38.1	....	18.0	12.3	10.8	11.7
♂	1603	96.4	57.3	21.4	52.8	37.5	68.5	17.6	....	10.0	....
					Logan County, Kansas						
?	1604	....	58.3	24.2	54.5	....	....	....	11.7	10.4	11.5
					Urocyon cinereoargenteus ocythous, Lawrence, Douglas County						
♂	1615	116.6	63.7	26.1	60.8	46.5	69.9	21.0	12.9	10.6	11.7
♂	1616	104.5	58.4	23.3	57.6	43.7	68.5	18.6	12.4	11.1	10.9
♀	1617	109.8	60.7	24.8	58.9	46.7	68.8	19.8	12.7	10.4	11.2
?	1614	114.4	61.7	26.2	61.4	48.0	72.3	20.4	12.4	10.2	11.3
					Procyon lotor hirtus, Douglas County						
♂	8	105.2	55.7	23.9	42.1	53.8	71.4	18.5	8.9	8.3	7.2
	min.	101.2	51.5	22.3	40.5	51.3	68.5	17.6	8.2	7.8	6.6
	max.	111.8	57.5	26.3	43.6	55.2	76.0	19.9	9.5	8.9	8.0
♀	4	102.0	51.8	22.9	42.3	51.6	69.7	18.1	8.7	8.0	7.3
	min.	97.6	49.5	21.3	39.1	49.4	65.2	17.4	8.0	7.6	6.5
	max.	106.9	54.1	24.6	44.7	54.2	75.9	18.6	9.1	8.9	8.3
					Mustela vison letifera, Douglas County						
♂	1474	63.4	24.5	15.0	13.0	33.7	39.0	18.3	....	....	....
♂	1473	63.2	24.5	15.5	12.6	33.2	39.1	18.5	....	....	....
♂	6218	62.7	24.7	16.2	13.1	34.0	40.7	17.0	....	....	....
					Linn County						
♀	8213	57.7	22.2	13.5	11.8	28.6	33.5	16.2	....	....	....
♀	8212	58.0	21.8	14.0	11.7	29.5	33.8	17.0	....	....	....
♀	7530	55.0	21.0	13.7	11.1	28.8	34.0	15.9	....	....	....
					M. frenata longicauda, Thomas County						
♂	7185	46.3	17.5	10.7	9.6	25.0	....	15.5	....	....	....
♂	12124	45.6	17.6	10.4	9.5	24.5	28.1	14.6	....	....	....
♂	12125	....	17.5	11.1	10.0	....	28.6	15.0	....	....	....
♀	7937	42.5	15.9	10.1	7.9	22.4	24.8	14.4	....	....	....
					M. f. primulina, Douglas County						
♂	4350	45.4	16.8	10.0	9.3	23.9	25.8	15.0	....	....	....
♂	3636	45.0	16.8	9.2	8.9	22.8	25.1	14.6	....	....	....
♂	4104	47.3	17.3	10.9	9.2	24.2	28.2	15.3	....	....	....
♀	3638	41.1	14.9	9.3	8.4	20.3	23.8	13.8	....	....	....
♀	4348	39.6	14.5	9.2	8.5	21.4	23.2	13.5	....	....	....
♀	3084	40.7	14.4	8.2	7.9	20.2	22.8	14.8	....	....	....
					M. f. neomexicana, Seward County						
♀	1485	51.5	17.9	12.3	....	28.2	35.0	17.0	....	....	....
					M. nigripes, Lincoln County						
♂	10177	62.2	23.2	16.2	13.8	34.4	38.8	19.0	....	....	....
					Hamilton County						
♂	11077	66.8	25.2	18.5	15.3	36.0	43.0	18.9	....	....	....

TABLE 37.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF CARNIVORES, EXCEPT CANIS.—*Continued*

Sex	Number averaged or catalogue number	Basilar lenght (of Hensel)	Length of tooth-rows	Least interorbital constriction	Orbitonasal length	Mastoidal breadth	Zygomatic breadth	Length of tympanic bullae	Length of ml	P4 Lateral	P4 Medial
					Kingman County						
♂	1487	63.8	23.3	18.0	14.2	37.3	42.1	18.3	....	....	....
					Taxidea taxus taxus, Thomas County						
♂	8417	111.7	52.4	28.5	29.1	76.0	82.3	27.7	13.5	11.1	5.8
♂	9130	109.0	53.8	28.8	27.8	77.4	78.0	28.0	13.8	12.3	5.8
♂	8450	111.8	52.3	28.2	28.7	82.9	79.1	25.5	13.9	12.9	6.0
♀	8449	107.6	51.3	27.1	30.6	73.7	75.7	26.6	13.7	12.1	5.1
♀	8451	107.7	52.4	29.3	28.1	78.2	78.8	26.1	13.7	12.2	5.3
♀	8420	100.4	48.8	24.3	26.2	68.2	71.5	23.0	12.8	11.8	5.8
					Mephitis mephitis varians, Rawlins County						
♂	3473	69.0	31.1	23.5	20.1	39.9	48.3	....	....	....	....
					Morton County						
♀	10330	62.2	29.2	20.5	19.5	35.0	42.9	....	....	....	....
♀	10323	61.9	28.6	20.1	17.9	37.5	42.6	....	....	....	....
♀	10967	60.2	27.4	20.6	17.5	35.5	42.8	....	....	....	....
					M. m. avia, Douglas County						
♂	1327	70.8	30.0	25.5	19.3	40.7	49.2	....	....	....	....
♂	2633	68.4	29.9	23.6	19.9	39.4	48.5	....	....	....	....
♂	1328	65.6	29.4	20.4	18.2	37.5	46.1	....	....	....	....
♀	1312	60.8	28.1	20.0	17.6	36.0	43.6	....	....	....	....
♀	1322	61.5	27.1	19.7	17.6	35.4	42.0	....	....	....	....
♀	4818	62.3	27.5	20.5	18.6	36.5	44.3	....	....	....	....
					M. m. mesomelas, Pawnee County, Oklahoma						
♂	16550	61.3	27.9	....	18.4	36.0	43.5	....	....	....	....
					Greenwood County, Kansas						
♀	8622	59.6	26.9	20.7	17.0	36.8	43.3	....	....	....	....
					Dewey County, Oklahoma						
♀	10057	55.9	25.1	18.5	16.6	....	....	....	....	....	....
					Spilogale interrupta, Douglas County						
♂	1281	51.4	21.5	15.7	14.0	32.4	35.1	17.8	....	....	....
♂	1288	54.2	21.8	16.3	14.9	33.2	36.5	18.9	....	....	....
♂	4820	55.2	22.8	16.9	13.1	31.3	36.7	17.6	....	....	....
♀	2517	....	20.7	14.4	12.1	....	31.6	17.6	....	....	....
♀	1231	47.6	20.1	14.1	11.7	27.0	31.0	16.0	....	....	....
♀	1286	46.2	20.9	13.6	11.7	28.2	30.8	16.3	....	....	....
					Lutra canadensis interior, Woodward County, Oklahoma						
♀	2077	....	43.0	24.6	16.0	62.8	70.8	....	....	....	....
					Seward County, Nebraska						
♂	28728*	103.0	....	24.0	....	66.5	74.5	....	....	....	....
					Felis concolor azteca, Arizona						
♂	13267	164.5	67.4	42.7	41.3	87.7	155.6	33.9	19.1	24.2	....
					F. c. missoulensis, East Fork, Ravalli County, Montana						
♀	14554	143.3	61.3	35.9	37.1	75.8	123.2	30.6	15.9	20.8	....
					Lynx rufus baileyi, Scott County						
♂	2641	115.5	47.7	24.3	28.4	58.9	93.4	28.2	....	....	....
					Logan County						
?	5321	103.8	43.1	22.4	25.0	53.3	82.3	24.3	....	....	....

TABLE 37.—CRANIAL MEASUREMENTS (IN MILLIMETERS) OF CARNIVORES, EXCEPT CANIS.—*Concluded*

Sex	Number averaged or catalogue number	Basilar length (of Hensel)	Length of tooth-rows	Least interorbital constriction	Orbitonasal length	Mastoidal breadth	Zygomatic breadth	Length of tympanic bullae	Length of ml	P4 Lateral	P4 Medial
					Lynx rufus baileyi, Comanche County						
?	2240	112.7	43.0	23.3	25.8	56.5	90.4	27.3	....	....	....
					L. r. rufus, Douglas County						
♂	12096	110.6	45.5	22.0	27.4	....	87.1	27.5	....	....	....
♀	12095	103.1	40.9	22.8	25.2	52.7	85.7	25.6	....	....	....
					Greenwood County						
?	8410	98.4	41.5	21.7	22.6	52.7	82.6	25.3	....	....	....

a. 4 averaged.
b. 5 averaged.
* Catalogue number of Univ. of California Museum of Vertebrate Zoology; measurements given by Swenk (1918:4).

Order ARTIODACTYLA

Artiodactyls

The artiodactyls have the first or inner digit suppressed, so that there are at most only four functional toes; most genera have all but two (the third and fourth) toes suppressed. The terminal phalanges of the limbs form a hoof. Members of this order are usually of large size and are herbivorous. Three families of this order occur, or occurred, in Kansas within historic times.

The artiodactyls, including the wapiti, deer, antelope, and bison, were once extremely abundant on the plains of Kansas and were important animals in the early history of the state. They furnished the main source of meat for the diet of the early explorers and settlers. Today, however, most of the artiodactyls are extinct in the state.

The following key will aid in the separation of these families.

1. Males with antlers; females without antlers or horns; lateral digits present ..... CERVIDAE, p. 269
1'. Males and females with horns (permanent bone-core covered with horny sheath); lateral digits vestigial 2
2.(1') Underside of neck crossed by two white bars; horns with single fork in males, rarely 8 inches long in males and 2 inches in females; two hooves on each foot, rarely one additional vestigial hoof, ANTILOCAPRIDAE, p. 274

2′. Underside of neck without white bars; horns not forked; four hooves (including two vestigial hooves) on each foot, BOVIDAE, p. 276

Family Cervidae

Members of this family occur in North and South America, Europe, and Asia. Characteristics of this family include: bony antlers present in the males, rarely in the females; upper incisors absent; upper canine usually absent; and the lower canine incisor-like.

Two genera, including three species, of this family occur or formerly occurred in Kansas. The following key will aid in the separation of these species.

1. Tail straw-colored; row of upper cheek teeth more than 110; knoblike canine tooth at union of maxillary and premaxillary bones ..... *Cervus canadensis*, p. 269
1′. Tail brown or white with black tip; row of upper cheek teeth less than 110; no canine tooth present 2
2.(1′) Tail brown above, white below; ears approximately ½ length of head; antler with one main beam and smaller tines branching from it ..... *Odocoileus virginianus*, p. 273
2′. Tail white, tipped with a black tuft; ears approximately ⅔ length of head; antler branching dichotomously (into two equal parts), *Odocoileus hemionus*, p. 271

Genus Cervus Linnaeus

Wapiti (American Elk)

This genus occurs in North America, Europe, and Asia. Generic characteristics include: upper canines small or absent in females, much larger in males; frontals without ridges; antlers arising at right angles to median line of skull, supported by short pedicles; antlers not forked at first division and generally of large size. The dental formula is: i. $\frac{0}{3}$, c. $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$. One species of this genus formerly occurred in Kansas.

Cervus canadensis

Wapiti

This species formerly occurred in a belt running east-west across North America, as far north as central Canada and as far south as northern Oklahoma. In Kansas its distribution was probably formerly state wide; it is now extinct in the state. Hoffmeister (1947: 75-76) reported some early observations on the wapiti in Kansas. He pointed out (p. 75) that: "In the collections of the Museum of

Natural History of the University of Kansas, there is no specimen, nor part of a specimen, other than remains of fossil elk, which occurred naturally in Kansas."

