Spring 1959

The Effects of Cattle Enclosures on Small Mammals

William P. Hanzlick
Fort Hays Kansas State College

THE EFFECTS OF CATTLE EXCLOSURES ON SMALL MAMMALS

being

A thesis presented to the Graduate Faculty
of the Fort Hays Kansas State College in
partial fulfillment of the requirements for
the degree of Master of Science

by

William P. Hanzlick, B.S.
Fort Hays Kansas State College

Date 5-11-59 Approved Edwin P. Martin
Major Professor

Ralph G. Coder
Chairman Graduate Council

THESIS ABSTRACT

An investigation to determine the effects of cattle exclosures on the habits and activities of small mammals within and surrounding these protected areas was conducted from September to November of 1958.

Four exclosures, located in a 750 acre moderately grazed mixed prairie near Hays, Kansas that were sampled included a shortgrass exclosure, a little bluestem exclosure, and two exclosures diagonally dissected by a transition area.

Live-traps were placed inside each exclosure in a grid with 10 feet intervals. The species, sex, and approximate age of each individual were recorded. Each exclosure was live-trapped from 10 to 14 days.

Snap-traps were used outside each exclosure to determine the distance the marked rodents travelled from within the exclosure. Four concentric rings of snap-traps were placed around each exclosure. The rings were 10 feet apart and the intervals between traps varied from five to 10 feet. The snap-traps were checked daily at each exclosure for a period of seven to 14 days.

The point contact method was used to determine the percentage composition and basal cover of the vegetation within and surrounding each exclosure.

The principle species of small mammals captured during the study were (Peromyscus maniculatus nebrascensis), (Microtus ochrogaster haydenii), (Sigmodon hispidus texianus), and (Onychomys leucogaster leucogaster). Peromyscus were the most commonly captured mammals at the four exclosures, and were generally taken in sparsely vegetated hillside areas. Microtus and Sigmodon were captured almost exclusively

in the heavy vegetation within or adjacent to the protected areas. When Microtus and Sigmodon were found together, Sigmodon occupied the more favorably vegetated areas. Onychomys occurred in greatest numbers within or adjacent to sparsely vegetated hillside areas.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The existing semi-arid climate and the type of vegetation found in western Kansas permits the existence of a wide variety of animal life. The animal life consists chiefly of small mammals such as rodents, small carnivores, and other relatively small forms of wildlife. These animals, although seldom observed, are of major importance as constituents of food webs which provide food for other mammals and birds.

The purpose of this study was to determine, through live-trapping and snap-trapping, what effects cattle exclosures had on the habits and activities of small mammals within and immediately surrounding these protected areas. Exclosures are small vegetated areas that have been protected from disturbance by domestic or native forms of animals. One of the principal uses for such an area is to determine the climax type of vegetation.

The study was devoted chiefly to gathering data on the habitat preference, movements within and adjacent to the exclosures, and general information on the habits and life histories of various small mammal species commonly found in western Kansas. The time element was an important factor in limiting the length and scope of this study.

A review of literature pertaining to the habits and activities of small mammals in western Kansas disclosed that few such studies have been conducted. Publications that were useful in obtaining information concerning movements and habitat preference of small mammals included those of Martin (1956, 1959), Brown (1946), Cockrum (1948), Jameson (1955), Hays (1958), and Phillips (1936).

The publications of Hall (1955), Cockrum (1952), Odum (1955), Svihla (1929), Calhoun (1945), and Cogshall (1928) were helpful in determining the general habits and activities of various small mammals. Information concerning vegetative aspects of the study was taken from Albertson (1937) and from a number of theses submitted to the Department of Botany, Fort Hays Kansas State College.

METHODS

The principal methods used to study the movements of small mammals within and immediately surrounding each of the four exclosures were live-trapping and snap-trapping. Data were collected from late August to late November of 1958. Except for a relatively short cold period, temperatures were above normal throughout the four months of study (Anonymous, 1958). Due to sufficient moisture and otherwise good growing conditions, vegetation on uplands, hillsides, and lowland remained green about three weeks longer than usual.

Photographs were taken of the vegetation within and surrounding each exclosure to illustrate the variations in the vegetative composition of each study area, and also to compare the difference in foliage growth of the protected and moderately grazed areas.

