FOOD HABITS AND CONTROL OF COYOTES IN NORTHCENTRAL OKLAHOMA

By

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IN NORTHCENTRAL OKLAHOMA

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PREFACE

In September, 1952, the writer undertook the task of examining the food habits of coyotes in northcentral Oklahoma. It was hoped that suggestions for improving the predator control policy in Oklahoma could be made on the basis of the study.

This study was made possible through a fellowship from the Oklahoma Cooperative Wildlife Research Unit.* Special thanks go to Dr. A. M. Stebler, Leader of the Oklahoma Cooperative Wildlife Research Unit, for directing the study. Robert L. Thomas, then a federal hunter, is also due acknowledgement for his wholehearted cooperation.

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* Oklahoma Department of Wildlife Conservation, Oklahoma State University, U. S. Fish and Wildlife Service, and The Wildlife Management Institute Cooperating.

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CHAPTER I

INTRODUCTION

Interest in increased coyote control in Oklahoma is frequently strong. This suggests either that present control measures may be inadequate or that the character of coyote predation is not clearly understood.

The present study attempts to evaluate the role of coyotes in the natural economy of northcentral Oklahoma and to recognize conditions under which control may be indicated. A survey of the literature has revealed only fragmentary information applicable to the problem in this region.

Man's most important concern with the coyote appears to center upon depredation of game, livestock, and poultry. There is less general concern in this region regarding their preying upon rabbits and rodents. An estimation of these matters has been the major concern of this study. This was approached through an investigation of coyote food habits in an agricultural region.

The coyotes studied here demonstrated a positive adaptiveness in their feeding habits. For example, they fed heavily on cotton rats--an animal not found in many parts of

the coyote range. Likewise, they were able to fare well in the absence of such prey as the ground squirrels, prairie voles, and big game carrion which contribute importantly to the support of coyotes elsewhere.

A second adaptive feature of the feeding of these coyotes was that they increased their use of certain food items during the seasons when the availability of these items increased. For example, fruits and insects were eaten with greater frequency during the summer and fall, while poultry use increased during the spring.

These coyotes showed further adaptiveness by varying their diet from one habitat type to another. Residues of favored foods which were most abundant in one habitat type were most prevalent in the scats from that type. Thus, wood rat and sand plum residues appeared in scats from a prairie-woodland ecotone, but they were absent or of much less prominance in scats from prairie areas. Likewise, rabbits and livestock assumed their greatest importance in the diet of coyotes from the prairie areas.

Some food preferences were indicated in this study. Scat analysis showed that coyotes seldom ate carnivores or omnivores but readily took herbivores. However, certain plentiful herbivores, for example gophers and songbirds, were not important foods. This appeared to be due to decreased availability of these items resulting from their size, fossorial habits, or flying abilities.

Most previous coyote food habits studies have suggested that livestock remains were of minor significance when compared with rabbits and rodents. This was especially true in the present study even though the area studied is one of considerable livestock production.

CHAPTER II

METHODS AND MATERIALS

Most of the food habits information was obtained from scats which were collected during each of twelve consecutive months beginning in February, 1952. These were used rather than stomachs, because they were more readily available. A shortcoming of the method was that it could not be determined if a food item was eaten as carrion or whether it represented a direct coyote kill.

Although all scats were collected from coyote runs, it is possible that a few came from animals other than coyotes. The number of misidentified scats is probably statistically insignificant.

There was no evidence to suggest that coyotes hunted most in pastures, croplands, brushy areas, or wooded areas. Tracks were common in all such places. Most of the scats, however, were collected from areas predominantly grassland.

Scat analysis was conducted by comparing the food residues with known reference materials. In the case of unknown hairs, the method of Hardy and Plitt (1940) was used. All mammalian genera were successfully separated in this manner except Sylvilagus and Lepus. These have been

lumped together as "rabbits." Microscopic identification of feathers was not undertaken.

Each scat was considered as one unit, and the different kinds of residues of its contents were recorded as percentages of the volume of that unit. This information was later consolidated into tables showing the percentage frequency and percentage volume of all items occurring in the scats (Tables I and II). No attempt was made to determine the number of animals of one kind occurring in any one scat.

The availability of mammals from the ecotone was estimated roughly from knowledge of their habitat conditions, which suggests population density and vulnerability, from knowledge of their habits, and from the information in Table III. This table is a condensation of the records of trapping programs carried out near Stillwater from 1950 through 1953 in connection with the North American Census of Small Mammals. A total of 6,940 trap nights, in which "museum special" and rat snap traps were used, is represented. Unfortunately, similar census information for the prairie areas was not available.

Coyote scats were collected from two habitat types within the study region--a large prairie area and a prairie-woodland ecotone. It was felt that differences in the coyote diet between these two habitat types might occur. Therefore, all food habits information from the prairie area was tabulated separately from that pertaining to the

ecotone. Results of the scat analysis then were entered in four columns to show seasonal variations. For this purpose, the periods of March through May, June through August, September through November, and December through February were considered as spring, summer, fall, and winter, respectively.

CHAPTER III

THE STUDY REGION

Due to a lack of time and facilities, it was necessary to restrict the study to Noble and Payne counties in north-central Oklahoma. This area was chosen partly because it was reached easily from headquarters at Oklahoma State University and partly because the investigator was intimately familiar with it. Moreover, it contained both woodland and prairie habitat types, which facilitated a study of coyotes in two different habitat situations. Coyote food habits, however, were studied only in the prairie and in the prairie-woodland ecotone.

The prairie habitat type occupies roughly the northern two-thirds of the study region, while a "cross-timbers" type accounts for the other one-third (Figure 1). The ecotone or contact between these two habitat or vegetative types is a zone one to several miles wide (Figure 2). About one-fourth of this ecotone is under cultivation, and most of the remainder is grazed.