J. R. Mead wrote three letters to L. L. Dyche at the University of Kansas Museum of Natural History in 1892 in which he reported several observations on the elk in Kansas. Hoffmeister (1947:75-76) reported these observations, a summary of which follows:

In 1859 to 1864 the eastern limits of the range of the wapiti in Kansas was a line drawn north and south through El Dorado, Butler County. As to the abundance of the wapiti in Kansas in the 1850's and 1860's, Mead wrote: "I have seen 1000 more or less in one drove, and they crossed the Saline [River] at the fork right where the town of Lincoln now stands. . . . I have killed Elk on the Solomon, Saline, Smoky Hill, and Arkansas rivers and their tributaries."

Phillips (1890:351), in describing western Kansas as it appeared approximately one hundred years ago, wrote: ". . . and then came the buffalo and the buffalo grass, and the beautiful herds of antelope, and the majestic herds of elk. I have, as late as 1866, seen several thousand of these latter magnificent creatures in a herd; and small bands of black-tailed deer along the bluffs and cedars of the upper Smoky, Saline and Solomon [rivers]. . . ."

J. A. Allen (1874:48) reported that in 1871, near the vicinity of Fort Hays, the wapiti was: ". . . more or less common near the streams, especially on Paradise Creek, and occurs as far east at least as Fort Harker [Ellsworth County]."

Knox (1875:20) reported that the wapiti was ". . . quite common in the west of the State."

Probably the wapiti became extinct in Kansas soon after this for Lantz (1905A:172) disposed of the wapiti in his listing of the mammals in Kansas with the following terse comments: "Formerly common throughout the state. Now extinct."

Cervus canadensis canadensis Erxleben

[*Cervus elaphus*] *canadensis* Erxleben, Syst. Regni Anim., 1:305, 1777, type from eastern Canada.

Cervus canadensis canadensis, Miller, Bull. U. S. Nat. Mus., 128:483, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:247, 1933; Hibbard, Trans. Kansas Acad. Sci., 47:86, 1944; Brumwell, Amer. Midland Nat., 45:214, 1951.

Cervus Canadensis, J. A. Allen, Bull. Essex Inst., 6:48, 1874; Knox, Trans. Kansas Acad. Sci., 4:20, 1875.

Cervus canadensis, Lantz, Kansas State College Exp. Sta. Bull., 129:333, 1905; Lantz, Trans. Kansas Acad. Sci., 19:172, 1905.

Cerves [*sic*] *canadensis canadensis*, Tihen and Sprague, Trans. Kansas Acad. Sci., 42:509, 1939.

Distribution.—Formerly state wide; now extinct.

Remarks.—No specimen taken in Kansas of this species have been preserved. Bailey (1926:33) stated that adult bulls have been estimated to weight from 700 to 1,000 pounds and adult cows from 500 to 600 pounds.

Specimens examined.—None.

Genus **Odocoileus** Rafinesque

American Deer

This genus occurs in North and South America. Generic characteristics include: upper canines absent; antlers large with lower prong larger than upper one; auditory bullae slightly inflated, and tail long and thickly haired beneath. The dental formula is: i. $\frac{0}{3}$, c. $\frac{0}{1}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$. Two species of this genus occur, or formerly occurred, in the state. These are the white-tailed deer and the black-tailed or mule deer.

Odocoileus hemionus

Black-tailed or Mule Deer

Black-tailed deer occurred throughout much of western North America, from west-central Canada southward and eastward through the mountains and western Great Plains into Mexico.

The black-tailed deer formerly occurred over much of western Kansas, at least during the winter months. Mead (1899:281), in reporting some natural history notes for 1859, wrote that: "Black-tailed deer were numerous in winter in the hills between the Saline and Solomon [rivers], going in bunches of three or four to twenty or thirty. I suppose they came down from the foothills of Colorado to winter, as I did not see them in summer." Phillips (1890:351) reported: "I have, as late as 1866, seen . . . small bands of black-tailed deer among the bluffs and cedars of the upper Smoky, Saline and Solomon [rivers]." J. A. Allen (1874:48) reported that in 1871, in central and western Kansas, the black-tailed deer was: ". . . more or less common along the wooded portions of the streams, especially on the Smoky and the Paradise."

Baker (1889:57) reported that near Wakeeney, Trego County, the black-tailed deer was: ". . . quite common till within the past few years; now found only occasionally and in the roughest country."

Kellogg (1915: unpublished thesis) reported that: "H. T. Martin informs me that he saw two [black-tailed deer] on Beaver Creek in Logan County in 1884. So far as is known the last mule

deer in Logan County was killed in 1885 on a ranch near Chalk Creek by Jay Swink and Jink Davis." Lantz (1905A:172) reported that the black-tailed deer ". . . was still found in western Kansas in 1884, but has now probably entirely disappeared." Hibbard (1933:247 and 1944:86) reported this deer as extinct in the state.

Tihen and Sprague (1939:509), in recording the mammals of the Meade County State Park, reported that: "A number of mule deer have been introduced into the park area where they have become very tame, and have shown an increase in number each year. During the summer of 1937, while camped at the park, a young buck deer with two points was chased up the Cimarron river on the plains north of Plains, Kan. The deer was winded and stiff when found and driven into a barn, since it was thought to have been an escape from the park. Due to injuries received, it was dead by the time we reached it. The deer did not belong in the park, but was one of the few wild deer still found along the Cimarron breaks. The specimen is now in the University Museum."

Last summer (1950) I learned that twenty black-tailed deer had been moved from the state park in Meade County and released in Morton County on land controlled by the United States Department of Agriculture, Soil Conservation Service. The original habitat of these animals is unknown to me.

Odocoileus hemionus hemionus (Rafinesque)

Cervus hemionus Rafinesque, Amer. Monthly Magazine, 1:436, 1817, type from Sioux River, South Dakota.

Odocoileus hemionus hemionus, Miller, Bull. U. S. Nat. Mus., 128:485, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:247, 1933; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:509, 1939; Hibbard, Trans. Kansas Acad. Sci., 47:86, 1944.

Odocoileus hemionus, Lantz, Trans. Kansas Acad. Sci., 19:172, 1905.

O[*docoileus*] *hemionus*, Lantz, Kansas State College Exp. Sta. Bull., 129:333, 1905.

Cervus macrotis, J. A. Allen, Bull. Essex Inst., 6:48, 1874; Baker, Trans. Kansas Acad. Sci., 11:57, 1889.

C[*ervus*] *macrotis*, Knox, Trans. Kansas Acad. Sci., 4:20, 1875.

Distribution.—Formerly in the western two-thirds of the state; at present extinct in the state. Reintroduced stocks of the black-tailed deer are found in some of the southwestern counties.

Remarks.—No external measurements of specimens taken in Kansas are available.

Specimens examined.—Total, 1, from the following locality: *Meade County:* 7 mi. NW Plains, 1.

Odocoileus virginianus

White-tailed Deer

The white-tailed deer occurred from southern Canada southward, through all but the southwestern part of the United States, through Mexico, into central America. Probably but one subspecies of white-tailed deer occurred in Kansas.

Mead (1899:281), reported that, in 1859: ". . . white-tailed deer were numerous in the hills about the forks of the Solomon [River] and the hilly country of Barber and Comanche counties, and occasionally found elsewhere." Knox (1875:20) reported that the white-tailed deer was: ". . . frequent in large bodies of timber in different parts of the state."

Kellogg (1915:unpublished thesis) reported that: "In 1867 two men by the name of Wilcox and Livsa killed over one hundred white-tailed deer near the mouth of Lightning Creek on the Neosho River [Cherokee County]. Ross McDonald killed a doe at Chetopa, Labette County, in 1881. . . . Dave Dunham killed a buck on Lightning Creek near Columbus [Cherokee County] in 1896. The latter record seems to be the last for that part of Kansas."

By 1905, however, the numbers of white-tailed deer were so reduced that Lantz (1905A:172) reported: "It is now probably extinct in the state." Hibbard (1933:247 and 1944:86) considered the white-tailed deer to be extinct in the state.

Tihen and Sprague (1939:509) reported that the white-tailed deer had been introduced into the Meade County State Park. W. C. Justice (*in litt.*) informs me that two bucks and one doe of white-tailed deer were introduced from Texas into Cowley County. In 1948, he reported that these deer were plentiful, at least locally, within a radius of 50 miles of Arkansas City.

In eastern Kansas, since 1945, several white-tailed deer have been observed. Every year a number of newspaper accounts concerning such observations are published. Apparently the white-tailed deer is again becoming established in the eastern part of the state. I am uncertain as to the original source of these deer. Perhaps many are descendents of animals released in various parts of eastern Kansas. Perhaps others are animals that have wandered into the state from Missouri. Although I realize that the white-tailed deer in Kansas today is probably of mixed parentage, that is, crosses between two or more subspecies, I recognize only one subspecies as being native to the state.

Odocoileus virginianus macrourus (Rafinesque)

Cervus (misspelled *Corvus*) *macrourus* Rafinesque, American Monthly Magazine, 1:436, 1817, type from plains of Kansas River, upper Mississippi Valley.

[*Odocoileus virginianus*] *macrurus,* Trouessart, Catal. Mamm. suppl., p. 704, 1905.

Odocoileus virginianus macrourus, Miller, Bull. U. S. Nat. Mus., 128: 489, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:247, 1933; Tihen and Sprague, Trans. Kansas Acad. Sci. 42:509, 1939; Hibbard, Trans. Kansas Acad. Sci., 47:86, 1944; Brumwell, Amer. Midland Nat., 45:214, 1951.

Odocoileus americanus macrourus, Lantz, Trans. Kansas Acad. Sci., 19:172, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:333, 1905.

C[*ervus*] *Virginianus,* Knox, Trans. Kansas Acad. Sci., 4:20, 1875.

Distribution.—Formerly state wide; probably exterminated in the state and reintroduced within recent years. Perhaps the introduced animals are of a different subspecies.

Remarks.—No external measurements of specimens taken in Kansas are available. In general the white-tailed deer varies in total length from 1500 to 1700 mm.; the tail comprises approximately 250 mm. of this total.

Specimens examined.—Total, 5, distributed as follows: *Leavenworth County:* Tonganoxie State Park (introduced), 3. *Douglas County:* Bismark Grove (introduced), 2.

Family Antilocapridae

Members of this family are restricted in their geographical distribution to western North America. There is but one living genus recognized in this family.

Genus **Antilocapra** Ord

Prong-horned Antelope

This genus includes but one living species. Characteristics include: upper canines absent; lachrymal not articulating with nasal, being separated by large lachrymal vacuity; horns deciduous and branched; and horn core a long, flattened bony process attached to frontal bone. The dental formula is: i. $\frac{0}{3}$, c. $\frac{0}{1}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$.

Antilocapra americana

Prong-horned Antelope

The antelope formerly occurred in western North America, from the northern edge of the Great Plains in Canada southward, through most of the western United States, into Mexico.

The antelope formerly occurred over most of Kansas. Lantz (1910: 11) stated: "Pike found it common in eastern Kansas in 1806."

Mead (1899:281) reported in 1859, in central and western Kansas, "Antelope were abundant everywhere, in summer, migrating south in winter to the Staked Plains." J. A. Allen (1874:48) reported that in Kansas in 1871, the antelope was: "Common in summer as far east as the middle of the state, and formerly ranged much further eastward. Not observed in winter much to the eastward of the Colorado boundary, at this season they mostly [abandoned] . . . this portion of the state for the milder portions of the country to the southward and westward. We observed them in June about Fort Hays in small parties of six to a dozen. They were, however, exceedingly wary and difficult to approach. Fawns a few days old were frequently brought into the Post during the first two weeks of June. . . . Although tolerably frequent in northwestern Kansas in summer, they are far less numerous here than in eastern Colorado, or on the plains of Wyoming." Knox (1875:20) reported that antelope were present ". . . in great numbers on the western [Kansas] plains, in herds of ten or twenty." Baker (1889:57) reported that near Wakeeney, Trego County, antelope were ". . . still comparatively common; and, until quite recently, very numerous." The numbers of antelope in the state fell rapidly after 1890. Lantz (1905A:173) reported that antelope were ". . . fast disappearing. A recent law protects these animals, but the law is ignored by many of the settlers in western Kansas. A few small herds have been reported to me within the last year as occurring in the extreme western counties of the state."

Kellogg (1915: unpublished thesis) recorded: "C. D. Bunker saw three [antelope] in Stanton County in 1912." Hibbard (1933: 247) stated: "The antelope has been the last of the large game animals of Kansas to disappear. It has been seen in Kansas until the last few years."