The live-traps used in the study were modified from specifications by Fitch (1950) (Fig. 1). These traps are effective in trapping small mammals without causing them injury. According to Cockrum (1947), live-trapping disturbs the biota less than snap-trapping. Live-traps were placed inside each exclosure in a grid with ten-feet intervals. Chicken scratch was used as bait. Each exclosure was live-trapped at least 10 days, and some were trapped for 14 days. The species, sex, and approximate age (adult, sub-adult, and juvenile) of each individual captured in the live-traps were recorded, and each was marked by toe clippings (Fitch, 1952) and immediately released.

Museum special snap-traps and ordinary snap-traps, baited with rolled oats and peanut butter, were used outside each exclosure to deter-

Fig. 1. Type of live-trap used for capturing small mammals within the exclosure.

mine the distance the marked rodents traveled from within the exclosure. Four concentric rings of snap-traps were placed around each exclosure. The rings were 10 feet apart and the intervals between traps varied from five to 10 feet. The snap-traps were checked daily at each exclosure for periods of seven to 14 days. The species and approximate age of the dead individuals were recorded. Trapping was concluded at the exclosure after two consecutive days of declining catches.

The point transect (Clarke, et al., 1942) was used to determine the percentage composition and basal cover of the vegetation of each study area. This instrument consisted of 10 brass rods (0.125 inch in diameter) two inches apart in an upright metal frame (Fig. 2). Contacts with a stem or a crown of a grass plant were recorded by species.

The method employed in sampling the vegetation of each study area was to use the point transect in three adjacent rectangular areas, five feet in width, extending the length of each side of the exclosure (Fig. 3). Point data collected within each rectangle were obtained by using an X-shaped pattern with the point transect. The same X-shaped pattern was used to sample the vegetation within each exclosure. A minimum of 300 points were taken in each rectangle, and a minimum of 500 points were taken inside each exclosure.

The only exclosure not treated in the described manner was the smaller, shortgrass exclosure. In this area the basal cover and species composition within and surrounding the exclosure were estimated. The species of forbs were also recorded, but no attempt was made to determine their abundance or importance.

Fig. 2. Point contact apparatus used in analyzing vegetation within and surrounding each exclosure.

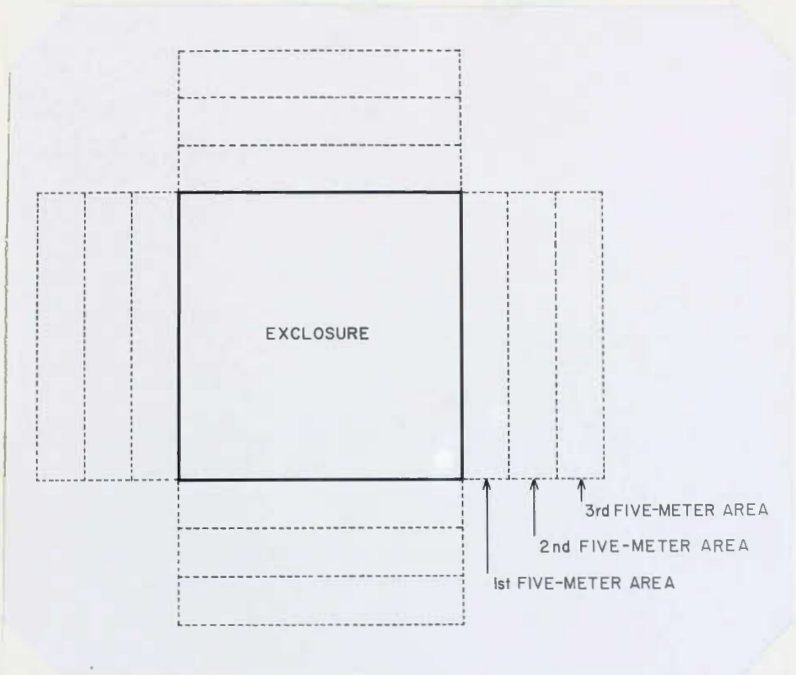

Fig. 3. Pattern of sampling the vegetation within and surrounding each exclosure. Broken lines surround the areas sampled outside the exclosure. Dots indicate the sampling pattern.

Much of the information concerning activities, food habits, and habitat preferences of small mammals in mixed prairie near Hays, Kansas was taken from the literature or from unpublished data by Martin (1959).