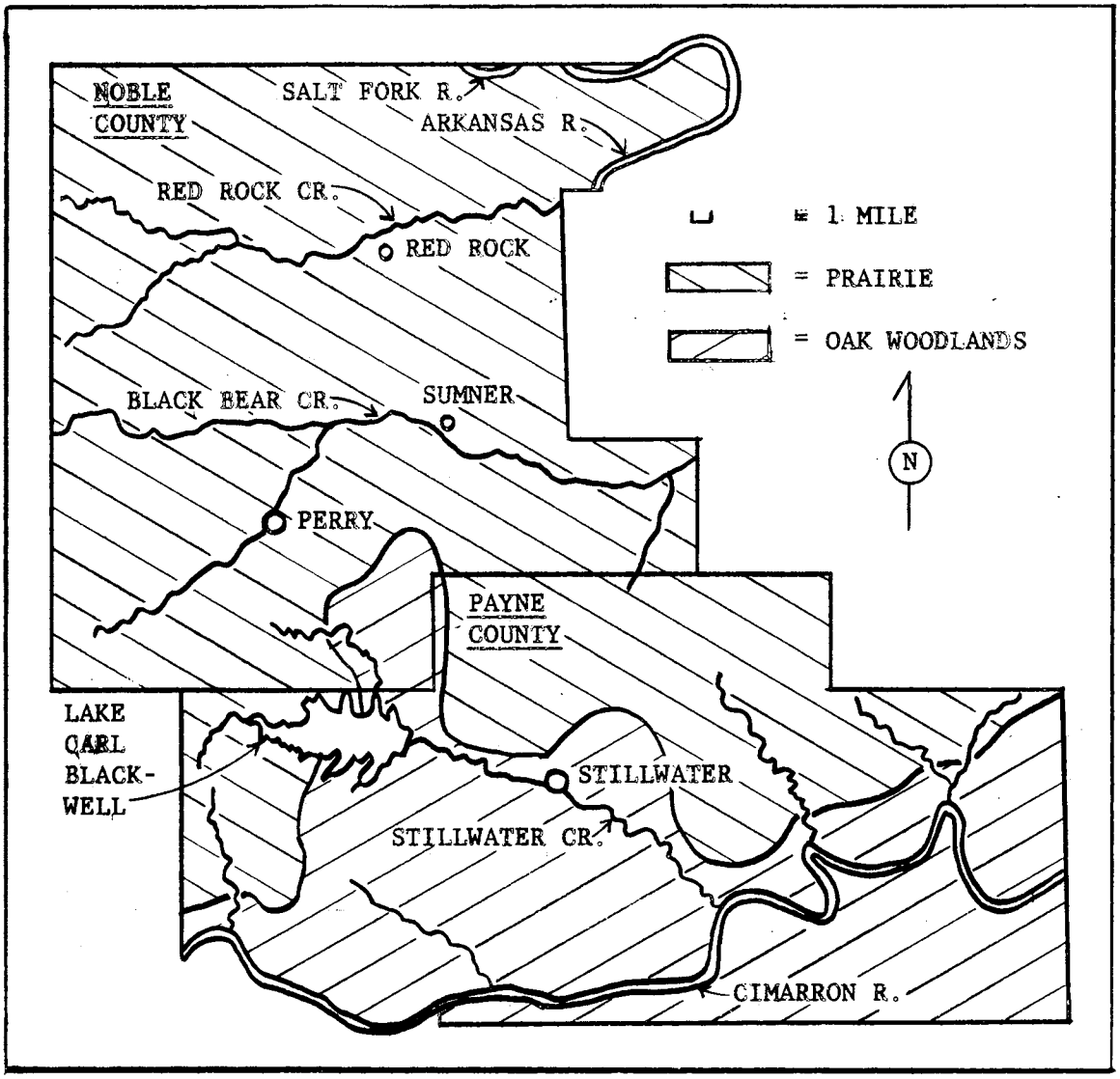

Figure 1. The Study Region in Northcentral Oklahoma (Vegetative types after Blair and Hubbell, 1938).

Figure 2. The Prairie-woodland Ecotone near Lake Carl Blackwell in Payne County.

Characteristic plants of the "cross-timbers" which are common in the prairie-woodland ecotone include post oak (Quercus stellata), blackjack oak (Quercus marilandica), smooth sumac (Rhus glabra), and coralberry (Symphoricarpus orbiculatus). The principal plants of the adjoining prairie, such as little bluestem (Andropogon scoparius), silver beardgrass (Andropogon saccharoides), big bluestem (Andropogon furcatus), indian grass (Sorghastrum nutans), and switch grass (Panicum virgatum), also are found in this ecotone.

Coyote populations in the prairie-woodland ecotone here were high during the study. This was made apparent by the foxhound field trials held at Lake Carl Blackwell during September, 1953. Hunting was limited to three mornings, yet seven coyotes were caught. Possibly these belonged to one

or two family groups. Also, Robert L. Thomas, then a federal hunter, caught nearly one hundred coyotes within ten miles of this lake during the preceding twenty months. Most of the study materials representing the prairie-woodland ecotone were collected in the vicinity of the same lake.

The prairie habitat type can be divided into two areas according to land use. The first of these is the area north of Red Rock Creek (Figure 3). It is about half pasture and half cropland. Many of the pastures are dominated by three-awned grass (Aristida spp.), while others retain good stands of native tall grasses. Most of the cultivated lands are managed for grain production and winter wheat pasture.