Antilocapra americana americana (Ord)

Antilope americana Ord, Guthrie's Geography, 2nd American ed., 2:292, 1815, type from "plains and highlands of the Missouri."

Antilocapra americana americana, Miller, Bull. U. S. Nat. Mus., 128: 493, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:247, 1933; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:509, 1939; Hibbard, Trans. Kansas Acad. Sci., 47:86, 1944.

Antilocapra americana, Baker, Trans. Kansas Acad. Sci., 11:57, 1889; Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Lantz, Kansas State College Exp. Sta., Bull., 129:333, 1905; Lantz, U. S. Dept. Agric., Biol. Surv. Bull., 36:11, 1910.

Antilocapra Americana, J. A. Allen, Bull. Essex Inst., 6:48, 1874; Knox, Trans. Kansas Acad. Sci., 4:20, 1875.

Distribution.—Formerly most of the state; now extinct.

Remarks.—No reliable external measurements of specimens taken in Kansas are available to me.

Specimens examined.—Total, 13, distributed as follows: *Logan County:* Unspecified, 4. *Reno County:* Nickerson, 3. *Meade County:* Meade County State Park (captives), 3. *Western Kansas:* Unspecified, 3.

Family Bovidae

Members of this family occur in North America, Europe, Asia, and Africa.

Genus **Bison** H. Smith

Recent members of this genus occur in North America and Europe. Characteristics include: upper canines absent; horns unbranched, cylindrical, short, thick at base and tapering rapidly to a point; horns bent outward and upward for half their length; nasals short, separated by a wide space from the premaxillae. The dental formula is: i. $\frac{0}{3}$, c. $\frac{0}{1}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$.

Bison bison

Bison

The bison, or "American Buffalo", formerly occurred from Alaska south through Yukon Territory, Alberta, Saskatchewan, and Manitoba, Canada, into the United States. In the United States the buffalo occurred from Idaho, Utah, and New Mexico east to Pennsylvania, western Virginia, North Carolina, South Carolina and northwestern Georgia. (See Skinner and Kaison, 1947.)

The male bison reached a length of approximately 11 feet and a weight of 1800 pounds. The female was smaller, rarely being over seven feet in total length and rarely weighing more than 1000 pounds.

The bison formerly occurred throughout Kansas. Judging from the reports of early travellers, only the bulls grazed over eastern Kansas. Pike (1810:183-184) reported: "For some distance from the Osage Villages, you find deer, then elk, then cabrie [pronghorned antelope], and finally, buffaloe. But it is worthy to remark, that although the male buffaloes were in great abundance, yet in all our route from the Osage to the Pawnees, we never saw one female." For western Kansas Pike (*loc. cit.*:200-201) reported: "In the afternoon [we] discovered the north side of the [Arkansas] river to be covered with animals, which, when we came to them, proved to be cows and calves. . . . I do not think it an exaggeration to say there were three thousand in one view. It is worthy of remark, that in all the extent of country yet crossed, we never

saw one cow, and that now the face of the earth appeared to be covered with them."

J. A. Allen (1874:46) reported that in 1871: "The great buffalo country of the United States is now mainly restricted to Western Kansas and Eastern Colorado, between the Arkansas and Platte Rivers,—a region extending about two hundred miles in a north and south direction and merely three hundred miles in an easterly and westerly direction, over much of which territory they still range in countless hordes. They are, however, partially migratory, moving eastward in summer and westward in winter. In the northern part of the state their summer range, in 1871, extended eastward from the western boundary of the state to the vicinity of Fort Harker [Ellsworth County]. In winter their eastern limit scarcely extended east of Ellis. . . ." Allen (*loc. cit.*:47) further recorded that: "Respecting the whole number now annually killed in Kansas, it is almost impossible to obtain reliable statistics. Through the kindness of Mr. W. T. Bowen, General Superintendent of the Kansas Pacific Railway, I have learned that the meat and hides shipped to eastern cities over this road during the year 1871 represented about twenty thousand individuals. In the fall of 1872 forty-three thousand hides are reported to have been shipped from Fort Dodge alone, besides about a million and a half pounds of meat. The grand total killed in the season of 1872-3, in the immediate vicinity of Fort Dodge, is stated to be not less than one hundred thousand!"

Knox (1875:20) reported that vast numbers of bison still roamed over much of western Kansas but: "They are being slaughtered by the ten thousand annually, for their hides, meat, bones, and sport of killing them. Should not legislation put a stop to this wholesale destruction?"

By 1885, however, the numbers of bison were so reduced in Kansas that Cragin (1885:44) wrote: "Small herds of Buffalo, scattered remnants of their rapidly vanishing race, have this winter been chased with the usual wholesale "success" in several of our western counties. They are probably the last, or about the last, that will be seen in Kansas. At best, it can be but a year or two till the Buffalo, once a highly characteristic feature of our prairie fauna, shall have passed, in its swift flight to extinction, beyond the limits of the State."

Baker (1889:56-58) reported the mammals found near Wakeeney, Trego County, listing: ". . . only such species . . . as have been taken by the writer within the past five years." Baker did not

mention the bison, although he did report black-tailed deer and antelope.

Bison bison bison (Linnaeus)

[*Bos*] *bison* Linnaeus, Syst. Nat., ed., 10, 1:72, 1758.

Bison bison bison, Dice, Jour. Mamm., 4:112, 1923; Miller, Bull. U. S. Nat. Mus., 128:494, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:247, 1933; Tihen and Sprague, Trans. Kansas Acad. Sci., 42:509, 1939; Hibbard, Trans. Kansas Acad. Sci., 47:87, 1944.

Bison bison, Lantz, Trans. Kansas Acad. Sci., 19:173, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:333, 1905.

Bos Americanus, J. A. Allen, Bull. Essex Inst., 6:46, 1874; Knox, Trans. Kansas Acad. Sci., 4:20, 1875; Cragin, Bull. Washburn College Lab. Nat. Hist., 1:44, 1885.

Distribution.—Formerly state wide, now extinct.

Remarks.—No external measurements of specimens taken in Kansas are available to me. In general, however, adult male bison reach a total length of nine to 11 feet (approximately 2 ft. of this being the tail) and weigh approximately 2000 pounds. Adult females are somewhat smaller; they weigh 700 to 1000 pounds.

Specimens examined.—None.

HYPOTHETICAL LIST

The mammals listed below include those wrongly listed as occurring in Kansas and those concerning the occurrence of which there is some doubt.

Myotis grisescens Howell

Gray Bat

Myotis grisescens Howell, Proc. Biol. Soc. Washington, 22:46, 1909, type from Nickajack Cave, near Shellmound, Marion County, Tennessee; Hibbard, Trans. Kansas Acad. Sci., 36:248, 1933.

Remarks.—This bat probably occurs in southeastern Kansas. It has been recorded from Salt Peter Cave, McDonald County, Missouri (KU no. 2061) and from Scraper, Cherokee County, Oklahoma (Blair, 1939:100). Hibbard (1933:248) thought that this bat should occasionally occur in southeastern Kansas.

Myotis sodalis Miller and Allen

Social Bat

Myotis sodalis Miller and Allen, Bull. U. S. Nat. Mus., 144:130, 1928, type from Wyandotte Cave, Indiana.

Remarks.—This bat may occur in eastern Kansas. It has been recorded from Rocheport Cave, Boone County, Missouri (Guthrie, 1933:16) and Bat Cave, NW of War Eagle, Benton County, Arkansas (Black, 1936:30).

Myotis keenii septentrionalis (Trouessart)

Long-eared Brown Bat

Vespertilio gryphus var. *septentrionalis* Trouessart, Catal. Mamm. viv. foss., p. 131, 1897, type from Halifax, Nova Scotia.

Myotis keenii septentrionalis, Miller and Allen, Bull. U. S. Nat. Mus., 144:105, 1928; Hibbard, Trans. Kansas Acad. Sci., 36:248, 1933; Brumwell, Amer. Midland Nat., 45:209, 1951.

Remarks.—This bat should occur throughout eastern Kansas. It has been recorded from one-half mile west of Meadow, Sarpy Co., Nebraska (KU no. 35077), from Rocheport Cave, Boone County, Missouri (Guthrie, 1933:17), and Crystal Cave, 5 mi. N Bentonville, Benton County, Arkansas (Dellinger and Black, 1940: 188). Hibbard (1933:248) thought that this bat should occur in northeastern Kansas.

Citellus variegatus grammurus (Say)

Rock Squirrel

S[*ciurus*] *grammurus* Say, Long's Exped. Rocky Mountains, 2:72, 1823, type from Purgatory [= Purgatoire] River, near mouth of Chacuaco Creek, Las Animas County, Colo.

Citellus variegatus grammurus, Howell, N. Amer. Fauna, 56:142, 1938.

Remarks.—This rock squirrel should occur in the southwestern part of the state. It has been recorded from 18 mi. S LaJunta, Otero County, Colorado (Howell, 1938:145) and Beaver County, Oklahoma (Blair, 1939:110).

Cratogeomys castanops castanops (Baird)

Pocket Gopher

Pseudostoma castanops Baird, Report Stansbury's Exped. to Great Salt Lake, p. 313, 1852, type from "Prairie road to Bent's Fort", near present town of Las Animas, Bent County, Colorado, on the Arkansas River.

Cratogeomys castanops castanops, Miller, Bull. U. S. Nat. Mus., 128: 259, 1924.

Cratogeomys castanops, Lantz, Trans. Kansas Acad. Sci., 19:175, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Rinker, Jour. Mamm., 22:88, 1941; Hibbard, Trans. Kansas Acad. Sci., 47:75, 1944.

Remarks.—This animal has been reported from Monon, Baca County, Colorado (Cary 1911:130), a ghost town formerly on Bear Creek, only two miles west of the Kansas state line. Rinker (1941:88) reported finding the fragmentary skull and lower jaws of this gopher in Meade County. Hibbard (1944:75) reported that Rinker collected a second recent skull of this gopher, in the summer of 1942, in Meade County. The second skull was found on a fresh mound of earth thown up by *Geomys*. Both Rinker and Hib-

bard reported that extensive trapping in southwestern Kansas had failed to take any gophers of the genus *Cratogeomys*.

In the summer of 1950 I trapped several days in Stanton County, just two miles east of the locality in Baca County where Cary (1911:130) reported taking *Cratogeomys*. I took several *Geomys* but no *Cratogeomys*.

Peromyscus nuttallii aureolus (Audubon and Bachman)

Golden Mouse

Mus (*Calomys*) *aureolus* Audubon and Bachman, Proc. Acad. Nat. Sci. Philadelphia, 1:98, 1841, type from "In the oak forests of South Carolina."

Peromyscus nuttallii aureolus, Osgood, N. Amer. Fauna, 28:225, 1909; Black, Kansas State Board Agric., 30th Biennial Rept., p. 196, 1937.

Peromyscus nuttalli [*sic*] *aureolus*, Hibbard, Trans. Kansas Acad. Sci., 36:249, 1933.

Hesperomys Nuttalli, Knox, Trans. Kansas Acad. Sci., 5:65, 1877.

Remarks.—Knox (1877:65) reported that a specimen of this mouse was: "In Col. Goss' Museum, Neosho Falls. Taken at Colony, March 7, 1873, by J. J. Fairbanks." Although many of the specimens collected by Goss were later deposited in other institutions, I can find no trace of this specimen today (1951).

Based on this record, Hibbard (1933:249) tentatively listed *P. n. aureolus* as a member of the Kansas fauna. Black (1937:196), without additional specimens, argued that it occurred in the state. He stated (*loc. cit.*) "Recent sight records from Colony could hardly refer to any other mouse [than *P. n. aureolus*], and it is therefore thought best to return this species to full rank [that is, as a member of the Kansas fauna]."

The golden mouse builds a characteristic nest in briers, vines, and brush, well above the ground. In December, 1950, H. B. Tordoff and I spent a day in the Neosho River valley between Colony and Neosho Falls, Kansas, looking for some sign of this mouse. We failed to find any. The locality nearest to Kansas at which the golden mouse has been taken is one and one-half miles west of Fayetteville, Washington County, Arkansas (Dellinger and Black, 1940:190), approximately 160 airline miles south and east of Colony, Anderson County, Kansas.