DESCRIPTION OF THE STUDY AREAS

The areas selected for study were located in 750 acres of moderately grazed mixed prairie owned by Fort Hays Kansas State College. The topography of this area was typical of that found in western Kansas, as the land was dominated by gently sloping uplands, which were frequently dissected by ravines and tributaries. According to Albertson (1937), this area was divided into an upland site of deep residual soil, a hillside site of shallow, immature soil, and a lowland site of rich, deep alluvium eroded from adjacent hillsides (Table I). The almost level upland area was characterized by a shortgrass type of vegetation, composed chiefly of blue grama grass (Bouteloua gracilis)[1] and buffalo grass (Buchloe dactyloides). However, western wheatgrass (Agropyron smithii) had become increasingly abundant in depressions on upland sites since Albertson's report.

The hillside area was characterized by an open type of vegetation which consisted of widely scattered areas of little bluestem (Andropogon scoparius), side-oats grama (Bouteloua curtipendula), big bluestem (Andropogon gerardi), and blue grama grass. This site was characterized by numerous particles of disintegrated Fort Hays limestone, which is the parent material found throughout the study areas (Albertson, 1937). Soils on the hillside areas seldom reach maturity due to gravitational erosion caused by occasional rains.

---

[1] Nomenclature of the grasses follows A. S. Hitchcock's "Manual of the grasses of the U. S." (Revised by Agnes Chase, 1950); that of other species is according to "Flora of the prairies and plains of central North America " by P. A. Rydberg, 1932.

TABLE I

	Exc. 1 and 2			Asc Exc.			Shortgrass Exc.		
Depth (inches)	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay
8	45.4	33.2	21.4	32.5	37.5	29.9	11.7	57.1	31.2
15	49.5	27.1	23.4	30.6	33.8	35.6	10.3	52.5	37.2
24	56.6	24.2	19.2	rock	rock	rock	10.7	54.7	34.7
36	rock	rock	rock	rock	rock	rock	15.1	58.9	26.0

Table I. Composition of the soil of each study area. The numbers represent percentages.

The lowland area consisted chiefly of such tall grasses as big bluestem, switch grass (Panicum virgatum), tall dropseed (Sporobolus asper), and western wheatgrass.

The soils in this area were composed of a deep mantle of fertile alluvium. The additional moisture carried into this area from hillsides promoted luxuriant growth of a mesic type of vegetation.

This region of the mixed prairie has been characterized by long, hot summers, cold winters, and frequent droughts. Average annual precipitation was approximately 23 inches, with the greater portion of moisture occurring during the growing season from April to September.

Shortgrass Exclosure

The shortgrass exclosure was located in a typical upland area of the native pasture, being surrounded by shortgrass vegetation (Fig. 4). This study area, the smallest of the four sampled, was 60 feet long and 25 feet wide. Blue grama and buffalo grass occurred in nearly equal proportions outside the exclosure. Western ragweed (Ambrosia psilostachya) was abundant throughout the entire area. An oilfield road ran approximately 20 feet from the south fence of the exclosure.

Observations of the vegetation within the shortgrass exclosure indicated that blue grama and buffalo grass occurred in equal abundance, and completely dominated the understory of vegetation. Wild alfalfa (Psoralea tenuiflora) was a moderately abundant forb within the exclosure, but was less conspicuous in the vegetation surrounding the study area. Little difference in the size of vegetation within and surrounding the exclosure was noted.

Fig. 4. Shortgrass exclosure. Blue grama and buffalo grass dominated the vegetation within and surrounding the exclosure. Western ragweed was very abundant throughout the area.

Little Bluestem Exclosure

The little bluestem exclosure was located on a moderately sloping hillside, where fragments of limestone were abundant in the thin mantle of soil. Vegetation surrounding this exclosure was composed chiefly of widely scattered small areas of little bluestem, big bluestem, and side-oats grama, with blue grama and hairy grama (Bouteloua hirsuta) distributed between the taller species of grass (Fig. 5). The vegetation within the little bluestem exclosure consisted of the same species of grass that surrounded the area. Little bluestem appeared in greater abundance within the exclosure. Vegetation within the little bluestem exclosure was noticeably taller than the vegetation surrounding the area, but more bare areas were observed among the protected grasses. Little mulch was found within or surrounding the exclosure.