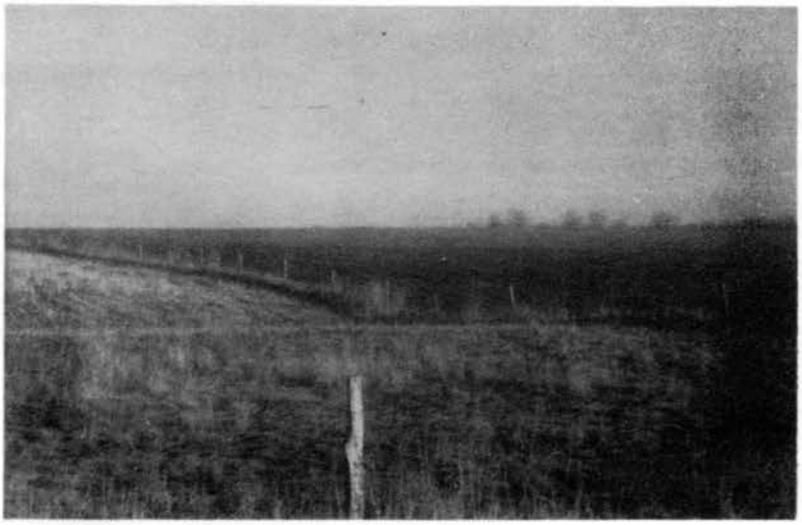

Figure 3. The Prairie Area north of Red Rock Creek.

The second prairie area lies north of the prairie-woodland ecotone and south of Red Rock Creek (Figure 4). It is mostly grassland and has few roads or cultivated fields. Grazing usually is moderate, and the "Andropogon" grasses dominate.

Figure 4. The Prairie Area south of Red Rock Creek.

"Signs," such as tracks and scats, suggested that coyotes were common north of Red Rock Creek. By the same measure, however, coyotes on the grassland area south of Red Rock Creek appeared much more abundant. The greater density of coyotes on the latter areas also was suggested by the catches of Robert L. Thomas who trapped there during most of 1953. On one square mile north of Sumner, he trapped twenty coyotes in less than two months. On another square mile, fo r miles south of Perry, he trapped twenty-two coyotes

during a three-month period. While these represent his highest catches in this area, they also suggest the abundance of coyotes there. This does not mean that the coyote density was twenty per square mile. It does, however, indicate that the travels of dispersing coyotes, and the home ranges of others, enable as many as twenty coyotes to use or traverse parts of one section of land during such a period of time.

CHAPTER IV

USE OF FOOD MATERIALS

Mammals

The results of scat analysis are contained in Tables I and II. These point out that small mammals were by far the most important source of food for coyotes. Nearly all of the mammals represented here were herbivores.

In both the prairie and the ecotone, rabbits and cotton rats were the coyote dietary staples throughout the year. There were two apparent reasons for this. First, these mammals were evidently very acceptable to coyotes and second, they may be presumed to be the most abundant prey species readily available. The present study, as well as several others, suggests that in its geographic range the cotton rat is one of the principal foods of predators. Sperry (1941) indicated that cotton rats are of great significance in the diet of coyotes from some parts of Texas. Also, Korschgen (1952) showed that cotton rats are of considerable importance in the coyote dietary in southern Missouri.

Table 1. Percentages by Frequency of Food Items in 358 Coyote Scats from Prairie and 404 from Prairie-oodland Ecotone in Payne and Noble Counties, Oklahoma, February, 1952, to February, 1953

	Spring		Summer		Fall		Winter		Year's Av.
Number of Scats	86	255	53	49	87	28	132	78	358 404
Region collected in	P*	E**	P	E	P	E	P		P
Food Items:									
Animal	100.0	100.0	100.0	97.7	100.0	100.0	100.0	100.0	100.0 99.5
Mammals	95.4	99.6	79.3	90.7	95.4	96.4	98.5	100.0	93.6 98.5
Rabbits	51.2	39.6	58.5	25.6	55.2	21.4	62.1	25.7	57.3 34.2
Cotton Rats	50.0	65.8	30.2	39.5	48.3	71.4	46.2	64.1	45.3 63.1
Wood Rats	2.3	12.2	5.7	14.0	4.6	14.3	1.5	17.9	3.1 13.6
White-Footed Mice	11.6	3.1	5.7	4.7	4.6	1.4	8.3	3.8	7.8 4.0
Harvest Mice	---	1.6	---	---	1.2	---	.8	---	.6 1.0
Pine Mice	3.5	2.0	---	7.0	14.9	---	10.6	1.3	9.8 2.2
Fox Squirrels	---	---	---	7.0	---	---	---	---	--- .7
Opossums	---	.8	---	---	1.2	---	2.3	---	1.1 .5
Sheep	1.2	---	1.9	---	---	---	.8	---	.8
Cattle	11.6	2.7	---	2.3	4.6	3.6	6.1	1.3	6.1 2.5
Trace Items	---	.4	---	---	2.3	3.6	2.3	---	1.4 .5
irds	16.3	14.5	37.7	25.6	8.0	21.4	12.1	12.9	15.9 15.
Poultry	15.1	4.7	28.3	14.0	4.6	---	6.8	5.1	11.5 5.4
Bobwhite Quail	---	.4	---	---	---	3.6	---	1.3	--- .7
Meadowlarks	---	.4	1.9	---	1.2	---	---	1.3	.8 .5
Unidentified	1.2	9.0	7.5	11.6	3.4	17.9	5.3	8.8	3.9 9.9
Reptiles	1.2	2.4	1.9	---	1.2	---	.8	---	1.1 1.2
Snakes	1.2	.4	1.9	---	1.2	---	.8	---	1.1 .2
Lizards	---	2.0	---	---	---	---	---	---	--- 1.
Insects	4.7	2.8	11.3	20.9	12.6	60.7	9.9	10.3	9.5 10.1
Beetles	2.3	2.0	3.8	11.6	8.0	7.1	3.0	---	4.2 3.0
Grasshoppers	---	.8	5.7	11.6	5.7	57.1	7.6	10.3	5.3 7.7
Unidentified	2.3	.4	1.9	---	---	---	.8	---	1.1 .2
Unidentified Animals	11.6	2.0	3.8	2.3	5.7	7.1	3.8	5.1	3.1 1.0
Plant	19.8	8.2	35.9	23.3	21.8	32.1	23.5	7.7	24.0 11.6
Grass	14.0	7.5	35.9	18.6	16.1	28.6	22.7	5.1	20.1 9.7
Small Grains	4.7	.4	---	2.3	4.6	---	---	---	2.2 .5
Persimmons	---	---	---	---	2.3	3.6	---	---	.6 .5
Trace Items	3.5	1.2	1.9	2.3	2.3	---	9.1	---	5.0 1.0
Unidentified	2.3	1.2	---	---	---	---	3.0	2.6	1.7 .7
Miscellaneous Items	2.3	---	1.9	---	---	3.6	.3	---	1.7 .2