Oryzomys palustris texensis Allen

Rice Rat

Oryzomys palustris texensis J. A. Allen, Bull. Amer. Mus. Nat. Hist., 6:177, 1894, type from Rockport, Aransas County, Texas; Hibbard, Trans, Kansas Acad. Sci., 36:243, 1933; Black, Kansas State Board Agric., 30th Biennial Rept., p. 196, 1937; P. B. Allen, Kansas State

Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):43, 1940; Hibbard, Trans. Kansas Acad. Sci., 47:79, 1944.

H[esperomys] palustris, Knox, Trans. Kanasas Acad. Sci., 4:21, 1875.

Hesperomys (Oryzomys) palustris, Coues, Monogr. N. Amer. Rodentia, p. 117, 1877.

Oryzomys palustris, Lantz, Trans. Kansas Acad. Sci., 19:174, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:335, 1905; Lantz, Trans. Kansas Acad. Sci., 20(2):216, 1907.

Remarks.—The only record to date of this animal in Kansas is the specimen taken by Capt. B. F. Goss at Neosho Falls, Woodson County, and deposited in the United States National Museum. According to the original catalogue entry this specimen was captured in January, 1859, and catalogued in the United States National Museum collection on January 24, 1859. Because the specimen was already mounted when catalogued, it seems improbable to me that the animal could have been collected in January, mounted, and transported to Washington, D. C. (under the transportation difficulties of that time), in time to have been catalogued on January 24th.

Further, no specimens have been taken in surrounding states nearer than Rocky, Polk County, Arkansas, a distance of approximately 260 airline miles from Neosho Falls, although efforts have been made to trap this species in intervening localities. However, as Lantz (1907A:216) so aptly stated: "Whether these animals once occurred in Kansas or whether there was an error as to the locality from which the Goss specimens came will probably never be known." I am inclined to believe that the latter situation is the case.

Myocastor coypus (Molina)

Nutria

Mus coypus Molina, Sagg. Stor. Nat. Chili, pp. 287-288, 342, 1782, type from rivers of Chili.

Myocastor coypus, Hoffmeister and Kennedy, Trans. Kansas Acad. Sci., 49:445, 1947.

Remarks.—The nutria is a South American rodent with fur much like that of the muskrat. It has been introduced into the United States and attempts to raise it on fur farms have been made in most areas. Often the nutria escapes and becomes established as a member of the mammalian fauna. Such feral populations of nutria, as pointed out by Hoffmeister and Kennedy (1947:445), have been reported in Montana, Washington, Oregon, Louisiana, and New Mexico in the United States as well as in Engand and France.

Hoffmeister and Kennedy (*loc cit.*) reported that a feral nutria was captured in central Kansas in the fall of 1945. It was taken

along Peace Creek, twenty-four miles west and two miles north of Hutchinson, Reno County. This animal is now in the collection of the University of Kansas Museum of Natural History.

Perhaps the nutria is not as yet established in the wild in Kansas. If it ever does become established, the nutria will probably be an unwelcome introduction. It will compete with the muskrat and might succeed in replacing the muskrat in many ecological niches. The nutria, where established, often becomes a pest around gardens and vegetable farms. As pointed out by Hoffmeister and Kennedy (1947:446): "Since the fur of the nutria is currently less valuable than that of the muskrat and since the feral nutria might become an agricultural pest, it seems wise, if possible, to prevent the establishment of the nutria in Kansas."

Vulpes macroura Baird

Mountain Red Fox

Vulpes macrourus Baird, Report Stansbury's Exped. to Great Salt Lake, p. 309, 1852, type from Wasatch Mountains bordering Great Salt Lake, Utah.

V[*ulpes*] *macrourus*, Lantz,, Kansas State College Exp. Sta. Bull., 129: 336, 1905.

Vulpes macroura, Miller, Bull. U. S. Nat. Mus., 128:144, 1924; Hibbard, Trans. Kansas Acad. Sci., 36:248, 1933.

Vulpes fulva macroura, Lantz, Trans. Kansas Acad. Sci., 20(2):216, 1907.

Remarks.—Mead (1899:280) reported: "There were red foxes living on the plains with the wolves, called 'Swifts' from their remarkable speed." Hibbard (1933:248) quoted this as evidence that the mountain red fox formerly occurred in Kansas. However, Mead (1899:280) added: "They lived in pairs; not more than two found together. No other foxes were found on the plains. They were unlike the timber foxes." From this, I conclude that Mead was referring to *Vulpes velox*, the swift fox. This fox is known to have occurred in the area referred to by Mead.

Lantz (1905:336 and 1907:216) stated that N. S. Goss reported two specimens of the mountain red fox in Cowley County. This report, which I have not seen, was published in Field and Stream (vol. 27, p. 465, January 6, 1887) and was quoted by Lantz (1907: 212) as follows: "A little over a year ago Mr. Fred Whitney killed a Prairie Fox (*Vulpes macrorus* Baird) in Cowley County. He had the animal mounted, and it is now at his home in Meade County. It is the light color variety spoken of by Professor Baird in his work on mammals (P. R. R. Rept., vol. 8, p. 130), and the first, to my

knowledge, captured in the state. Mr. Whitney says that another one has since been killed in the same vicinity."

Hibbard (1933:248) was also aware of Lantz's report. Since the mounted specimen referred to by Goss has been lost, and, to my knowledge, no other records exist for the state, I am placing this species in the list of hypothetical members of the Kansas mammalian fauna.

Bassariscus astutus flavus Rhoads

Ring-tailed Cat

Bassariscus astutus flavus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1893, p. 417, 1894, type from Texas.

Bassaris astuta, J. A. Allen, Bull. Essex Inst., 6:45, 1874; Knox, Trans. Kansas Acad. Sci., 4:19, 1875.

Bassariscus astutus, Lantz, Trans. Kansas Acad. Sci., 19:177, 1905; Lantz, Kansas State College Exp. Sta. Bull., 129:337, 1905; Lantz, Trans. Kansas Acad. Sci., 20(2):216, 1907.

Remarks.—J. A. Allen (1874:45) first reported the ring-tailed cat in Kansas. He stated: "Although I did not meet with it, an animal was described to me by different persons that so accurately agrees with the Texas civet cat [= ring-tailed cat] that I have no doubt of its being this species. It is apparently rather rare, however, as none of my informants had seen more than two or three individuals in the region under consideration. The northern boundary of Kansas probably forms its ordinary northern limits of distribution on the plains."

Based on Allen's report, Knox (1875) and Lantz (1905A, 1905B) listed the ring-tailed cat as a member of the Kansas mammalian fauna. Lantz (1907A:216) questioned whether of this species was a member of the fauna of Kansas and reported that Allen had based his observation on second-hand information.

Later lists of mammals of Kansas have not included the ring-tailed cat. However, data released by the United States Fish and Wildlife Service (Anon., 1939:8; 1940:8; 1946:8; Ashbrook, 1950:9) lists a total of 86 pelts of ring-tailed cats sold for their fur in the state in 1938. None was reported as sold in the state in 1934 nor in the period 1940-1949. Perhaps the 86 reported in 1938 were actually trapped elsewhere and shipped to Kansas before they were sold. W. C. Justice (*in litt.*) has reported to me that within the past eleven years, six "Texas ring-tailed cats" have been taken in Cowley County. Justice believes that they occur naturally in that area. Perhaps one or more may, in time, find their way into a museum collection as a permanent record of the occurrence of this species in the state.

Martes caurina origenes (Rhoads)

Marten

Mustela caurina origenes Rhoads, Proc. Acad. Nat. Sci. Philadelphia, p. 458, 1902, type from Marvine Mountains, Garfield County, Colorado.

Martes caurina origenes, Miller, N. Amer. Land Mamm., 1911, p. 93, 1912; Hibbard, Trans. Kansas Acad. Sci., 36:248, 1933.

Remarks.—Hibbard (1933:248) included the marten in a hypothetical list and stated: "There is a chance that we may find a skull of the marten in western Kansas . . . there are no specimens on record which have been taken in Kansas." Hibbard listed the marten as a former member of the fauna of Kansas because Mead (1899:28) wrote: "Martens were rare." I think that the marten has not occurred in Kansas within historic times.

The nearest locality from which martens have been recorded in historic times, to the best of my knowledge, is the headwaters of the Cimarron River in Gunnison County, Colorado (Cary, 1911: 190), a locality that is some 260 miles west of Kansas. Further, in Colorado, the marten is an inhabitant of the high mountains and lives in ecological conditions quite unlike any that occur in Kansas.

Conepatus mesoleucus figginsi W. Miller

Hog-nosed Skunk

1925. *Conepatus mesoleucus figginsi* W. Miller, Jour. Mamm., 6:50, January 9, type from Furnace Canyon, western Baca County, Colorado.

Remarks.—The hog-nosed skunk, *Conepatus mesoleucus,* has not yet been recorded from Kansas but may be expected to occur in the southwestern part of the state. The type locality of this subspecies, *C. m. figginsi,* is Furnace Canyon in western Baca County, Colorado, approximately 55 miles, by air line, from the southwestern corner of Kansas.

The hog-nosed skunk is a medium-sized black skunk with a single broad white stripe on its back. The white stripe extends from the back of the head to the tip of the tail. The nose pad is broad, approximately twice as wide as that of the striped skunk, and is used for "rooting" for insects.

In the summer of 1950, I spent several days collecting mammals in Morton and Stanton counties, in the southwestern part of Kansas. I examined several striped skunks that had been killed on highways in these two counties and made inquiries of several ranchers. None had seen or heard of such an animal in that area although one rancher told me of his experiences with hog-nosed skunks in Texas.

TYPE LOCALITIES IN KANSAS

RILEY COUNTY

1. Manhattan
   Scalopus aquaticus machrinoides Jackson, p. 51.

LEAVENWORTH COUNTY

2. 4 mi. SE McLouth
   Taxidea taxus kansensis Schantz [=*Taxidea taxus taxus* (Schreber)], p. 253.

TREGO COUNTY

3. Wakeeney
   Fiber zibethicus cinnamonimus Hollister [=*Ondatra zibethicus cinnamonimus*], p. 198.
4. Banner [= 8 mi. S, 1 mi. E Collyer]
   Vespertilio ciliolabrum Merriam [=*Myotis subulatus subulatus* (Say)], p. 63.
   Perognathus paradoxus Merriam [=*Perognathus hispidus paradoxus*], p. 149.
   Taxidea taxus merriami Schantz [=*Taxidea taxus taxus* (Schreber)], p. 253.

DOUGLAS COUNTY

5. NW corner sect. 4, T12S, R20E, 5½ mi. N, 1¾ mi. E Lawrence
   Zapus hudsonius pallidus Cockrum and Baker, p. 215.
6. Lawrence
   Reithrodontomys dychei Allen [=*Reithrodontomys megalotis dychei*], p. 166.
7. 7 mi. SW Lawrence
   Marmota monax bunkeri Black, p. 118.

LANE COUNTY

8. Pendennis
   Citellus tridecemlineatus arenicola Howell, p. 124.
   Neotoma campestris Allen [= *Neotoma floridana campestris*], p. 189.

WOODSON COUNTY

9. Neosho Falls
   Arvicola (*Synaptomys*) *gossii* Coues [= *Synaptomys cooperi gossii*], p. 195.

MEADE COUNTY

10. 1½ mi. N Fowler
    Geomys bursarius industrius Villa-R and Hall, p. 142.
    Microtus ochrogaster taylori Hibbard and Rinker, p. 205.
11. Meade County State Park, 14 mi. SW Meade
    Synaptomys cooperi paludis Hibbard and Rinker, p. 196.

BARBER COUNTY

12. Natural Bridge, 5½ mi. S Sun City
    Antrozous bunkeri Hibbard, p. 81.

MONTGOMERY COUNTY

13. Independence
    Lepus melanotis Mearns [= *Lepus californicus melanotis*], p. 100.

KANSAS ?