Exclosure II

This exclosure was located on a slightly sloping, ordinary upland area that bordered a steep hillside on the west. The soils on the upper slope of the exclosure contained more clay, and were deeper and more compact than those on the lower slope.

A transition area, or ecotone, between the two types of soils bisected the exclosure from southwest to northeast. Vegetation on the lower slopes was composed chiefly of big bluestem, little bluestem, side-oats grama, and hairy grama, while such upland grasses as blue grama, buffalo grass, and western wheatgrass occupied the upper slope of the area (Fig. 6 and 7).

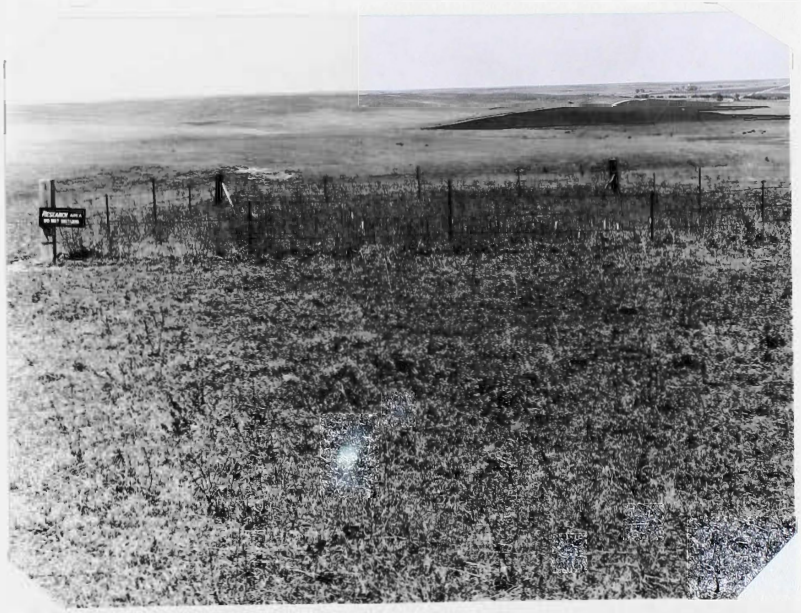

Fig. 5. Little bluestem exclosure. Little bluestem is the dominant grass, with big bluestem and side-oats grama occurring in lesser quantities.

Fig. 6. Hillside community inside exclosure II. Bluestem and side-oats grama were dominant grasses.

Fig. 7. Upland community outside exclosure II.

Blue grama and buffalo grass were dominant grasses.

The major difference in the vegetation found on the upland portion within, and surrounding the study area, was an increase in the amount of blue grama in the protected area. Big bluestem and little bluestem appeared more abundant on the lower slope of the exclosure in comparison with a similar type of vegetation surrounding the exclosure.

Exclosure I

This exclosure was located on a gently sloping area, lying partially on the edge of a steep hillside, and partially on an ordinary upland site. This study area closely resembled exclosure II in topography and vegetative composition. The major differences observed between the two study areas were greater amounts of rock particles in the soil on the hillside area of exclosure I, resulting in a greater abundance of little bluestem, and the relative absence of western wheatgrass on the shortgrass area of the same exclosure.

RESULTS AND DISCUSSION

The principle species of small mammals captured during the study were the plains deer mouse (Peromyscus maniculatus nebrascensis)[1], the prairie vole (Microtus ochrogaster haydenii), the hispid cotton rat (Sigmodon hispidus texianus), and the grasshopper mouse (Onychomys leucogaster leucogaster). Other small mammals captured included the western harvest mouse (Reithrodontomys megalotis albescens), the 13-lined ground squirrel (Spermophilus tridecemlineatus arenicola), the least short-tailed shrew (Cryptotis parva parva), and the house mouse (Mus musculus) (Table II). Only the four prominent species captured during the study will be discussed as to habitat preference, activities, and life history, since the others were not caught in sufficient numbers to permit conclusions to be drawn.

Exclosure I

The species of the protected vegetation within this exclosure was almost the same as that surrounding it. However, a marked difference in the relative abundance of certain species of grass inside and surrounding the exclosure was apparent.