*Prairie
**Prairie-Woodland Ecotone

Table II. Percentages by Volume of Food Items in 358 Coyote Scats from Prairie and 404 from Prairie-oodland Ecotone in Payne and Noble Counties, Oklahoma, February, 1952, to February, 1953

	Spring		Summer		Fall		Winter		Year's Av.	
Number of Scats	86	255	53	43	87	28	132	78	358	404
Region collected in	P*	E**	P	E	P	E	P	E	P	E
od Items:										
Animal	96.3	99.7	96.7	96.9	97.9	94.5	96.8	99.6	96.5	99.0
Mammals	82.6	95.7	71.1	76.6	89.1	73.9	91.1	94.7	85.6	92.1
Rabbits	37.4	29.6	41.2	19.5	42.8	12.5	47.9	18.7	43.2	26.0
Cotton Rats	31.0	52.3	21.2	36.5	36.2	43.2	29.8	57.6	30.5	50.6
Wood Rats	1.5	7.9	4.7	10.9	3.3	10.7	1.5	14.8	2.4	9.6
White-Footed Mice	4.1	1.4	3.4	.3	1.5	1.4	2.0	1.7	2.3	1.3
arvest Mice	---	.7	---	---	.1	---	.2	---	.1	.4
Pine Mice	.9	.9	---	.5	4.5	---	6.3	.6	3.7	.7
ox Squirrels	---	---	---	6.6	---	---	---	---	---	.7
Opossums	---	.6	---	---	.4	---	.3	---	.2	.4
Sheep	.6	---	.6	---	---	---	.3	---	.4	
Cattle	7.1	1.9	---	2.3	.3	3.6	2.5	1.3	2.7	1.
Trace Items	---	.4	---	---	t***	2.5	.3	---	.1	
irds	7.7	3.0	23.3	16.4	3.3	7.9	3.3	3.8	7.0	4.7
Poultry	7.7	1.7	19.3	13.6	1.6	---	2.9	3.1	6.1	3.0
Bobwhite Quail	---	t	---	---	---	.9	---	.4	---	.1
Meadowlarks	---	t	1.7	---	1.1	---	---	.1	.3	t
Unidentified	t	1.3	2.2	2.8	.6	7.0	.4	.2	.6	1.6
Reptiles	.1	.2	t	---	t	---	t	---	t	.1
Snakes	.1	t	t	---	t	---	t	---	t	t
Lizards	---	.2	---	---	---	---	---	---	---	.1
Insects	.3	.3	1.0	2.3	2.7	10.7	.9	.8	1.4	1.4
Beetles	.1	.2	.6	1.4	2.1	t	.2	---	.7	.2
Grasshoppers	---	.1	.3	.9	.6	10.7	.5	.8	.5	1.2
Unidentified	.2	t	.1	---	---	---	.2	---	.2	t
Unidentified Animals	5.6	.5	1.4	1.6	2.8	2.0	1.5	.3	2.5	.7
Plant	3.4	.3	3.1	3.1	2.1	5.5	3.1	.4	3.3	1.0
Grass	.9	.2	3.1	.8	.3	2.3	.8	.3	1.1	
mall Grains	.1	t	---	t	.1	---	---	---	t	t
Persimmons	---	---	---	---	1.2	3.2	---	---	.3	.2
Trace Items	1.2	.1	t	2.3	.5	---	1.8	---	1.2	.3
Unidentified	1.2	t	---	---	---	---	.5	.1	.7	t
Miscellaneous Items	.3	---	.2	---	---	t	.1	---	.2	
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Prairie

**Prairie-Woodland Ecotone

***Trace, less than .05 percent

Rabbits and cotton rats accounted for 75.1 percent of the total scat contents. According to the scat analysis, rabbits were more important as a coyote food in the prairie than were cotton rats. The reverse appeared to be true in the ecotone area. This situation might have been expected because the denser grass cover on the scat collecting sites of the ecotone is probably more favorable to cotton rats than the more closely-grazed grass of the prairie areas. It is probable that most rabbits represented in the scats were cottontails, for these appeared to be much more abundant on the landscape than did jack rabbits--the only other lagomorph present.

Wood rat remains were noted in 13.6 percent of the scats from the ecotone and in 3.1 percent of those from the prairie. In most of the ecotone areas, wood rats seemed to be plentiful, but in the grassland areas they were found only in bottomland timber and even there appeared to be uncommon.

Pine mouse remains occurred in 9.8 percent of the scats from the prairie and in 2.2 percent of those from the ecotone. Likewise, white-footed mouse* remains were found in 7.8 percent of the scats from the prairie and in 4 percent of those from the ecotone. The greater use of pine

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*Includes both Peromyscus leucopus and Peromyscus manicubtus wherever used.

mice and white-footed mice as a coyote food on the prairie areas could mean that these mice were more abundant on the prairie areas. It also could mean that because cotton rats may have been less common in the prairie areas, as compared with the ecotone, coyotes feeding there made greater use of these mice, as well as of rabbits, livestock, and poultry.