14. Plains of Kansas River, Upper Mississippi Valley.
    Cervus (misspelled *Corvus*) *macrourus* Rafinesque [= *Odocoileus virginianus macrourus*], p. 274.

BIBLIOGRAPHY

ALBERTSON, F. W.

1937. Ecology of mixed prairie in west central Kansas. Ecological Monographs, 7:481-547.

ALBERTSON, F. W., and WEAVER, J. E.

1942. History of the native vegetation of western Kansas during seven years of continuous drought. Ecological Monographs, 12:23-51.

ALDOUS, G. M.

1933. Notes on a black-footed ferret raised in captivity. Jour. Mamm., 21:23-26.

ALLEN, G. M.

1939. Bats.
Harvard Univ. Press, pp. x + 368, 57 figs.

ALLEN, H.

1894. A monograph of the bats of North America. Bull. U. S. Nat. Mus., 43:ix + 198, 38 pls.

ALLEN, J. A.

1874. Notes on the mammals of portions of Kansas, Colorado, Wyoming and Utah. Part I. On the mammals of middle and western Kansas. Bull. Essex Inst., 6:43-52.

1894. Descriptions of ten new North American mammals, and remarks on others. Bull. Amer. Mus. Nat. Hist., 6:317-332.

1895. List of mammals collected in the Black Hills region of South Dakota and in western Kansas by Mr. Walter W. Granger with field notes by the collector. Bull. Amer. Mus. Nat. Hist., 7:258-274.

ALLEN, P. B.

1940. Kansas mammals. Kansas State Teachers College Emporia, Bull. Information, Nat. Hist. Surv., 20(5):1-62.

ANDERSON, R. M.

1947. Catalogue of Canadian recent mammals. National Museum Canada, Bull., 102, Biol. Ser., 31, pp. v + 238.

ANDERSON, R. M., and RAND, A. L.

1943. Variation in the porcupine (genus *Erethizon*) in Canada. Canadian Jour. Research, 21:292-309, 5 figs.

ANON.

1878. Bounty upon wolf, coyote, wild cat, fox and rabbit scalps. Pp. 584-589 in First Biennial Rept. Kansas State Board Agric., pp. 1-632.

1939. A survey of the annual fur catch of the United States. U. S. Dept. Agric., Bur. Biol. Surv., Wildlife Research and Management leaflet, BS-140:1-19, mimeographed.

1940. The annual fur catch of the United States. U. S. Fish and Wildlife Service, Wildlife leaflet, 170:1-21, mimeographed.

1945. Annual fur catch of the United States. U. S. Fish and Wildlife Service, Wildlife leaflet, 276:1-22, mimeographed.

1946. Annual fur catch of the United States. U. S. Fish and Wildlife Service, Wildlife leaflet, 290:1-22, mimeographed.

ANTHONY, H. E.
1928. Field book of North American Mammals. G. P. Putnam's Sons, New York, pp. xxvi + 674, 48 pls., 150 figs.

ASDELL, S. A.
1946. Patterns of mammalian reproduction. Comstock Publ. Co. Ithaca, New York, pp. xii + 437, 12 pls.

ASHBROOK, F. G.
1950. Annual fur catch of the United States. U. S. Fish and Wildlife Service, Wildlife leaflet 315:1-23, mimeographed.
1951. Annual fur catch of the United States. U. S. Fish and Wildlife Service, Wildlife leaflet 315 (revised):1-25, mimeographed.

AUDUBON, J. J., and BACHMAN, J.
1856. The Quadrupeds of North America. Vol. 1-3, V. G. Audubon, New York.

BAILEY, V.
1893. The prairie ground squirrels or spermophiles of the Mississippi valley. U. S. Dept. Agric., Div. Orn. and Mamm. Bull., 4:1-69, 3 pls., 4 maps.
1895. The pocket gophers of the United States. U. S. Dept. Agric., Div. Orn. and Mamm. Bull., 15:1-47, frontispiece, 2 colored pls., 1 col. map., 6 figs.
1900. Revision of the American voles of the genus Microtus. N. Amer. Fauna 17:1-88, 5 pls., 17 figs.
1902. Synopsis of the North American species of Sigmodon. Proc. Biol. Soc. Washington, 15:101-116.
1905. Biological survey of Texas. N. Amer. Fauna, 25:1-222, 16 pls., 24 figs.
1907. Wolves in relation to stock, game and the National Forest Reserves. Forest Service Bull., 72:1-31, 3 pls., 7 figs.
1922. Beaver habits, beaver control and possibilities in beaver farming. U. S. Dept. Agric. Bull., 1078:1-29, 7 pls., 7 figs.
1926. A biological survey of North Dakota. N. Amer. Fauna, 49:vi + 226, 21 pls., 8 figs.
1927. Beaver habits and experiments in beaver culture. U. S. Dept. Agric., Tech. Bull., 21:1-40, 14 pls., 6 figs.
1928. The red fox in America. Nature Magazine, 28:269-72; 317, 3 photographs, 1 map.
1929. Life history and habits of grasshopper mice, genus Onychomys. U. S. Dept. Agric., Tech. Bull., 145:1-19, 4 pls., 1 map.
1932. Mammals of New Mexico. N. Amer. Fauna, 53:1-412, 22 pls., 58 figs.

BAILEY, V. and SPERRY, C. C.
1929. Life history and habits of grasshopper mice, genus Onychomys. U. S. Dept. Agric., Tech. Bull., 145:1-20, 4 pls., 1 fig.

BAIRD, S. F.
1858. Explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean. War Department. Mammals, Part I, xxxii + 757, pls., 17-60, 35 figs. in text.

BAKER, A. B.
1889. Mammals of western Kansas. Trans. Kansas Acad. Sci., 11:56-58.
BAKER, R. H.
1943. May food habits of armadillos in eastern Texas. Amer. Midland Nat., 29:379-380.
BEACH, E.
1931. The spermatogenesis of the meadow vole, *Microtus pennsylvanicus*. Trans. Kansas Acad. Sci., 34:125-131, 2 pls.
BEAMER, R. H., PENNER, L. R., and HIBBARD, C. W.
1943. Some notes on the biology of the pack rat Cuterebrid (*Cuterebrid beameri* Hall) in Kansas. Jour. Kansas Ent. Soc., 16:47-50, 1 pl.
BENNITT, R.
1948. The coyote bounty system in Missouri, 1936-1947. Trans. 13th N. Amer. Wildlife Conference, p. 314-322, 1 fig.
BENSON, S. B.
1935. The status Reithrodontomys montanus (Baird). Jour. Mamm., 16:139-142, 1 fig.
BLACK, J. D.
1935A. Tadarida mexicana from the Trego-Gove County Region of Kansas, at Castle Rock. Jour. Mamm., 16:147.
1935B. Observations on the vitality of the Virginia opossum as exhibited in the skeleton. Jour. Mamm., 16:223.
1935C. The golden harvest mouse from Anderson County, Kansas. Jour. Mamm., 16:231-232.
1935D. A new woodchuck from Kansas. Jour. Mamm., 16:318-320.
1936. Mammals of northwestern Arkansas. Jour. Mamm., 17:29-35.
1937. Mammals of Kansas. Kansas State Board Agric., 30th Biennial Report, 35:116-217.
BLAIR, W. F.
1937. The burrows and food of the prairie pocket mouse. Jour. Mamm., 18:188-191.
1939. Faunal relationships and geographic distribution of mammals in Oklahoma. Amer. Midland Nat., 22:85-133, 1 fig.
1942. Systematic relationships of Peromyscus and several related genera as shown by the baculum. Jour. Mamm., 23:196-204, 2 figs.
BLAIR, W. F., and HUBBELL, T. H.
1938. The biotic districts of Oklahoma. Amer. Midland Nat., 20:425-454, 1 fig.
BOLE, B. P., and MOULTHROP, P. N.
1942. The Ohio Recent mammal collection in the Cleveland Museum of Natural History. Sci. Publ. Cleveland Mus. Nat. Hist., 5(6):83-181.
BROWN, E. G., LATTIMORE, J. L., and HOFMANN, J. C.
1933. Tularemia: summary of 120 cases reported in Kansas. Jour. Kansas Medical Soc., Aug. 1933.
BROWN, H. L.
1940. The distribution of the whitetailed jack rabbit (*Lepus townsendii campanius* Hollister) in Kansas. Trans. Kansas Acad. Sci., 43:385-389, 1 fig.

1945. Evidence of winter breeding of Peromyscus. Ecology, 26:308-309.
1946. Rodent activity in a mixed prairie near Hays, Kansas. Trans. Kansas Acad. Sci., 48:448-456.
1947A. Why has the white-tailed jack rabbit (*Lepus townsendii campanius* Hollister) become scarce in Kansas. Trans. Kansas Acad. Sci., 49:455-456.
1947B. Jack rabbit, cottontail, vegetation in a mixed prairie. Trans. Kansas Acad. Sci., 50:28-44.

BRUMWELL, M. J.
1941. An ecological survey of the Fort Leavenworth Military Reservation. Unpublished Master's Thesis, University of Kansas, pp. 1-187.
1951. An ecological survey of the Fort Leavenworth Military Reservation. Amer. Midland Nat., 45:187-231, 6 pls.

BRYANT, M. D.
1945. Phylogeny of Nearctic Sciuridae. Amer. Midland Nat., 33:257-390, 8 pls., 48 figs.

BUGBEE, R. E., and RIEGEL, A.
1945. Seasonal food choices of the fox squirrel in western Kansas. Trans. Kansas Acad. Sci., 48:199-203, 4 figs.

BUNKER, C. D.
1940. The Kit Fox. Science, 92 (2376):35-36.

BURNETT, W. L.
1913. Report on prairie dog investigations in Colorado. Office of the State Entomologist, Fort Collins, Colo. Circular no. 8.
1914. Pocket gophers. Office of State Entomologist, Fort Collins, Colo. Circular no. 10.
1930. Hayden's vole *Microtus haydeni* (Baird). Occas. Papers Mus. Zool. and Ent., Colorado Agric. College, 1:5-11, 3 figs.

BURT, W. H.
1928. Additional notes on the life history of the Goss Lemming Mouse. Jour. Mamm., 9:212-216.
1945. The Bunker bat in Oklahoma. Jour. Mamm., 26:309.
1946. The mammals of Michigan. Univ. of Michigan Press, pp. xv + 288, 13 pls., 107 figs., 67 maps.

CAGLE, F. R., and COCKRUM, E. L.
1943. Notes on a summer colony of *Myotis lucifugus lucifugus*. Jour. Mamm., 24:474-492, 1 pl., 7 figs.

CARDWELL, A. B., and FLORA, S. D.
1942. The climate of Kansas. Kansas State College Agric. Exp. Sta. Bull., 302:1-108, 11 figs., 2 photographs.

CARTER, F. L.
1939. A study of jackrabbit shifts in range in western Kansas. Trans. Kansas Acad. Sci., 42:431-435.

CARY, M.
1911. A biological survey of Colorado. N. Amer. Fauna, 33:1-256, 12 pls., 39 figs.

CHADDOCK, T. T.
1938. Some facts concerning cottontails imported into Wisconsin. Wisconsin Conservation Bull., 3(4):49-52.

CLARK, F. H.
1936. Geotropic behavior on a sloping plane of arboreal and non-arboreal races of mice of the genus Peromyscus. Jour. Mamm., 17:44-47.
1941. Correlation and body proportions in mature mice of the genus Peromyscus. Genetics, 26:382-300.

CLARK, H. W.
1937. Association types in the north coast ranges of California. Ecology, 18:214-230, 5 figs.

CLEMENTS, F. E., and SHELFORD, V. E.
1939. Bio-ecology. John Wiley and Sons, New York, pp. viii + 425, 85 figs.

COCKRUM, E. L.
1948. The distribution of the hispid cotton rat in Kansas. Trans. Kansas Acad. Sci., 51:306-312, 2 figs.
1949. Longevity in the little brown bat, *Myotis lucifugus lucifugus*. Jour. Mamm., 30:433-434.

COCKRUM, E. L., and BAKER, R. H.
1950. A new jumping mouse (genus Zapus) from Kansas. Proc. Biol. Soc. Washington, 63:1-4, 1 fig.