Vegetation of the shortgrass community within the exclosure was dominated by blue grama, with buffalo grass occurring in slightly lesser quantities (Table III). The shortgrass type of vegetation outside the exclosure was composed chiefly of the same two species, but the relative

---

[1]Scientific nomenclature of mammals follows E. Raymond Hall's "Handbook of mammals of Kansas," Univ. of Kansas Nat. Hist. Misc. Publ., 7:1-303.

TABLE II

	Exc. I		Exc. II		Asc Exc.		Sht. Exc.		Total	
Species	in	out	in	out	in	out	in	out	in	out
Peromyscus	1	7	5	6	3	9	2	10	11	32
Sigmodon	2	-	-	-	1	-	10	2	13	2
Microtus	4	-	14	4	-	-	1	6	19	10
Onychomys	-	12	1	8	-	-	-	1	1	21
Cryptotus	-	2	-	-	-	-	-	3	-	5
Spermophilus	-	-	-	-	-	-	-	2	-	2
Reithrodontomys	-	-	-	-	-	-	-	1	-	1
Mus	-	-	-	-	-	2	-	-	-	2
Total	7	21	20	18	4	11	13	25	44	73

Table II. Numbers and species of mammals captured within and surrounding each exclosure.

TABLE III

Exc. / Spp.	Exclosures I & II (Asc, Age, Bcu) hillside in	hillside out	shtgrass in	shtgrass out	Asc Exc. (Asc, Age) hillside in	hillside out	Shtgr. Exc. (Bgr, Bda) shtgrass in	shtgrass out
Basal area	18.0	22.0	26.3	41.1	18.2	17.9	84.0	88.0
Bgr	-	36.9	69.6	32.1	-	3.6	50.0	40.0
Bda	-	5.4	27.8	67.9	-	-	40.0	50.0
Bcu	19.4	38.8	1.3	-	17.6	44.7	-	-
Age	58.3	11.5	-	-	9.9	32.5	-	-
Asc	22.3	3.5	-	-	72.5	17.7	-	-
Bhi	-	1.9	-	-	-	1.5	-	-
Alo	-	.3	-	-	-	-	2.0	3.5
Pvi	-	1.7	-	-	-	-	-	-

Bgr - Blue grama
Bda - Buffalo grass
Bcu - Side-oats grama
Age - Big bluestem
Asc - Little bluestem
Bhi - Hairy grama
Alo - Red three-awn
Pvi - Switch grass

Basal areas for shortgrass exclosure was estimated.

Table III. Species composition of the vegetation within and surrounding each exclosure. Numbers are percentages.

abundance of each was reversed. The shift in dominance outside the exclosure was attributed to grazing pressure on the vegetation.

Hillside vegetation within the exclosure differed from that surrounding the study area (Table III). Bluestems were more abundant, and side-oats grama was a subdominant within the protected area. The grazed vegetation was dominated by blue grama and side-oats grama, with bluestems comprising a smaller portion of the vegetation composition. Where grama grasses were present the cover was relatively high, but in areas where bluestems were dominant the cover was low and quite open.

A total of seven small mammals were captured within exclosure I during the period of study (Table II). Four of the mammals were prairie voles, two were hispid cotton rats, and one was a prairie deer mouse. All four of the prairie voles were captured in the shortgrass type of vegetation near the transition area of the exclosure. Extensive runways were found throughout the more heavily vegetated shortgrass areas inside the study area. Prairie voles are believed to utilize these runways for securing food. Voles, if given a choice between grazed or ungrazed shortgrass, will generally utilize the ungrazed vegetation, due to higher cover and the presence of mulch in the protected area.

The hispid cotton rats were captured in the hillside vegetation where foliage cover and mulch were most abundant. Cotton rats are commonly found in this type of habitat during fall months, utilizing the tall vegetation to a great extent (Martin, 1959). Cotton rats, like prairie voles, usually are not tolerant of heavily grazed habitats where cover is very sparse. Cotton rats also construct runways, but

they are ill-defined in comparison with the runways of the prairie voles (Hall, 1955).

The prairie deer mouse was captured in the transition area between the two types of vegetation, near a fence-line of the exclosure. The possibility that the deer mouse was a transient bears consideration as this species generally exhibits preference for habitats that are characterized by open cover and rocky soil.