It seems strange that pine mice were not caught during the small mammal census (Table III). Possibly the trapping techniques were selective in this case. Also, pine mice populations appeared to be less uniformly distributed than most rodents caught. Thus the census probably did not include a pine mouse colony.

Table III. Relative Abundance of Small Mammals Near Stillwater in Payne County as Suggested by "The North American Census of Small Mammals," 1950-1953, Expressed as Percentages of the Total Catch

Mammals	Percentages
Cotton Rats	73.0
White-footed Mice	20.0
Harvest Mice	2.7
Wood Rats	3.3
Thirteen-lined Ground Squirrel	.3
Spotted Skunk	.3
Least Shrew	.3

Harvest mouse remains occurred in but six scats, four of which came from the ecotone. The only scat which contained pocket mouse remains also came from the ecotone. A scat from the prairie contained the only house mouse remains found. The relative scarcity of these three species of mice, as compared with white-footed mice, for example, and their small size were probably responsible for the paucity of their remains in the scats.

It is noteworthy that pocket gophers were not represented in the scats, although gopher mounds were frequent in most areas. It seems likely that the fossorial habits of gophers make them more or less invulnerable to coyotes. It is also possible that, as with some gophers reported upon by Fichter, Schildman, and Sather (1955), these were even more unavailable to coyotes because of hard soils.

Coyote "sign" was more common along the creeks during the summer than at any other time of the year. The coyotes seemed to have been drawn here by the water, lower temperatures, and concealment for the puppies. On one score this shift was reflected in the coyote diet, for the only scats containing fox squirrel remains were collected during this season. The fox squirrel remnants formed 90 percent of the three scats in which they were found. These came from the ecotone.

Carnivorous and omnivorous mammals were common in the study area but were represented infrequently in the scats.

Although common in the field when the scats were collected, the traces of least shrew, opossum, skunk, house cat, and coyote were the only indications of such animals found during analysis. These remains were collected mostly during the winter months when food for coyotes may be less abundant.

On several occasions instances of mole tunnels having been mined in puppy playgrounds were observed. It is not known how many moles were caught in this manner or if it they were used as food. Both shrews and moles appeared rather common along most creeks. Traces of the least shrew in one scat, however, were the only insectivore remains found during the entire analysis.

Opossums and skunks were common in most parts of the study region when the scats were collected. However, their remains were found in only six scats. Opossum remains were found in four scats from the prairie and in one from the ecotone. Another scat from the prairie contained the only skunk remains found. Clues were found near a coyote den, where an adult skunk apparently had been killed and partially eaten by a coyote. In another case, a skunk carcass was found near a hole recently cleaned out by "prospecting" coyotes. Likewise, an opossum carcass was found in a similar situation. It seems likely that coyotes were enlarging for their own use holes belonging to these animals, and when the occupants were reached, they were

killed. It is noteworthy that the two last-mentioned carcasses had not been fed upon.

The only scat containing house cat residues was composed almost entirely thereof and was collected from the ecotone during April. A few coyote hairs were noted in a scat collected from the prairie during October.

The remains of sheep, horse, and cattle comprised the livestock remains found in the scats. Cattle remains were noted in 2.5 percent of the scats from the ecotone and in 6.1 percent of those from the prairie. Likewise, they formed 1.9 percent of the contents of the scats from the ecotone and 2.7 percent of those from the prairie and were most common in the late winter scats. Observations, as well as scat analysis, suggested that cattle flesh was more plentiful in the prairie than in the ecotone. This was especially noted on a large grassland tract immediately southeast of Red Rock. In one day's time during April, 1953, the carcasses of five adult cattle and two calves were found on an area of about nine square miles. All were judged to have been dead from one to four months. While only one of these represented an animal small enough to have been susceptible to coyote predation, all had been fed on by carnivores, mostly coyotes. In no other part of the study region did livestock appear to be as available as on this tract.

As a result of cold weather, calving, and a less adequate diet, more range cattle probably die during the winter than at any other time of the year. This would make cattle carrion more available to scavengers then and may well be the reason for the greater frequency of cattle remains in the late winter scats.

Only one scat was found in which horse remains were identified. This came from the prairie and was collected during February. As compared with cattle, there were very few horses in the study region. That horse remains were only noted in one scat does not, therefore, suggest that horse meat was less palatable to coyotes than cattle flesh or even rodents.

Two scats from the prairie and one from the ecotone, collected during February, March, and June, contained sheep remains. A significant part of each of these was made up of sheep wool. If these remains represent sheep kills, they suggest that some coyotes are, at times, a menace to the few sheep ranchers of the study region. Domestic dogs, however, were usually more destructive to sheep than coyotes. On four occasions between 1940 and 1947, the writer has seen evidence of dog predation on sheep herds in this region.

Only one other report of coyote predation on sheep in the study region has come to the writer's attention. Mr. Jay Ratliff, a farmer in Noble County, reported that some years ago he shot a coyote in the act of killing a ewe.

Mr. Ratliff said that this coyote, a "perfect" specimen, had visited his sheep pen twice earlier, killing one sheep each time.

Birds

Bird remains, although occurring in 18.2 percent of the scats, were of minor significance when compared with mammal remains. Poultry residues accounted for 76.2 percent of the bird remains and occurred in 44.4 percent of the scats in which bird residues were found. The scats collected during the warm months, especially those from the prairie, most frequently contained poultry remains.

Guinea fowl or domestic duck may have been represented in the poultry remains. It is felt, however, that most of the poultry remains were from chickens, because other fowl form but a small portion of the poultry population of the study region. However, the writer once tracked a coyote one mile from the vicinity of a farm house to a spot where a domestic duck had been eaten. It is not known if the duck was dead before the coyote obtained it.

Turkeys were common in the study area, but no remains of them were identified in the scats. However, two reports of coyote predation on turkey flocks were brought to the writer's attention. Again, positive evidence was not obtained.