COUCH, W. E.
1933. Pocket-gopher control. U. S. Dept. Agric. Farmers' Bull., 1709:1-20, 17 figs.

COUES, ELLIOTT
1877. The fur-bearing animals of North America. Estes and Lauriat, Boston, pp. xiv + 348, 20 pls.
1877. Monographs of North American Rodentia. Rept. U. S. Geol. Surv. Terr., pp. x + 1091, 77 figs.

CRAGIN, F. W.
1885. Notes on some mammals of Kansas, with a few additions to the list of species known to inhabit the state. Bull. Washburn College Lab. Nat. Hist., 1:42-47.

DALQUEST, W. W.
1948. Mammals of Washington. Univ. Kansas Publ., Mus. Nat. Hist., 2:1-444, 140 figs.

DAMON, D.
1941. Notes on the gray eastern chipmunk. Jour. Mamm., 23:326-327.

DAVIS, W. B.
1939. The Recent mammals of Idaho. The Caxton Printers, Ltd., Caldwell, Idaho, pp. 1-400, 2 pls., 33 figs.

DAVIS, W. B., and JOERIS, L.
1945. Notes on the life-history of the little short-tailed shrew. Jour. Mamm., 45:136-138.

DAVIS, W. B., and LOWERY, G. H., JR.
1940. The systematic status of the Louisiana muskrat. Jour. Mamm., 21:212-213.

DELLINGER, S. C., and BLACK, J. D.
1940. Notes on Arkansas mammals. Jour. Mamm., 21:187-191.

DICE, L. R.
1922. Some factors affecting the distribution of the prairie vole, forest deer mouse and prairie deer mouse. Ecology, 3:29-48, 1 fig.
1923A. Notes on the communities of the vertebrates of Riley County, Kansas, with especial reference to amphibians, reptiles and mammals. Ecology, 4:40-53, 3 figs., one table.
1923B. Notes on some mammals of Riley County, Kansas. Jour. Mamm., 4:107-112.
1927. The transfer of game and fur-bearing mammals from state to state, with special reference to the cottontail rabbit. Jour. Mamm., 8:90-96.
1929. An attempt to breed cottontail rabbits in captivity. Jour. Mamm., 10:225-229.
1937. Additional data on variation in the prairie deer-mouse, *Peromyscus maniculatus bairdii*. Occas. Papers Museum of Zool., Univ. of Michigan, 351:1-19, 3 figs.
1941. Variation of the deer mice (*Peromyscus maniculatus*) on the sand hills of Nebraska and adjacent areas. Contr. Univ. Michigan Lab. Vert. Genetics, 15:1-19.
1943. The biotic provinces of North America. Univ. of Michigan Press, pp. viii + 78, 1 map.

DYCHE, L. L.
1890. Notes on three species of gophers found at Lawrence, Kas. Trans. Kansas Acad. Sci., 12:29-31.
1903. Food habits of the common garden mole. Trans. Kansas Acad. Sci., 18:183-186.
1905. The puma or American lion. Trans. Kansas Acad. Sci., 19:160-163.
1907. A Kansas beaver (*Castor canadensis* Kuhl). Trans. Kansas Acad. Sci., 21:165-167.

ELLERMAN, J. R.
1940-1941. The families and genera of living rodents. British Museum (Natural History), London. Vol. 1 (1940), pp. xxvi + 689; vol. 2 (1941), xii + 690, 49 figs.

ELLIOT, D. G.
1899. Description of apparently new species and subspecies of mammals from Oklahoma Territory. Field Columb. Mus., publ. 37, Zool. Ser., 1(14):280.
1901. A synopsis of the mammals of North America and the adjacent seas. Field Columb. Mus., Publ. 45, Zool. Ser., 2:1-475, 143 pls.
1907. A catalogue of the collection of mammals in the Field-Columbian museum. Field Columb. Mus., Publ. 115, Zool. Ser., 8:viii + 694, 92 figs.

ENGELS, W. L.
1936. Distribution of races of the brown bat (*Eptesicus*) in western North America. Amer. Midland Nat., 17:653-660, 1 fig.

FICHTER, E., and HANSON, M. F.
1947. The Goss lemming mouse, *Synaptomys cooperi gossii* (Coues), in Nebraska. Bull. Univ. Nebraska State Mus., 3(2):1-8, 2 figs.

FLORA, S. D.
1948. Climate of Kansas. Rept. Kansas State Board Agric., 67:xii + 320, illus.

FREMONT, J. C.
1845. Report of the exploring expedition to the Rocky Mountains in the year 1842 . . . etc. Blair and Rives; Washington.

FRYE, O. E., and LAY, D. W.
1942. Fur resources and fur animals of Texas. Texas Game, Fish and Oyster Comm. Bull., 25:iii + 42, 19 unnumbered figs.

GATES, F. C.
1937. Grasses in Kansas. Rept. Kansas State Board Agric., 55(220-A): 1-349, frontispiece, 270 figs., 224 maps.

GILMORE, R. M.
1946. Mammals in archeological collections from southwestern Pennsylvania. Jour. Mamm., 27:227-254, 1 map.

GLASS, B. P.
1947. Geographic variation in Perognathus hispidus. Jour. Mamm., 28:174-179.

GOLDMAN, E. A.
1910. Revision of the wood rats of the genus Neotoma. N. Amer. Fauna, 31:1-124, 8 pls., 14 figs.
1937. The wolves of North America. Jour. Mamm., 18:37-45.
1944. Classification of wolves. Part II *in* the wolves of North America by Young and Goldman. Publ. by American Wildlife Inst., Washington, D. C.
1950. Raccoons of North and Middle America. N. Amer. Fauna, 60:vi + 153, 22 pls., 2 figs.

GOLDMAN, E. A., and GARDNER, M. C.
1947. Two new cotton rats. Jour. Mamm., 28:57-59.

GOWELL, R. C.
1897. The myology of the hind limb of the raccoon, Procyon lotor. Kansas Univ. Quarterly, 6(A):121-126, 2 pls.

GRAHAM, E., and ULRICH, J.
1943. Animal parasites of the fox squirrel, *Sciurus niger rufiventer*, in southeastern Kansas. Jour. Parasitol., 29:159-160.

GRIFFIN, D. R.
1945. Travels of banded cave bats. Jour. Mamm., 26:15-23.

GRIFFIN, D. R., and GALAMBOS, R.
1941. The sensory basis of obstacle avoidance by flying bats. Jour. Experimental Zool., 86:481-506.

GRINNELL, J.
1914. An account of the mammals and birds of the Lower Colorado Valley, with especial reference to the distributional problems presented. California Univ. Publ. Zool., 12:51-294, pls. 3-13, 9 figs.

GRINNELL, J., and SWARTH, H. S.
1913. An account of the birds and mammals of the San Jacinto area of southern California with remarks upon the behavior of geographic races on the margins of their habitats. Univ. California Publ. Zool., 10:197-466, 5 pls., 3 figs.

GUTHRIE, M. J.
1933. Notes on the seasonal movements and habits of some cave bats. Jour. Mamm., 14:1-19.

HALL, E. R.
1923. Occurrence of the hoary bat at Lawrence, Kansas. Jour. Mamm., 4:192-193.
1928. Notes on the life history of the woodland deer mouse. Jour. Mamm., 9:255-256.
1936. Mustelid mammals from the Pleistocene of North America with systematic notes on some Recent members of the genera Mustela, Taxidea and Mephitis. Carnegie Inst. Washington Publ. 473:41-119, 5 pls., 6 figs.
1939. Extension of the known geographic range of the striated chipmunk (Tamias striatus). Amer. Midland Nat., 21:766.
1946. Mammals of Nevada. pp. xi + 710, frontispiece, 11 pls., 473 figs., Univ. California Press, Berkeley and Los Angeles, California.

HALL, E. R. and DALQUEST, W. W.
1950. A synopsis of the American Bats of the genus Pipistrellus. Univ. Kansas Publ. Mus. Nat. Hist., 1:591-602, 1 fig.

HAMILTON, W. J. JR.
1933. The insect food of the big brown bat. Jour. Mamm., 14:155-156.
1939. American Mammals. Their lives, habits and economic relations. McGraw-Hill, New York, pp. xiv + 434, 92 figs.
1943. The mammals of eastern United States. Comstock Publ. Co., Inc., Ithaca, N. Y., pp. 1-432, frontispiece, 184 figs.
1944. The biology of the little short-tailed shrew, *Cryptotis parva*. Jour. Mamm., 25:1-7, 1 pl.

HAMLETT, G. W. D.
1939. Identity of Dasypus septemcinctus Linnaeus with notes on some related species. Jour. Mamm., 20:328-336.

HAYDEN, F. V.
1875. Catalogue of the collections in geology and natural history obtained by the expedition under command of Lieut. G. K. Warren. Reprinted from "Preliminary report of explorations in Nebraska and Dakota in the years 1855-'56-'57" by G. K. Warren, and originally published "with the documents accompanying the President's annual message to congress in December 1858, in the annual report of the Secretary of War."

HENDRICKSON, G. O.
1938. Winter food and cover of Mearns cottontail. Third N. Amer. Wildlife Conference, 787-793.
1939. Inventory methods for Mearns cottontail. Fourth N. Amer. Wildlife Conference, 209-215.
1940. Nesting cover used by Mearns cottontail. Trans. Fifth N. Amer. Wildlife Conference, 1940, pp. 328-331.
1943A. Gestation period in Mearns cottontail. Jour. Mamm., 24:273.
1943B. Mearns cottontail investigation in Iowa. The Ames Forester, 21:59-74.

HIBBARD, C. W.
1933. A revised checklist of Kansas mammals. Trans. Kansas Acad. Sci., 36:230-249.
1934A. The occurrence of Erethizon epixanthum bruneri and Mustela nigripes in Kansas. Jour. Mamm., 15:70-71.
1934B. Antrozous bunkeri, a new bat from Kansas. Jour. Mamm., 15: 227-228.
1934C. Notes on some cave bats in Kansas. Trans. Kansas Acad. Sci., 37:235-238.
1936. Established colonies of the Mexican free-tailed bat in Kansas. Jour. Mamm., 17:167-168.
1937. Peromyscus leucopus aridulus in Kansas. Jour. Mamm., 18:101-102.
1938. Distribution of the genus *Reithrodontomys* in Kansas. Univ. Kansas Sci. Bull., 25:173-179, 1 map.
1944. A checklist of Kansas mammals, 1943. Trans. Kansas Acad. Sci., 47:61-88.

HIBBARD, C. W., and RINKER, G. C.
1942. A new bog-lemming (*Synaptomys*) from Meade County, Kansas. Univ. Kansas Sci. Bull., 28:25-35, 3 figs.
1943. A new meadow mouse (*Microtus ochrogaster taylori*) from Meade County, Kansas. Univ. Kansas Sci. Bull., 29 (pt. 2 no. 4):255-268, 5 figs.

HIDE, J. C.
1946. Rotations, crop residues, manures and lime. In Soil Conservation in Kansas. Kansas State Board Agric., Report., 65(271):20-33.

HILL, J. E., and HIBBARD, C. W.
1943. Ecological differentation between two harvest mice (*Reithrodontomys*) in western Kansas. Jour. Mamm., 24:22-25.

HISAW, F. L.
1923. Feeding habits of moles. Jour. Mamm., 4:9-20.

HISAW, F. L., and EMERY, F. E.
1927. Food selection of ground squirrels, *Citellus tridecemlineatus*. Jour. Mamm., 8:41-44.

HITCHCOCK, H. B.
1949. Hibernation of bats in southeastern Ontario and adjacent Quebec. The Canadian Field-Naturalist, 63:47-59, 1 fig.

HOFFMEISTER, D. F.
1947. Early observation on the elk in Kansas. Trans. Kansas Acad. Sci., 50:75-76.

HOFFMEISTER, D. F., and KENNEDY, C. D.
1947. The Nutria, a South American rodent, in Kansas. Trans. Kansas Acad. Sci., 49:445-446.

HOLLISTER, N.
1925. The systematic name of the Texas armadillo. Jour. Mamm., 6:60.

HOWELL, A. H.
1901. Revision of the skunks of the genus Chincha. N. Amer. Fauna, 20:1-62, 8 pls.