Twelve grasshopper mice and seven plains deer mice were captured in snap-traps surrounding exclosure I (Table II). One of the deer mice had been marked. No prairie voles or hispid cotton rats were caught outside this exclosure. Six of the grasshopper mice were caught in the transition area, and the remaining six individuals were taken in areas where vegetation was closely cropped, and widely scattered.

Five of the deer mice were captured in hillside vegetation where the cover was sparse, and the remaining two specimens were taken in the transition area between the two types of vegetation. Throughout the period of study, prairie deer mice exhibited a marked preference for sparsely vegetated areas commonly found in hillside sites. Unlike voles or hispid cotton rats, this small mammal is tolerant of bare areas. However, deer mice also survive well in densely vegetated areas such as found in shortgrass and transition areas. Deer mice compete very little with prairie voles or hispid cotton rats for food or nesting material. Deer mice subsist principally on plant seeds and small insects. They inhabit nearly all types of habitat, utilizing open burrows, weed piles, holes beneath rocks, and cracks in banks (Brown, 1946).

The distribution of the mammals captured in this area suggested that high basal cover and foliage cover were probably necessary for voles and cotton rats. Grasshopper mice and deer mice, however, avoided the heavier cover and preferred the more open grazed site.

Exclosure II

The vegetation within and surrounding this exclosure was similar to the vegetation of exclosure I (Table III). However, the vegetation in the hillside portion of the exclosure was sparse and the accumulation of mulch was small. The shortgrass area outside the exclosure was relatively level, but the hillside area was located on a very steep slope.

A total of 20 small mammals were captured within this exclosure (Table II). Fourteen were prairie voles, five were deer mice, and one was a grasshopper mouse. Mortality among the mammals was high, as seven voles and one deer mouse were found dead in the live-traps during the study. A light snow, and a sudden drop in temperature were the probable causes of the deaths.

Nine of the prairie voles captured in live-traps within the exclosure were taken in shortgrass vegetation, four were taken in hillside vegetation, and only one vole was taken in the transition area of the exclosure. Prairie voles captured in the hillside vegetation were located in traps where foliage growth was heaviest.

Habitat preference of the deer mice inside exclosure II was less apparent than that of the prairie vole, as three deer mice were captured in the more open cover of the hillside vegetation. Two deer mice were

captured in shortgrass vegetation, and one was captured in the transition area of the exclosure.

The single grasshopper mouse was captured in hillside vegetation where cover was probably the lowest and where the percentage of rock fragments appeared to be extremely high.

Eighteen small mammals were caught in the snap-traps surrounding exclosure II, and only three of these were marked. Eight of the mammals were grasshopper mice, five of which were captured in the ring of traps nearest the exclosure, two were captured in the second row of traps, and one was captured in the third ring of traps. Two grasshopper mice were taken in shortgrass vegetation, one was taken in the transition area, and the remaining five individuals were taken in hillside vegetation. None of these mammals were marked.

Grasshopper mice captured near the study areas exhibited a preference for open cover and sparsely vegetated areas, such as found on hillsides. Previous workers (Bailey and Sperry, 1929, Hibbard, 1944) found that grasshopper mice preferred the shortgrass type of vegetation where cover is greater. The habitat preference of the grasshopper mouse at this exclosure may have been caused by exclusion from the shortgrass vegetation by hispid cotton rats, or by the abundance of insects, primarily grasshoppers, in the sparsely vegetated areas. Grasshopper mice subsist principally on insects, as nearly 90 per cent of their food is animal matter, of which 80 per cent is insects. They also take seeds and other vegetable foods when insects are scarce (Hall, 1955, Cockrum, 1952).

Deer mice exhibited a preference for hillside vegetation at this exclosure, as five of the captures were made in this community and only one was in the shortgrass vegetation. One of the marked deer mice was caught in the second ring of traps within the hillside type of vegetation.

Of the four prairie voles captured outside the exclosure, three were taken in shortgrass and one was taken in hillside vegetation. All of the trapped individuals were taken in areas where cover and foliage growth appeared more luxuriant than those of surrounding vegetation. An extensive maze of runways, probably constructed by prairie voles, were found in shortgrass vegetation outside the exclosure.

Data collected on the habitat preference of prairie voles during the study period indicated that these small mammals preferred dense shortgrass vegetation. Voles exhibited secondary preference for hillside vegetation where foliage cover was high and mulch had accumulated.