The greater frequency of poultry residues in scats from the prairie may have been due to a larger supply of poultry there. On the other hand, there was no positive evidence of this. Possibly an abundance of cotton rats in the ecotone diverted some coyote attention from poultry there.

There are several factors which could acco nt for the increased se of poultry during he summer. At this time parent coyotes require more food as a res lt of having to feed their young. Also poultry, especially chickens and turkeys, are most vulnerable during the summer. This is partly due to their foraging activities which, in the case of chickens, may take them a q arter of a mile from the farm b ildings. Turkeys may travel several miles in this manner.

Predation on pou try s further aggravated by a common practice of planting grain and row crops near farm buildings. Poultry are attracted by both the grain and associated insect . Furthermore, these crops, as well as orchards and wooded ravines, provide concealment for preda- ors. Wallowed-dow spots rewn wi h feather in such sit a ion may be indica ive of preda ion so ind ced, or they may signify hat happens to poultry which, having died in the po l ry yard, are di carded by the farm r and later carri d of and eaten by a scav ng r. It is suspected that a significant part of the poultry remains in the scats represent coyote kills, for about one-fo rth of he farmers ques ioned professed to have wi ne s d chicken-stealing by

coyotes. The writer knows of one incident of attempted poultry predation by a coyote.

No evidence of wild duck in the coyote diet was noted, either through scat analysis or field observations. Nevertheless, many of the scats came from the Lake Carl Blackwell area which is visited annually by large flights of waterfowl. It appears likely that hunter-killed waterfowl sometimes are eaten by coyotes.

The remains of small unidentified brown birds occurred in 6.4 percent of the scats, mostly from the ecotone. No attempt was made to identify these beyond "unidentified birds," but it is suspected that they mostly represent the several species of ground-inhabiting sparrows so common throughout the study region. These sparrows, as well as meadowlarks, are commonly flushed from their roosts on open grassy hillsides. Coyotes probably could catch some of them from these roosts.

Closer attention was given to the identification of the larger and more diagnostic remains of bobwhite quail and meadowlark. Quail remains were only found in three scats from the ecotone, yet quail were common in both habitat types when the scats were collected. Three scats from the prairie and two from the ecotone contained meadowlark remains. Like quail, they appeared to have been a chance item in the coyote diet.

Amphibians and Reptiles

No amphibian remains were noted in the scats. However, traces of five snakes and five lizards were discovered. The snake remains were in scats from all seasons, while lizard traces were only found in scats collected during April and May. Both amphibians and reptiles were common during the warm months when scats were collected.

Insects

Insects, although of frequent occurrence, accounted for less than 2 percent of the total scat volume. These remains were about two-thirds grasshoppers* and almost one-third June beetles. Traces of miscellaneous beetles, crickets, and unidentified insects, apparently of the order Homoptera, were of little significance. One very large warble was found in a scat containing mostly rabbit hair; possibly it was a parasite of the rabbit. The prominence of grasshopper remains was brought about by a very high occurrence of them during November.

In the ecotone insects were of greatest importance as a coyote food during the summer and fall. In the prairie areas, however, they were used rather consistently during

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*Where appearing in Tables I and II includes cricket remains.

all seasons. Neither scat analysis nor field observations suggested a reason for this notable difference.

Unidentified Animal Remains

Now and then portions of matter which could be identified no further than "animal matter" were found in the scats. This was mostly undigested flesh.

Plant Matter

Plant matter occasionally was noted in the scats and usually was present in trace quantities. These residues were found in scats collected during all seasons, but they were most prevalent in those representing the summer.

Grass occurred in 15 percent of the scats and was the leading plant item. It was most frequent in scats collected during the summer, especially in those from the prairie. Although usually found in trace quantities, it made up more than half of each of four scats. Possibly most of the traces of grass were eaten accidentally while the coyotes fed on other things. The larger quantities were no doubt eaten deliberately.

Oats, corn, sorghum, and wheat grains occasionally were found in the scats. These were usually in trace quantities and associated with poultry remains which seems to explain their presence in the scats.

Persimmon remains accounted for 89.6 percent of the only three scats in which they were found. This suggests that persimmons may at times be an important item in the diet of some coyotes. Scats containing persimmon remains were collected during October and November from both habitat types. These trees are common along the creeks and often produce heavily.

Plant items found in trace quantities in one or two scats were black locust, mulberry, hackberry, pecan, sandplum, watermelon, wild grape, ragweed, seeds of composite plants, and plant items of unknown origin. One scat from the ecotone contained only sandplum.

Miscellaneous

Several pieces of egg shell and a scrap of leather were found in the scats. The egg shells probably represented eggs of ground nesting birds. Likewise, some of the feathers found in the scats may have belonged to the same birds as did these eggs.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Many Oklahoma farmers accredit coyotes with the loss of most of those chickens, lambs, or even small calves which disappear from their farmsteads or are found to be dead from unknown causes. It is possible that these charges, largely if not entirely unsupported, can or are leading to unnecessary government spending for predator control.

The present study attempts to evaluate through a food habits investigation the over-all validity of these charges and, consequently, the need for control. Several significant findings concerning the food habits of the coyotes studied and having bearing on the need for control were disclosed.

Some Coyote Feeding Habits

Tables I and II represent a record of what coyotes ate on a selected area during a particular time. They are, therefore, of limited value for future management, because as a result of changing conditions, coyotes here likely will vary this diet from year to year. However, if supplemented with certain other ecological information, these tables can

be used to determine characteristics of coyote feeding. Unlike food use tables, knowledge of feeding habits can be applied to future management.

Some ecological information useful for appraising feeding habits of the coyotes studied is available. This comes from first-hand field observations previously discussed and from Table III. From these sources some habits of coyote feeding of particular application to the assessment of coyote management needs have been noted.