1906. Revision of the skunks of the genus Spilogale. N. Amer. Fauna, 26:1-55, 10 pls.
1914. Revision of the American harvest mice (Genus Reithrodontomys). N. Amer. Fauna, 36:1-97, 7 pls., 6 figs.
1915. Revision of the American marmots. N. Amer. Fauna, 37:1-80, 15 pls., 3 figs.
1918. Revision of the American flying squirrels. N. Amer. Fauna, 44:1-64, 7 pls., 4 figs.
1928. Descriptions of six new North American ground squirrels. Proc. Biol. Soc. Washington, 41:211-214.
1929. Revision of the American chipmunks (genera Tamias and Eutamias) N. Amer. Fauna, 52:1-157, 10 pls., 9 figs.
1938. Revision of North American ground squirrels with a classification of the North American Sciuridae. N. Amer. Fauna, 56:1-256, 32 pls., 10 figs.

HOVEY, C.
1874. Rabies Mephitica. Amer. Jour. Sci. and Arts, 3rd Series, 7(41): 477-483, 1874. [Reprinted in full in Coues, 1877, pp. 224-229].

JACKSON, H. H. T.
1914. New Moles of the genus Scalopus. Proc. Biol. Soc. Washington, 27:19-21.
1915. A review of the American moles. N. Amer. Fauna, 38:1-100, 6 pls., 27 figs.
1928. A taxonomic review of the American long-tailed shrews. N. Amer. Fauna, 51:vi + 238, 13 pls., 24 figs.

JAMESON, E. W., JR.
1947. Natural history of the prairie vole. (Mammalian genus *Microtus*). Univ. Kansas Publs., Mus. Nat. Hist., 1:125-151, 4 figs.

JOHNSON, C. E.
1921. The "hand-stand" habit of the spotted-skunk. Jour. Mamm., 2:87-89.
1923. Aquatic habits of the woodchuck. Jour. Mamm., 4:105-107.
1926. Notes on a pocket gopher in captivity. Jour. Mamm., 7:35-37.
1932. Notes on a family of red bats in captivity. Jour. Mamm., 13:132-135.

JOHNSON, G. E.
1925. Control of mammals injurious to agriculture in Kansas. Kansas State College Exp. Sta. Circ., 120:1-10, 1 fig.
1927. Observations on young prairie-dogs (Cynomys ludovicianus) born in the laboratory. Jour. Mamm., 8:110-115, 3 pls.
1929A. Hibernation of the thirteen-lined ground squirrel, *Citellus tridecemlineatus* (Mitchell). II. The general process of waking from hibernation. Amer. Nat., 63:171-180, 3 figs.
1929B. Hibernation of the thirteen-lined ground squirrel, *Citellus tridecemlineatus* (Mitchell). III. The rise in respiration, heart beat and temperature in waking from hibernation. Biol. Bull., 55:107-129, 6 figs.

1930. Hibernation of the thirteen-lined ground squirrel *Citellus tridecemlineatus* (Mitchell). V. Food, light, confined air, precooling, castration and fatness in relation to production of hibernation. Biol. Bull., 59:114-127, 1 fig.

1931A. Early life of the thirteen-lined ground squirrel. Trans. Kansas Acad. Sci., 34:282-290, 2 tables, 14 figs.

1931B. Hibernation in mammals. Quart. Rev. of Biology, 6:439-461.

JOHNSON, G. E., and CHALLANS, J. S.

1932. Ovariectomy and corpus luteum extract studies on rats and ground squirrels. Endocrinology, 16:278-284, 1 fig.

JOHNSON, G. E., FOSTER, M. A., and COCO, R. M.

1933. The sexual cycle of the thirteen-lined ground squirrel in the laboratory. Trans. Kansas Acad. Sci., 36:250-269, 12 figs.

JOHNSON, G. E., GANN, E. L., FOSTER, M. A., and COCO, R. M.

1934. The effect of daily hetero-pituitary extract implants into adult but sexually inactive male ground squirrels. Endocrinology, 18:86-96, 9 figs.

KALMBACH, E. R.

1943. The armadillo: Its relation to agriculture and game. Texas Game, Fish and Oyster Commission, pp. iv + 61, frontispiece, 4 pls., 4 figs.

KELLOGG, R.

1914. On the rentention of *Neotoma campestris* Allen as a separate subspecies from *Neotoma floridana baileyi* Merriam. Kansas Univ. Mus. Nat. Hist. Publ. 1, Zool. Series, 1(1):1-7.

1915. The mammals of Kansas with notes on their distribution, life histories and economic importance. Master's thesis, U. of Kansas, 15 Dec. 1915. (unpublished typescript).

KING, O. M.

1950. An ecological study of the Norway rat and the house mouse in a city block in Lawrence, Kansas. Trans. Kansas Acad. Sci., 53:500-528, 10 figs.

KNOX, M. V. B.

1875. Kansas Mammalia. Trans. Kansas Acad. Sci., 4:19-22.

1877. Additions to Kansas Mammalia. Trans. Kansas Acad. Sci., 5:65.

LANTZ, D. E.

1905A. A list of Kansas mammals. Trans. Kansas Acad. Sci., 19:171-178.

1905B. Kansas mammals in their relation to agriculture. Kansas State College Exp. Sta. Bull., 129:331-404.

1905C. Coyotes in their economic relations. U. S. Dept. Agric., Biol. Surv. Bull., 20:1-28.

1905D (1906). Meadow mice in relation to agriculture and horticulture. Yearbook of U. S. Dept. Agric. for 1905:363-376, 4 pls., 1 fig.

1907A. Additions and corrections to the list of Kansas mammals. Trans Kansas Acad. Sci., 20(2):214-217.

1907B. An economic study of field mice (genus *Microtus*) U. S. Dept. Agric., Biol. Surv. Bull., 31:1-64, 8 pls., 3 figs.

1908. Notes on Kansas mammals. Trans. Kansas Acad. Sci., 22:336-337.

1910. Raising deer and other large game animals in the United States. U. S. Dept. Agric., Biol. Surv. Bull., 36:1-62, 8 pls.

1918. Notes on Kansas mammals, 1915. Trans. Kansas Acad. Sci., 28:241-242.

LARSON, F.

1940. The role of the bison in maintaining the short grass plains. Ecology, 21:113-121.

LATIMER, H. B.

1937. Weights and linear dimensions of the skull and of some of the long bones of the skunk (*Mephitis mesomelas avia*). Jour. Morphology, 60:379-391, 1 fig.

LATIMER, H. B., and RILEY, R. B.

1934. Measurements of the skull and some of the long bones of the muskrat (*Ondatra zibethicus cinnamominus*). Jour. Morph., 56:203-212.

LEWIS, W., and CLARKE, W.

1814. History of the expedition under the command of Captains Lewis and Clarke to the sources of the Missouri, thence across the Rocky mountains and down the river Columbia to the Pacific Ocean. Performed during the years 1804-5-6, by order of the government of the United States. Prepared for the press by Paul Allen, Esquire. Bradford and Inskeep, Philadelphia, 2 vols.

LIEBIG, J.

1840. Chemistry in its application to agriculture and physiology. Taylor and Walton, London.

LINSDALE, J. M.

1925. Land vertebrates of a limited area in Eastern Kansas. Manuscript, University of Kansas Library.

1927. Notes on the life history of Synaptomys. Jour. Mamm., 8:51-54.

1928. Mammals of a small area along the Missouri River. Jour. Mamm., 9:140-146.

LOEWEN, S. L.

1934. A new cestode from a bat. Trans. Kansas Acad. Sci., 37:257-258.

LOWE, P. G.

1890. Kansas, as seen in the Indian Territory. Trans. Kansas Historical Soc., 4:360-366.

LOWERY, G. H., JR., and DAVIS, W. B.

1942. A revision of the fox squirrels of the lower Mississippi Valley and Texas. Occas. Papers of the Mus. of Zool., Louisiana State Univ., 9:153-172, 2 figs.

LOWRANCE, E. W.

1949. Variability and growth of the opossum skeleton. Jour. Morph., 85:569-593.

LUNN, M. P.

1940. The history and administration of the Kansas Forestry, Fish and Game Commission. Unpublished Master's Thesis, Univ. of Kansas, pp. 1-142.

LUTZ, H.

1950A. News release of Kansas Forestry, Fish and Game Commission, dated August 10, 1950. Pratt, Kansas.

1950B. News release of Kansas Forestry, Fish and Game Commission, dated August 23, 1950. Pratt, Kansas.

MACY, R. W.
1939. A correction. Jour. Mamm., 20:382.
MACY, R. M., and MACY, R. W.
1939. Hawks as enemies of bats. Jour. Mamm., 20:252.
MATHER, K., and HARRISON, B. J.
1949. The manifold effect of selection. Heredity, 3:1-52, 131-162.
MCNAIR, G. T.
1931. The deer mouse, Peromyscus, a valuable laboratory mammal. Jour. Mamm., 12:48-52.
MEAD, J. R.
1885. Notes on two Kansas mammals. Bull. Washburn College Lab. Nat. Hist., 1:91-92.
1899. Some natural history notes of 1859. Trans. Kansas Acad. Sci., 16:280-281.
1903. The drying-up of pools and streams in Central Kansas. Trans. Kansas Acad. Sci., 18:213-214.
1905. (1906). The Saline River country in 1859. Trans. Kansas State Historical Soc., 9:8-19.
MEARNS, E. A.
1890. Description of supposed new species and subspecies of mammals, from Arizona. Bull. Amer. Mus. Nat. Hist., 2:277-307.
MERRIAM, C. H.
1886. Description of a new species of bat from the western United States. Proc. Biol. Soc. Washington, 4:1-4.
1889. Preliminary revision of the North American pocket mice (genera *Perognathus* et *Cricetodipus* Auct.) with description of new species and subspecies and a key to the known forms. N. Amer. Fauna, 1: vii + 36, 4 pls.
1890. Descriptions of twenty-six new species of North American mammals. N. Amer. Fauna, 4: v + 60, 3 pls., 3 figs.
1894. The geographic distribution of animals and plants in North America. U. S. Dept. Agric. Yearbook for 1894, pp. 203-214, 1 map.
1895A. Revision of the shrews of the American genera Blarina and Notiosorex. N. Amer. Fauna, 10:5-34, 3 pls., 2 figs.
1895B. Monographic revision of the pocket gopher Family *Geomyidae*. . . . N. Amer. Fauna, 8:1-258, frontispiece, 19 pls., 71 figs., 4 maps.
1896A. Revision of the lemmings of the genus *Synaptomys*, with descriptions of a new species. Proc. Biol. Soc. Washington, 10:55-64.
1896B. Synopsis of the weasels of North America. N. Amer. Fauna, 11:1-44, frontispiece, 5 pls., 16 figs.
1897. Revision of the coyotes or prairie wolves with descriptions of new forms. Proc. Biol. Soc. Washington, 11:19-33.
1898. Life zones and crop zones of the United States. U. S. Dept. Agric., Biol. Surv. Bull., 10:1-79, frontispiece.
1901. The prairie dogs of the great plains. U. S. Dept. Agric. Yearbook for 1901:257-270, 3 pls., 2 figs.
1904. Jack Rabbits of the *Lepus campestris* group. Proc. Biol. Soc. Washington, 17:131-134.

