

FOOD HABITS OF COYOTES IN AN AREA OF HIGH FAWN MORTALITY

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Coyote scats were collected from the Wichita Mountains National Wildlife Refuge from May 1975 through May 1976 concurrent with studies of white-tailed deer fawn mortality. Volume and frequency of occurrence were determined for each food item. Rodents (45%) cattle (19%), lagomorphs (16%), deer (14%), armadillo (12%), and elk (9%) were the principal food items by frequency of occurrence identified in 671 scats. Rodents had the highest percent volume (28%) following by cattle (14%) and white-tailed deer (13%). Fawn hair occurred in 6% of the total diet by volume and appeared most frequently during the fawning season.

INTRODUCTION

A study of the food habits of the coyote (*Canis latrans*) was conducted on the Wichita Mountains National Wildlife Refuge (WMNWR) by collecting scats biweekly from May 1975 through May 1976 and analyzing the contents of the scats. The food habits study was conducted concurrently with studies of coyote home ranges and mortality of white-tailed deer (*Odocoileus virginia*) fawns. The purpose of this study was to document the percent volume and percent frequency of foods consumed by coyotes during the various seasons with special reference to white-tailed deer. Food habits of coyotes have been evaluated for western and west-central states (1), but few studies are available for Oklahoma (2, 3) and none have been conducted in conjunction with other intensive studies of coyotes and deer.

Evaluation of diet from scat analysis has limitations that include inability to determine whether ingested food was obtained as prey or carrion, failure of differential digestion rates of various foods to allow classification of material relative to time of ingestion (4), inability to determine if repeated visits are made to the same single food source (5), and inability to compensate for totally digested items. However, analysis of scats is the only currently available technique to study the food habits of the coyote in its natural environment without removing the animals.

STUDY AREA

The WMNWR is located in Comanche County in southwestern Oklahoma and encompasses 23,917 ha in and adjacent to the Wichita Mountains. Mature and dwarf blackjack-post oak forests (*Quercus marilandica* and *Q. stellata*) cover 12,505 ha while a combination of short, mid-length, and tall grass prairies cover approximately 8,547 ha (6). Bison (*Bison bison*), Texas longhorn cattle (*Bos taurus*), elk (*Cervus canadensis*), and white-tailed deer (*Odocoileus virginianus*) are the major herbivores on the refuge. Approximately one-third of the refuge is open to public use while the remainder is restricted in access and managed for wildlife. No special management activities were applied to coyote or deer populations on the refuge. Elk, bison, and longhorns were subject to annual reduction through hunting or sale.

MATERIALS AND METHODS

Coyote scats were collected along two routes chosen because they passed through areas of high coyote activity and traversed distinctly different habitats. The Pinchot Pasture route passed through grassland while the Burma Road route transversed oak woodland. Routes were cleared initially of all old scats, and new scats were collected biweekly for 13 months. Each scat was placed in a labeled paper bag, autoclaved, and stored at -40 C until analyzed.

Food items in each scat were separated by hand and identified to the species level when possible. Recognizable food items were recorded for each scat. Volume of each food item was determined to the nearest 1.0 ml using displacement in a graduated cylinder containing water and a surfactant.

Scat collections were grouped by season, from spring 1975 through spring 1976.

Divisions between seasons were adopted arbitrarily, with each biweekly collection assigned to an appropriate season. Dates for seasons were spring 1975 (19 May - 6 June 1975), summer (23 June - 6 September 1975), fall (20 September - 29 November 1975), winter (13 December 1975 - 27 February 1976), and spring 1976 (7 March - 25 May 1976).

Parts of mammals or birds (hair, feathers, skull parts, teeth, etc.) were identified by comparing them with study specimens from the Oklahoma State University (OSU) Museum. Verification of mammalian remains was made by Dr. B. P. Glass. A collection of selected mammalian hair shafts mounted on microscope slides was used to identify individual hair shafts. Plant material and insect identification were verified by Drs. J. K. McPherson and R. J. Tyrl, OSU School of Biological Sciences, and Dr. W. A. Drew, Department of Entomology, Oklahoma State University.

RESULTS

Analysis of 671 coyote scats revealed that rodents constituted the most important food source both by frequency of occurrence and volume occurring in the diet of the coyote (Table 1). Cotton rats (*Sigmodon hispidus*), wood rats (*Neotoma floridana*), and pine voles (*Microtus pinetorum*) were major rodents identified. Plant material and insects ranked second and third respectively in occurrence but contributed little to the total volume of the diet (Table 1). Only 92 rodents were trapped during 2,700 trap nights (3% success).

Cattle hair ranked fourth by frequency of occurrence but was second in important by volume (Table 1). Adult and calf hair could not be differentiated microscopically, but texture allowed classification.

Lagomorphs were the fifth most important food item by frequency of occurrence and ranked fourth by volume (Table 1). Eastern cottontail (*Sylvilagus floridanus*) made up 95% of the rabbits ingested. Lagomorphs were observed at a ratio of one lagomorph per 18 km of driving established routes.