One of the most significant habits noted was that coyotes tend to concentrate their feeding on herbivorous mammals of certain size and availability classes which offer them presumably adequate returns for their hunting. In this study rabbits and cotton rats were found to form the staple foods. These prey species were abundant, small enough for easy capture, and large enough to reward the coyotes well for their hunting.

Adaptiveness was another significant habit of coyote feeding noted. Coyotes in the ecotone profitably used wood rats and other items more abundant there (Tables I and II). Conversely, the diet of coyotes in the prairie included more livestock flesh, pine mice, and rabbits (Tables I and II).

Feeding adaptiveness also was noted in seasonal changes in the diet. The coyotes included more of an item in their diet during the season when that item was most available. Poultry and persimmon are examples. It was noted further

that coyotes are opportunists and feed on a great variety of things. In some cases, however, they seem to avoid some potential foods. For example, the coyotes studied here seldom ate insectivores, carnivores, omnivores, or reptiles. Similarly, amphibian remains were not noted in the scats. All of these animals were more common than scat analysis would suggest.

Scavenging is yet another feeding habit of coyotes here. A considerable amount of animal matter was eaten which would not normally be prey. One example is the flesh of dead cattle. No doubt, other carrion, such as road kills, hunter kills, and dead farm animals, are taken by scavenging coyotes.

Some Roles Played by Coyotes

Coyote feeding habits and the availability of food items together mold the coyote diet. The diet, in turn, indicates the roles played by coyotes in ecological and agricultural communities. The state of population security of prey or, where farm animals are concerned, the economic value of the prey also figure importantly in determining these roles.

Field observations, as well as the information in Tables I, II, and III, suggested several roles performed by coyotes of the study region. One of the most important of

these was that concerning the regulatory influence on rabbit and rodent populations. Rodents, however, are also heavily preyed upon by predatory birds (Baumgartner and Baumgartner, 1944). In the case of adult rabbits, coyotes are one of the few predators.

Although Tables I and II show that coyotes ate large quantities of rabbits and rodents, it is difficult to measure the effect of this feeding on these prey populations without a great deal of additional information. Yet, on the basis of a principle advanced by Errington and Hammerstrom (1936), some of these prey may be assumed to be in surplus of the carrying capacity of their habitats. To the extent this is true, the coyotes were beneficial by helping to balance the prey populations with the environment. Without the predation it is possible that the prey populations would have expanded to densities which might have impaired the quality of their environment.

The coyote sometimes plays the undesirable role of a poultry and livestock predator. The magnitude of this is highly controversial due to the lack of reliable information. Yet, there was some information uncovered in the present study concerning coyote depredations on poultry and sheep. In contrast to this, coyotes perform the sanitary role of scavenger. This was noted especially in the present study in the case of cattle on the prairie areas.

The role of a sport animal is one which figures considerably in economic importance and which often is overlooked in management plans. For example, in the vicinity of Stillwater, twelve hunters kept more than one hundred hounds during 1954 for the pursuit of this sport. No less than ten annual field trials, where the object is to chase coyotes, are held in Oklahoma.

CHAPTER VI

MANAGEMENT IMPLICATIONS OF THIS STUDY

Any approach to the management of the coyote problem in Oklahoma should, at the outset, be declared on at least two prominent questions. First, it must be determined under what conditions control measures are warranted. Second, the source of control funds must be decided. The present study has been concerned with the first question and offers some suggestions thereto.

On the basis of the scat analysis, coyote control in northcentral Oklahoma is only justified for reducing losses of farm animals. So few game animals were taken by the coyotes studied that control would not appear to be profitable on this account. It seems rather that the coyotes studied benefited game by eating rodents which compete with game for food.

The present study also suggested that coyote control for the protection of cattle in the study region would, in most cases, be economically unsound. By the same measure, some need for coyote control to reduce poultry losses was indicated. Sheep ranchers also may need coyote control on

occasion. However, this study suggested that few sheep in the study area were lost to coyotes.

The nature of poultry losses in the study region suggested several things which the poultryman might do to lessen the problem with coyotes and thus reduce his need for coyote control. He could keep an alert watchdog capable of frightening coyotes from the poultry. He could eliminate many conditions which offer concealment to coyotes while approaching poultry. In some cases he might find it advisable to fence or otherwise shield his flock from predators. He should make it a practice not to bait coyotes by the careless discarding of dead poultry. Burning or burying the carcasses would circumvent this.

In agricultural districts, such as are found over most of Oklahoma, coyote control by population decimation appears unsound. It would first be too expensive unless extensive poisoning could be used. Even where poisons can be used, it is possible to take the greater part of a coyote population and thereby invite irruptive rabbit and rodent populations. Such irruptions may inflict far more damage than the coyotes would have (Shindorf, 1953).

Large reductions of coyote numbers where prey is abundant are more likely to induce undesirable increases in prey numbers than if the prey population were not as large. That prey is abundant is suggested by healthy predator populations. This situation was noted in the case of the

coyote during this study. With the exception of one coyote infested with heartworms, all of twenty-five examined by the writer were vigorous-appearing animals.

There is also another aspect of coyote predation relating to farm animals which suggests that in many cases control by population abatement is unnecessary. It is reported that most farm animals lost to coyotes in agricultural districts are taken by habitual farm stock predators and that other coyotes in such a region seldom if ever prey on farm animals (Sampson and Brown, 1955). This concept is gaining acceptance.

The present study did not test this point. However, the writer is familiar with two incidents where the killing of individual coyotes in the near vicinity of farm buildings stopped poultry losses. Since many coyotes remained in the surrounding countryside, this suggests that the coyotes killed were the ones responsible for the losses.