MILLER, F. W.
1924. The range of Cryptotis parva (Say). Jour. Mamm., 5:199.
MILLER, G. S., JR.
1897. Revision of the North American bats of the family Vespertilionidae. N. Amer. Fauna, 13:1-140, 3 pls., 40 figs.
1912A. The names of the large wolves of northern and western North America. Smith. Misc. Coll., 59(15):1-5.
1912B. List of North American Land Mammals in the United States National Museum, 1911. U. S. Nat. Mus. Bull., 79:xiv + 455.
1924. List of North American Recent mammals, 1923. U. S. Nat. Mus. Bull., 128:xvi + 673.
MILLER, G. S., JR., and ALLEN, G. M.
1928. American bats of the genera Myotis and Pizonyx. U. S. Nat. Mus. Bull., 144:1-218, 1 pl., 1 fig., 13 maps.
MILLER, G. S., JR., and REHN, J. A. G.
1901. Systematic results of the study of North American land mammals to the close of the year 1900. Proc. Boston Soc. Nat. Hist., 30:1-352.
MOODY, J.
1886-1888. Alvar Nunez Cabeca de Vaca. Trans. Kansas State Historical Soc., 4:332-350.
NELSON, E. W.
1909. The rabbits of North America. N. Amer. Fauna, 29:1-314, 13 pls., 19 figs.
1926. Bats in relation to the production of guano and the destruction of insects. U. S. Dept. Agric., Dept. Bull., 1395:1-12, 4 figs.
OSGOOD, W. H.
1900. Revision of the pocket mice of the genus Perognathus. N. Amer. Fauna, 18:1-72, 4 pls., 15 figs.
1909. Revision of the mice of the American genus Peromyscus. N. Amer. Fauna, 28:1-285, 8 pls., 12 figs.
OYER, E. R.
1946. Identification of mammals from studies of hair structure. Trans. Kansas Acad. Sci., 49:155-160.
PALMER, F. G.
1937. Geographic variation in the mole Scapanus latimanus. Jour. Mamm., 18:280-314, 2 pls., 1 fig.
PALMER, T. S.
1897. The Jack rabbits of the United States. U. S. Dept. Agric., Biol. Surv. Bull., 8 (revised):1-88, 6 pls., 3 figs.
PATTIE, J. O.
1831. The personal narrative of James O. Pattie of Kentucky. . . . [edited by T. Flint]. Reprinted in 1930 with a historical introduction and annotations by M. M. Quaife by the Lakeside Press, Chicago, pp. xliii + 428.
PEARSON, O. P.
1944. Reproduction in the shrew (Blarina brevicauda Say). Amer. Jour. Anatomy, 75:39-93, 6 pls.

PETERKA, H. E.
1936. A study of the myology and osteology of three sciurids with regard to adaptation to arboreal, glissant and fossorial habits. Trans. Kansas Acad. Sci., 39:313-332.

PETERSON, R. L.
1946. Recent and Pleistocene mammalian fauna of Brazos County, Texas. Jour. Mamm., 27:162-169, 5 figs.

PHILLIPS, W. A.
1890. Kansas History. Trans. Kansas Historical Soc., 4:351-359.

PIKE, MAJOR Z. M.
1810. Account of an expedition to the sources of the Mississippi and through the western parts of Louisiana, to the sources of the Arkansaw, Kansas, La Platte and Pierre Jaune rivers; performed by order of the government of the United States during the years 1805, 1806, and 1807. And a tour through the interior parts of New Spain, when conducted through these provinces by order of the captain general, in the year 1807. Illustrated by maps and charts. Published by Philadelphia; C. and A. Conrad and Co.; Petersburg: Somervell and Conrad; Norfold: Bonsal, Conrad and Co. and Baltimore: Fielding Lucas, Jr. John Binns, printer.

REYNOLDS, H. C.
1945. Some aspects of the life history and ecology of the opossum in central Missouri. Jour. Mamm., 26:361-379.

RIEGEL, D. A.
1941. Some coactions of rabbits and rodents with cactus. Trans. Kansas Acad. Sci., 44:96-103, 1 pl.
1942. Some observations of the food coactions of rabbits in western Kansas during periods of stress. Trans. Kansas Acad. Sci., 45:369-375, 4 photographs.

RINKER, G. C.
1941. Cratogeomys castanops from a recent terrace in south-western Kansas. Jour. Mamm., 22:88.
1942A. An extension of the range of the Texas cotton rat in Kansas. Jour. Mamm., 23:439.
1942B. Litter records of some mammals of Meade County, Kansas. Trans. Kansas Acad. Sci., 45:376-378.
1944. Os clitoridis from the raccoon. Jour. Mamm., 25:91-92.

RYSGAARD, G. N.
1942. A study of the cave bats of Minnesota with especial reference to the large brown bat, *Eptesicus fuscus fuscus* (Beauvois). Amer. Midland Nat., 28:245-267.

SCHAFFNER, J. H.
1929. Extension of natural range of two mammals in Clay County, Kansas. Trans. Kansas Acad. Sci., 31:61-62.

SCHANTZ, V. S.
1950A. A new badger from Montana. Jour. Mamm., 31:90-92.
1950B. A new race of badger (*Taxidea*) from Kansas. Jour. Washington Acad. Sci., 40:92-93.
1950C. A new race of badger (*Taxidea*) from eastern Kansas. Jour. Mamm., 31:346-347.

SCHEFFER, T. H.
1908. The pocket gopher. Kansas State College Exp. Sta. Bull., 152:111-145, illustrated.
1910A. The common mole. Kansas State College Exp. Sta. Bull., 168:1-36, 12 figs.
1910B. The pocket gopher. Kansas State College Exp. Sta. Bull., 172:197-233, 9 figs.
1911A. Distributional, natural enemies and breeding habits of the Kansas pocket gopher. Trans. Kansas Acad. Sci., 23:109-114.
1911B. The prairie-dog situation in Kansas. Trans. Kansas Acad. Sci., 23:115-118.
1911C. Investigation of the mole. Trans. Kansas Acad. Sci., 23:119-131.
1912. The common mole. Runway studies; hours of activity. Trans. Acad. Sci., 25:160-163.
1931. Habits and economic status of the pocket gophers. U. S. Dept. Agric., Tech. Bull., 224:1-7, 8 pls., 2 figs.
1938. Study of a small prairie-dog town. Trans. Kansas Acad. Sci., 40:391-395, 1 fig.
1940. Excavation of a Runway of the pocket gopher (*Geomys bursarius*). Trans. Acad. Sci., 43:473-478, 3 figs.

SCHOEWE, W. H.
1949. The geography of Kansas. Part II, physical geography. Trans. Kansas Acad. Sci., 52:261-333, 43 figs.

SCHWARTZ, E., and SCHWARTZ, H. K.
1943. The wild and commensal stocks of the house mouse, *Mus musculus* Linnaeus. Jour. Mamm., 24:59-72.

SETON, E. T.
1929. Lives of game animals. Doubleday, Doran and Co., Inc., New York, issued in 4 volumes, each with two parts; each volume paged separately.

SETZER, H. W.
1949. Subspeciation in the kangaroo rat, Dipodomys ordii. Univ. Kansas Publs., Mus. Nat. Hist., 1:473-573, 27 figs.

SHAMEL, H. H.
1931. Notes on the American bats of the genus Tadarida. Proc. U. S. Nat. Mus., 78(19):1-27.

SHELFORD, V. E.
1945. The relative merits of the life zone and biome concepts. Wilson Bull., 57:248-252, 1 map.

SILVER, J.
1935. Eliminating bats from buildings. U. S. Dept. Agric. Leaflet, 109: 1-5, 2 figs.

SILVER, J., and MOORE, A. W.
1933. Mole control. U. S. Dept. Agric., Farmer's Bull., 1716:1-17, 14 figs.

SIMPSON, G. G.
1945. The principles of classification and a classification of mammals. Bull. Amer. Mus. Nat. Hist., 85:xvi + 114.

SKINNER, M. F., and KAISEN, O. C.
1947. The fossil *Bison* of Alaska and preliminary revision of the genus. Bull. Amer. Mus. Nat. Hist. 89(3):127-256, 19 pls.

SMITH, C. F.
1948. A burrow of the pocket gopher (*Geomys bursarius*) in eastern Kansas. Trans. Kansas Acad. Sci., 51:313-315, 1 fig.

SMITH, H. M.
1934. Notes on some bat-flies of southern Kansas and northern Oklahoma. Jour. Kansas Ent. Soc., 7:62-64.

SPRAGUE, J. M.
1938. Distributional records from Kansas. Jour. Mamm., 19:246.
1939A. Mammal distributional records for Kansas. Jour. Mamm., 20: 102-103.
1939B. Notes on mammal mortality on highways. Jour. Mamm., 20:110-111.
1939C. The distribution of the genus Peromyscus in Kansas. Trans. Kansas Acad. Sci., 42:487-493.
1939D. A preliminary study of the baculum of *Peromyscus leucopus* and *P. maniculatus* in Kansas. Trans. Kansas Acad. Sci., 42:495-497, 2 figs.

STENE, O. E.
1944. The development of Kansas wildlife conservation policies. Trans. Kansas Acad. Sci., 47:289-319.

STORER, T. I.
1926. Bats, bat towers and mosquitoes. Jour. Mamm., 7:85-90, 2 figs.

SWENK, M. H.
1938. Distribution of Marmota monax in the Missouri River region. Jour. Mamm., 19:348-353, 1 map.
1939. A study of local size variations of the prairie pocket gopher (Geomys bursarius), with description of a new subspecies from Nebraska. Missouri Valley Fauna, 1:1-8.
1940. A study of subspecies variation in the yellow pocket gopher (Geomys lutescens) in Nebraska, and the geographical and ecological distribution of the variants. Missouri Valley Fauna, 2:1-12.

TABOR, F. W.
1939. Extension of the range of the armadillo. Jour. Mamm., 20:489-493, 2 figs.

TAYLOR, W. P.
1934. Significance of extreme or intermittent conditions in distribution of species and management of natural resources, with a restatement of Liebig's law of minimum. Ecology, 15:374-379.

TIHEN, J. A., and SPRAGUE, J. M.
1939. Amphibians, reptiles and mammals of the Meade County State Park. Trans. Kansas Acad. Sci., 42:499-512, 1 map, 4 photographs.

TIMMONS, F. L.
1942. The dissemination of prickly pear seed by jack rabbits. Jour. Amer. Soc. Agron., 34:513-520.

TRUE, F. W.
1896. A revision of the American moles. Proc. U. S. Nat. Mus., 19(1101):1-111, 4 pls., 45 figs., 5 maps.

VILLA-R., B., and HALL, E. R.
1947. Subspeciation in pocket gophers of Kansas. Univ. Kansas Publs., Mus. Nat. Hist., 1:217-236, 2 figs.

WADE, O.
1928. Notes on the time of breeding and the number of young of Cynomys ludovicianus. Jour. Mamm., 9:149-151.

WEBB, J.
1940. Identification of rodents and rabbits by their fecal pellets. Trans. Kansas Acad. Sci., 43:479-481, 1 fig.

WEEKS, L. T.
1927. Autobiography of Leroy Titus Weeks. Wilson Bull., 39:86-90.

WHITAKER, H. L.
1939. Fox squirrel utilization of osage orange in Kansas. Jour. Wildlife Management, 3:117.

WILLIAMS, R. A.
1946. Forestry. pp. 117-125, in Soil conservation in Kansas, Rept. Kansas State Board Agric., 65:1-199.

WILLISTON, S. W.
1877A. The American antelope. Amer. Nat., pp. 599-603.
1877B. Spermophilus Richardsonii. Trans. Kansas Acad. Sci., 6:39-40.

WOOSTER, L. D.
1931. The present status of certain mammals in western Kansas. Trans. Kansas Acad. Sci., 34:112-113.
1935. Notes on the effects of drought on animal populations in western Kansas. Trans. Kansas Acad. Sci., 38:351-352.
1936. The contents of owl pellets as indicators of habitat preferences of small mammals. Trans. Kansas Acad. Sci., 39:395-397.
1937. The fauna: Mammals and birds of "Rock City". Trans. Kansas Acad. Sci., 40:197-198, 1 pl.
1938. An attempt at an ecological evaluation of predators on a mixed prairie area in western Kansas. Trans. Kansas Acad. Sci., 41:387-394, 2 figs.
1939A. The effects of drouth on rodent populations. Turtox News (Chicago), 17(1).
1939B. An ecological evaluation of predatees on a mixed prairie area in western Kansas. Trans. Kansas Acad. Sci., 42:515-517, 2 figs.

WRIGHT, S.
1931. Evolution of Mendalian populations. Genetics, 16:97-159.

YOUNG, S. P., and GOLDMAN, E. A.
1944. The wolves of North America. The American Wildlife Institute, pp. xxii + 636, 131 pls., 15 figs.
1946. The Puma, mysterious American cat. American Wildlife Inst., pp. xvi + 358, 93 pls., 6 figs.

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