Little Bluestem Exclosure

Vegetation within and surrounding this exclosure was dominated by big and little bluestem, side-oats grama, and blue grama (Table III). Cover was low and the individual grass plants were widely scattered.

The number of small mammals captured within and immediately surrounding the little bluestem exclosure was noticeably smaller than that found at the other study areas (Table II). The probable causes of a lower mammal population were, in part, sparse cover, little mulch, and low foliage growth within and adjacent to the exclosed area. Only four mammals, three deer mice and one hispid cotton rat, were captured inside the exclosure. All four rodents were captured on the same day

of the trapping period in traps adjacent to a fence-line of the exclosure. The vegetation within this exclosure appeared to hold some attraction to mammals as five of the nine mice were caught in the ring of traps nearest the exclosure.

Two house mice were also caught in the ring of snap-traps nearest the little bluestem exclosure. The presence of this species in the native vegetation of the College Pasture was confusing, as no buildings or country roads were located within one-half mile of the exclosure. House mice are normally found in or near buildings, and they usually cannot compete with grassland mammals for any length of time.

Shortgrass Exclosure

Foliage growth within this exclosure did not appear to be appreciably greater than the growth outside the protected area. The species composition remained relatively stable inside and outside the exclosure (Table III). Grazing by cattle in this area was moderate, thus the shortgrass exhibited a somewhat greater height.

Hispid cotton rats were the most abundant species captured within the shortgrass exclosure, as 10 individuals were taken in the protected vegetation. Two prairie deer mice and one prairie vole were also captured within the exclosure.

A variety of small mammal species was captured in the vegetation surrounding the shortgrass exclosure (Table II). The two most abundant species taken were the prairie deer mice, with 10 captures, and the prairie vole, with six captures. The principal factor contributing to the abundance of deer mice in shortgrass vegetation was

probably the great abundance of western ragweed plants in the area. Cogshall (1938) reported that deer mice exhibited a preference for ragweed and dandelion seeds. Nearly 50 per cent of the food consumed by prairie deer mice consists of vegetative matter, most of which is in the form of seeds. Insects are also an important consituent in their diet (Hall, 1955, Brown, 1946).

Other species of small mammals caught in snap-traps surrounding the exclosed area were the hispid cotton rat and 13-lined ground squirrel (two captures each), western harvest mouse and grasshopper mouse (one capture each), and the least short-tailed shrew (three captures). The captures were made in each of the three trap-lines. There appeared to be relatively little population concentration near the exclosure, as the number of mammals taken in each trap line differed by only one animal. The only species seemingly concentrated near the exclosure was the prairie vole. Four of the six individuals were captured in traps nearest the exclosure. The relative absence of prairie voles from the protected vegetation, and their abundance adjacent to the exclosure may have been attributed to the heavy concentration of hispid cotton rats in the area. These two mammals are considered ecological equivalents (Calhoun, 1945, Martin, 1956), as they both utilize the young, green matter of plant shoots for food, and inhabit vegetation that is dense and relatively tall. Cotton rats are larger and more aggressive than prairie voles, and the young of cotton rats are able to forage for themselves at a very early age.

Hispid cotton rats are essentially Southern in origin, and have only recently migrated into Kansas. Charles Sibley, as cited in Cockrum (1948), made a survey of small mammals in 1942, and found no cotton rats in Trego County. However, many cotton rats were taken by Sibley near Dodge City, Meade, and Dighton, Kansas. Cockrum conducted a similar study in 1947 and found no cotton rats near Colby and Goodland, Kansas. The first cotton rat in Ellis County was captured in 1949 (Cockrum, 1952). From 1933 to 1947 the cotton rat has expanded its geographic range northward, in Kansas, 100 miles (Hall, 1955).

SUMMARY AND CONCLUSIONS

Data were collected on the activities of small mammals within and immediately surrounding four cattle exclosures in a mixed prairie near Hays, Kansas. The study was conducted from September to November, 1958. Live-trapping and snap-trapping were the principal methods employed in determining the movements and relative populations of mammals. The point transect method of sampling the vegetation was used at each exclosure.

A total of 117 small mammals were captured during the study. Forty-four specimens were caught within the four exclosures and 73 were caught outside the exclosed areas.