The basic coyote control problem is one of protecting the farmer's investment in livestock and poultry. In principle, this is no different than the protection of field crops or binned grain from insects and rodents. In both cases nearly all of the fruits of such protection are received by the farmer. If this reasoning is correct, it would appear proper if the predator control program were set up so that farmers and ranchers carried a portion of the control burden commensurate with the portion of the profits

received therefrom. In the past this has not usually been done. Instead, funds for predator control came mostly from state general revenue monies and from federal sources. Another portion came from license monies of the Oklahoma Game and Fish Department--now the Oklahoma Department of Wildlife Conservation.

In view of the findings of this study and of the above points concerning the financing of, and the justification for, predator control, three needs of predator management in Oklahoma become evident. These are:

1. Except in unusual cases, coyote control to benefit wildlife populations need not be undertaken.
2. Those benefiting most from control, farmers and ranchers, should carry a correspondingly larger portion of the control burden.
3. Control should be directed to habitual farm stock predators. In the interest of economy, control efforts in agricultural districts should not be extended to coyotes outside the area where predation is being experienced. Coyote control thus becomes an intensely localized operation.

An assessment of the present coyote management in Oklahoma with respect to the three points above will, on the basis of this study, point out the relative desirability of measures to be used.

The only coyote control presently being employed in Oklahoma is the government trapper program. The accomplishments of this program are mostly due to the staff of skilled hunters, who first seek offending coyotes. However, it is handicapped on other accounts. For example, there are not enough hunters to answer all calls for control. Since the demand is great, it is sometimes months before a hunter can be assigned to a region where he is wanted. By this time either considerable losses have accrued, or the damage has subsided to the extent that a hunter is no longer needed.

A government hunter often moves into an area in compliance with a contract between federal and local authorities. This contract normally requires his presence for a period of several months to a year or more. As far as the hunter's success is concerned, this period usually can be divided into two parts. During the first part, the hunter concentrates his efforts on offending coyotes, greatly reduces or stops losses, and becomes popular with the rural people. The second part begins as soon as the offenders are caught. In order to catch coyotes during this latter period, the hunter must remove his traps from areas near farm buildings where he has been trapping the offenders and set them in fields and pastures. The coyotes which he now catches are seldom offenders. Therefore, his efforts during the second period normally do little to reduce losses from coyote predation although accounting for a corresponding portion of

the control funds. The farmers and ranchers, not realizing this, wish to retain the hunter.

Once a government hunter moves his control devices into the fields and pastures, he becomes unpopular to people who hunt with dogs. These hunters resent having to keep their dogs out of such areas. If a dog of theirs is caught or killed by a government hunter's control device, the resentment is amplified considerably. This sometimes results in organized efforts to remove the government hunter from the area (McFarland, 1956).

Under the government hunter system most frequently used in Oklahoma, the city dweller of a county usually carries a share of the control burden equal to that of the farmer or rancher of the same county, yet he profits considerably less.

Another type of control recently practiced in Oklahoma was the bounty system. While this system repeatedly has been discounted as an effective means of reducing coyote damage (Arnold, 1954; Cadieus, 1953; Douglas and Stebler, 1946; and Gerstell, 1941), it remains popular with the public.

Since bounty payments encourage the killing of coyotes, it is effective in reducing losses to coyotes to the extent that some offenders will be taken. Also, the practice of den hunting for bounties may reduce coyote populations so that offenders would be less frequent. The percentage of

the dens which would have to be destroyed to achieve an appreciable effect in the latter case is unknown. Other than these reductions of offenders, the bounty system is unsuited to the control needs in Oklahoma. The reasons for this are the same as those given by Gerstell (1941), Douglas and Stebler (1946), and others.

A detailed analysis of the agricultural losses to coyotes, of the nature of coyote population changes, and of the significance of coyote predation on wild animals is necessary for assessing the exact coyote management needs in Oklahoma. The present state of knowledge of these matters is not sufficient for such an assessment. However, on the basis of what has been discussed herein, the following two suggestions are offered:

1. It is suggested that the bounty not be reinstated. If the Oklahoma Department of Wildlife Conservation, the state legislature, and the predator control technicians in Oklahoma were free to do so, they would not likely reinstate the bounty. However, since public opinion primarily has been responsible for the existence of bounties in Oklahoma, it would first be necessary to inform the public of the futility, waste, and fraud associated with bounties. The Oklahoma Department of Wildlife Conservation and the Oklahoma Agricultural

Extension Service are media which could well serve this educational need.

2. The adoption of an "extension trapper" or a "trapper instructor" plan of predator control similar to that used in Missouri (Sampson and Brohn, 1955) or Michigan (Arnold, 1954) is suggested. This type of control appears best suited to Oklahoma's control needs since it embodies the three needs listed previously and does not contain the undesirable features already noted in the coyote control systems presently used in Oklahoma.

CHAPTER VII

SUMMARY

1. A study of coyote food habits in Payne and Noble counties, Oklahoma, was undertaken in February, 1952.
2. Seven hundred and sixty-two coyote scats were collected between February, 1952, and February, 1953, from prairie areas and from prairie-woodland ecotone areas.
3. The scat collections were analyzed for food residues, and these results were tabulated separately for the prairie and the prairie-woodland ecotone.
4. Cotton rats and rabbits were the staple coyote foods throughout the year in both vegetative types.
5. Wood rats, pine mice, white-footed mice, livestock flesh, poultry, small birds and insects appeared to be of considerable importance in the coyote diet.
6. The scat analysis suggested that the coyotes imposed no significant threat to game populations.
7. The following feeding characteristics were displayed by the coyotes studied:
   a. A seasonal and areal variation to the diet.
   b. A preference for small herbaceous mammals.

c. A dislike for carnivores, omnivores, insectivores, and cold blooded vertebrates.

8. The coyotes studied appeared to have served the following roles:

a. That of partial population regulation of rabbits and some rodents.

b. That of a livestock and poultry predator.

c. That of a sport animal.

d. That of a scavenger.

9. On the basis of the findings, the discontinuance of the bounty and the adoption of an extension type predator control program in Oklahoma are suggested.

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