Deer hair ranked sixth by frequency but was the third most important item by volume (Table 1). Fawn hair made up 6% of the total volume and appeared most frequently in May and June, the period when most fawns were dropped. Deer hair occurred in 14% of the coyote scats. Hair classified as originating from an adult (adults or molted juveniles) occurred in 8% of the scats. Sperry's study, as reported by Glass and Halloran (3), showed that deer hair occurred in 5% of the coyote stomachs examined in the late 1930's.

Armadillo (*Dasypus novemcinctus*) occurred in 12% of the scats and made up 6% of the diet (Table 1). Generally only dermal bones and chips from other bones were found. Armadillo have expanded their range northward (7) since the 1930's.

Elk hair occurred in 9% of the scats and made up 8% of the material in the scats (Table 1). Elk calf hair was encountered only once during summer. A controlled hunt was held on the refuge in December, and carrion related to the hunt is believed to be the source of elk consumed.

Feathers and an occasional foot or beak of birds were found in small amounts but occurred in 14% of the scats (Table 1). Scats collected during winter had the highest incidence of bird remains. Bobwhite (*Colinus virginianus*) and meadowlarks (*Sturnella* spp.) were the most frequently identified birds. Eggshells were encountered in scats collected in spring and probably were from ground-nesting birds. Skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), unidentified reptiles, and unassimilated animal tissue comprised the remainder of the material encountered.

Chi-square tests indicated significant ($p > 0.05$) differences between food items occurring in scats collected from Burma

TABLE 1. Percent frequency of occurrence and percent volume of the major food items found in 671 coyote scats collected from the WMNWR, May 1975 - May 1976.

Food Item	Percent Frequency of Occurrence	Percent Volume
Rodents	45	28
Plant material ^a	31	5
Insects	24	3
Cattle	19	14
Lagomorphs	16	11
Deer	14	13
Birds	14	2
Armadillo	12	6
Elk	9	8
Miscellaneous	7	9

^aExcludes grass and leaves

Road and Pinchot Pasture. Fawn, elk, and cattle hair were found more frequently in scats collected from the Pinchot Pasture.

A seasonal shift occurred in the diet of the coyote (Figure 1). Coyotes shifted from rodents and cattle in the spring to fawns, rabbits, and armadillos during summer. Calves may be less available to predation or scavenging at this time of year, and rodents might be relatively more difficult to capture. Use of deer, armadillo and rabbits show a slight decline in frequency from summer to fall. Increase in frequency of elk hair suggests that coyotes altered their diets in autumn.

Occurrence of fawn hair peaked during the latter half of June (Figure 2) and continued until October. Adult hair first appeared in August, reached its peak in November, and continued to appear into April. Steele (8) reported that fawns on the WMNWR suffered high mortality between July and January. The hunting season in Oklahoma occurs in November, and the deer hair eaten during that period may represent carrion available because of hunting or from other mortality factors. Knowlton (9) reported similar peaks in occurrence of deer hair in coyote scats in south Texas where a dramatic increase in June coincided with the fawning season. Knowlton reported a second peak of occurrence of hair during December. He suggested

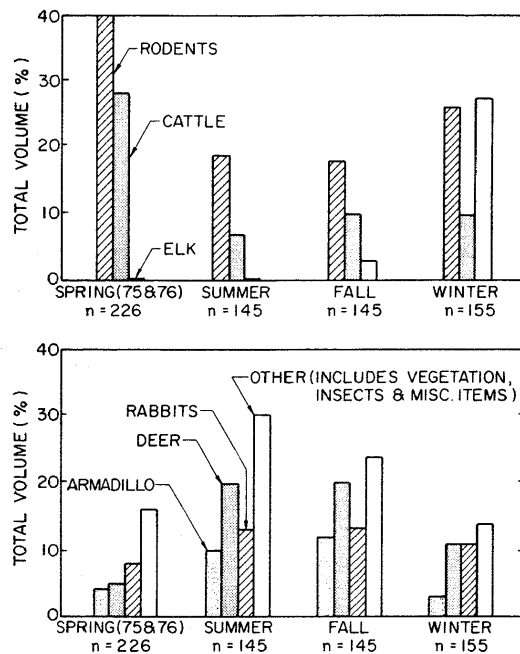


FIGURE 1. Seasonal trends of major food items in the diet of coyotes at the WMNWR, May 1975-May 1976.