The exclosures seemingly presented a more favorable habitat for small mammals than vegetation adjacent to the study areas. Movements of the inhabitants of the exclosures were usually restricted to the protected vegetation. In most instances animal populations outside the exclosures appeared more concentrated near the protected vegetation. Except for voles, however, animal populations near the shortgrass exclosure did not exhibit this population aggregation. The reason for this may have been the homogeneity of the vegetation throughout the shortgrass area.

Prairie deer mice were the most commonly captured animals at the four exclosures, and were generally taken in sparsely vegetated areas. Deer mice, however, were also abundant in the shortgrass area, due to the abundance of ragweed plants. Deer mice readily utilize the seeds of this plant for food.

Prairie voles and hispid cotton rats were captured almost exclusively in heavy vegetation within or adjacent to the study areas. Where voles and cotton rats were found together, cotton rats occupied the more favorably vegetated areas.

Grasshopper mice occurred in greatest numbers within or adjacent to sparsely vegetated hillside areas. Many grasshopper mice were captured in transition areas between upland and hillside sites, but few specimens were taken in areas where shortgrass vegetation prevailed.

LITERATURE CITED

Albertson, F. W. 1937. Ecology of a mixed prairie in west-central Kansas. Ecol. Monog., 7:481-547.

Anonymous. 1957. Climatological data, Kansas, annual summary 1957. U. S. Dept. Comm., 71:146-213.

Anonymous. 1958. Climatological data, Kansas, annual summary 1958. U. S. Dept. Comm., 72:158-176.

Bailey, Vernon, and Charles C. Sperry. 1929. Life history and habits of grasshopper mice, genus Onychomys. U.S.D.A. Tech. Bull., 145:1-19.

Brown, H. Leo. 1946. Rodent activity in a mixed prairie near Hays, Kansas. Trans. Kans. Acad. Sci., 48:448-456.

Calhoun, J. B. 1945. Diet activity rhythms of the rodents (Microtus ochrogaster) and (Sigmodon hispidus hispidus). Ecol., 26:251-273.

Clarke, S. E., J. A. Campbell, and J. B. Campbell. 1942. An ecological and grazing capacity study of the native grass pastures in southern Alberta, Saskatchewan and Manitoba. Dom. Canada, Dept. Agr. Tech. Bull., 44.

Cockrum, E. L. 1947. Effectiveness of live-traps vs. snap-traps. Jour. Mamm., 28:186.

Cockrum, E. L. 1948. The distribution of the hispid cotton rat in Kansas. Trans. Kansas Acad. Sci., 51:306-312.

Cockrum, E. L. 1952. Mammals of Kansas. Univ. Kansas Mus. Nat. Hist. Publ., 7:1-303.

Cogshall, A. S. 1928. Food habits of deer mice of the genus Peromyscus in captivity. Jour. Mamm., 9:217-221.

Fitch, H. S. 1950. A new style live-trap for small mammals. Jour. Mamm., 31:364-365.

Fitch, H. S. 1952. The University of Kansas Natural History Reservation. Univ. Kansas Mus. Nat. Hist. Misc. Publ., 4:1-38.

Hall, F. Raymond. 1955. Handbook of mammals of Kansas. Univ. Kansas Mus. Nat. Hist. Misc. Publ., 7:1-303.

Hays, Horace A. 1958. The distribution and movement of small mammals in central Oklahoma. Jour. Mamma., 39:235-243.

Hibbard, Claude W. 1944. A checklist of Kansas mammals, 1943. Trans. Kansas Acad. Sci., 47:61-88.

Jameson, E. W., Jr. 1955. Some factors affecting fluctuations of Microtus and Peromyscus. Jour. Mamm., 36:206-209.

Martin, F. P. 1956. A population study of the prairie vole (Microtus ochrogaster) in northeastern Kansas. Univ. Kansas Publ., 8:361-416.

Martin, E. P. 1959. Unpublished data. Fort Hays Kansas State College.

Odum, Eugene P. 1955. An eleven year history of a Sigmodon population. Jour. Mamm., 36:368-378.

Phillips, Paul. 1936. The distribution of rodents in overgrazed and normal grasslands of central Oklahoma. Ecol., 17:673-679.

Svihla, A. 1929. Life history notes on (Sigmodon hispidus hispidus). Jour. Mamm., 10:352-353.