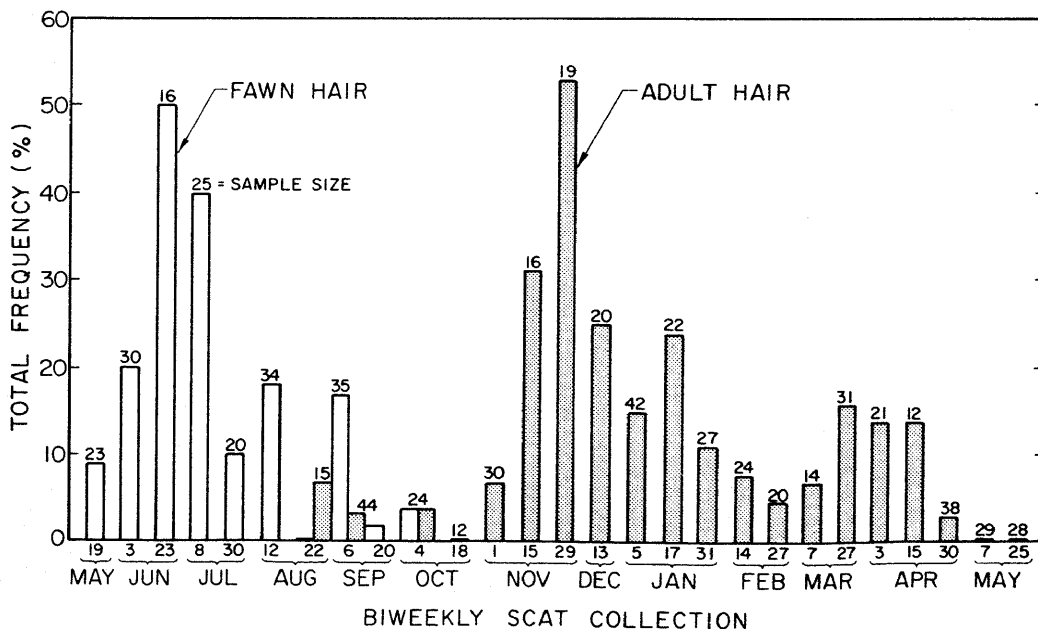


FIGURE 2. Percent frequency of occurrence on a biweekly basis for fawn and adult deer hair from coyote scats collected from the WMNWR, May 1975-May 1976.

that the increase in December might be due partly to carrion available from natural mortality.

A synopsis of finding from other studies (Table 2) shows the most important food sources of coyote to be rodents and lagomorphs. Rodents were also the most important food item in the present study. The occurrence of cattle hair was generally reported with a high degree of frequency. Hair from deer was recorded in only half of the studies, and when reported, occurred with less frequency. Plant material was ingested by coyotes with regularity but volume was minimal.

DISCUSSION

Coyotes at the WMNWR tended to utilize more cattle, deer, and armadillo in their diet than coyotes in surrounding states (10, 11, 12, 13) and other areas of Oklahoma (2, 3). Some foods available to coyotes on the WMNWR are unique to that area, and the uniqueness is reflected in the results of this study. Low rodent and lagomorph populations, presence of an un hunted population of deer that theoretically should reflect carrying capacity, and availability of carrion during the hunting season for elk were coincident major influences on the predator-prey base.

Refuge personnel carefully record calving by individual longhorn cattle on the refuge and report losses due to predation and stillbirths to be extremely low (Gene Bartinicki, 1977, personal communication). The cattle hair may have been obtained by coyotes from one of the several cow-calf operations near the refuge.

The occurrence of fawn hair in coyote scats in June and early July coincided with the timing of losses of fawns ascribed by Garner (14) to coyote predation. The population mechanism(s) that rendered the fawns vulnerable to predation is not known, but the population of deer on the Refuge appears stationary. If the population is stationary then mortality and natality must balance. The removal of fawns by coyotes may be related to the relationship between the density of the deer population and the capacity of the Refuge to provide for its needs.

The 28 percent volume and 45 percent occurrence of rodents in the diet of the coyote during a period when rodents were at a low ebb in density indicates the efficiency of the coyote in searching, locating, and capturing rodents. The lagomorph index was also depressed yet the coyotes were able to include rabbits in their diet with consistency. Deer were only season-

TABLE 2. Summary of coyote food habits determined through scat analysis for surrounding states and areas of Oklahoma in percent frequency of occurrence and percent volume.

Categories	N.C. Oklahoma ^a		Kansas ^b		Nebraska ^c		WMNWR 1937-40 ^d		Missouri ^e		Louisiana ^f	
	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.
Lagomorphs	46	35	26	43	23	--	19	--	80	64	40	43
Rodents	76	51	31	30	96	--	8	--	35	17	34	20
Cattle	4	2	13	21	28	--	6	--	1	1	14	11
Deer	--	--	--	--	8	--	5	--	--	--	2	6
Plant material	18	2	17	<5	39	--	13	--	35	13	68	5

^aEllis (2)
^bFitch and Packard (13)
^cFitcher et al. (12)
^dHalloran and Glass (3)
^eKorschgen (14)
^fMichaelson (15)

ally available to the coyotes, and most available when the fawns were small. Availability of rodents and lagomorphs, demands placed on the coyotes for feeding their young, and the capacity of the refuge habitat to support the deer population are considered as most important in the coyote-deer interactions on the refuge.

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