Seasonal Diets of Coyotes in Western Central Alabama[1]

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Abstract: Year-round diet of coyotes (*Canis latrans*) was assessed from 292 fecal samples using frequency of occurrence of prey types and relative percent volume of prey types. By both measures, the most important food item for each season was rodents, except in the fall when volume of white-tailed deer (*Odocoileus virginianus*) in scats exceeded the volume of rodents. In most cases the 2 methods ranked prey groups identically. Five of the 7 differences between adjacent seasons identified by frequency of occurrence were corroborated by differences in volume. Lagomorphs also were important, and their remains occurred in >16% of each season's samples. Coyotes utilized rodents, lagomorphs, white-tailed deer, and fruit most often, consistent with other southeastern studies of coyote food habits, although the composite annual average for white-tailed deer (37.6%) exceed all reported levels from southeastern studies. Identifiable remains of eastern wild turkey (*Meleagris gallopavo*) and northern bobwhite (*Colinus virginianus*) were detected in 3 coyote scats during the study period.

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Scat analysis is an important technique for describing carnivore food habits, but several methods may be used to report results. Primary among these is reporting relative frequency of occurrence of prey remains or food items in samples (Lee 1986, Parker 1986). As only presence/absence is recorded with this method, incidental and smaller prey items that may be of lesser importance in the diet are given equal weight relative to items that are substantive (Wise et al. 1981). As a check, Wise et al. (1981) used a bulk estimate and reported relative volumes. A third method estimates the relative biomass consumed (Floyd et al. 1978, Corbett 1989). Our study loosely follows the methods of Corbett (1989) in comparing importance of prey items as

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determined by frequency of occurrence to quantity of prey items determined by relative percent volume (aggregate percentage of Swanson et al. 1974).

We were interested in the year-round, complete diet of coyotes from Alabama, but gave special attention to the incidence of white-tailed deer, eastern wild turkey, and northern bobwhite remains in coyote scats. Many landowners and sportsmen throughout Alabama and other southern states are apprehensive about coyotes and their real and imagined threat to game and other wildlife.

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Methods

Scats were collected biweekly along 21 km of roads on a 550-ha privately-owned farm in the Upper Coastal Plain of western central Alabama from June 1988 to November 1989. The area is a mosaic of small stands of loblolly pine (*Pinus taeda*), mixed pine-hardwood, upland and bottomland hardwoods, sparse woodlands, and planted areas, all intensively managed for wildlife, especially bobwhites, deer, and turkeys.

We collected 292 coyote scats for analysis based on appearance, size, odor, and tracks, if present. For example, in an effort to exclude the scats of other carnivores and the occasional large hunting dog passing through the area, those >24 mm or <18 mm in diameter were not classified as coyote (Weaver and Fritts 1979, Green and Flinders 1981). For analysis, scats were assigned by date of collection to one of the 4 calendar seasons [winter (Dec-Feb), spring (Mar-May), summer (Jun-Aug), fall (Sep-Nov)]. Composite annual frequencies and volumes for diet items were generated by averaging the 4 seasonal figures.

Scats were washed with a mild detergent over a 0.45-mm mesh sieve in a closed basin and allowed to air dry under a hood. Hairs were taken from the basin and examined microscopically. Other remains (bones, teeth, toenails, hooves, feathers, skin, scales, seeds, vegetation, and insects) were identified using various keys (Day 1966, Glass 1973, Landers and Johnson 1976, Wilkins et al. unpubl. memo 1982), collections, and expert opinion. Items were recorded by frequency of occurrence and visually estimated to percent volume in each scat. Relative seasonal volumes were generated by summing the relative percentages of items within each scat.

Differences in the frequency of occurrence of items among seasons were determined using the categorical modeling procedure (CATMOD) (SAS Inst., Inc., 1987). The test is a log-linear, 2 x 2 contingency test, resulting in Woolf's G, a variant of the X^2 statistic (Sokal and Rohlf 1969, Howell 1987). Significance levels for data of this kind have been determined by applying a Bonferroni procedure (Pederson and Tuckfield 1983). A family level Type I error rate is assigned, and the

Table 1. Relative percent volume of group items, by season, in coyote scats from western central Alabama, 1988–1989.

Group	Winter (N = 38)	Spring (N = 58)	Summer (N = 69)	Fall (N = 127)
Rodents	40.1B[a]	60.1A	35.1B	33.0B
Lagomorphs	22.3AB	27.3A	20.6AB	9.2B
Deer	31.3A	8.4B	18.8AB	34.1A
Fruit	2.8B	1.1B	18.9A	19.3A
Insects	0.6	0.5	1.0	0.9
Birds	0.2	0.4	0.2	0.3

[a]Values sharing the same letter within rows are not different ($P > 0.01$, Duncan's multiple range test).

significance level for an individual item is the family error rate divided by the number of items comprising the family. In our study a family error level of $P = 0.05$ was divided by 7 groups (rodents, lagomorphs, white-tailed deer, fruits, insects, birds, and other) resulting in group significance levels of $P = 0.007$. Individual species per se were not evaluated with this method. However, most of the groups were comprised largely of a single item.

Differences in seasonal volumes were determined using the Duncan's multiple range test (Sokal and Rohlf 1969) aspect of the SAS multivariate analysis of variance procedure, GLM, at a significance level of $P = 0.01$ (the lowest limit of the procedure).

Results

Rodents were the most important food item in each season by both measurement methods, with the exception of fall when the volume of white-tailed deer remains was slightly higher (Table 1). The composite average annual frequency of rodent remains in scats was 66.0% (Table 2). The frequency of rodent remains in samples

Table 2. Percent frequency of occurrence of group items, by season, in coyote scats from western central Alabama, 1988–1989.

Group	Composite Annual Average	Winter % (N = 38)	G	Spring % (N = 58)	G	Summer % (N = 69)	G	Fall % (N = 127)	G
Rodents	66.0	57.9	9.70[a]	86.2	11.71[a]	59.4	NS	60.6	NS
Lagomorphs	36.3	39.5	NS	48.3	NS	37.7	7.31[a]	19.7	NS
Deer	37.6	44.7	8.49[a]	17.2	NS	33.3	8.64[a]	55.1	NS
Fruit	16.7	5.3	NS	3.4	15.29[a]	27.5	NS	30.7	12.69[a]
Insects	13.3	7.9	NS	5.2	NS	20.3	NS	19.7	NS
Birds	10.2	7.9	NS	15.5	NS	10.1	NS	7.1	NS

[a]Significant difference ($P < 0.007$).

was higher in spring than in winter ($G = 9.70$, 1 df, $P = 0.0018$) or summer ($G = 11.71$, 1 df, $P = 0.0006$). Respective changes in volume also were significantly different. The most prominent species of rodent in the diet was the cotton rat (*Sigmodon hispidis*), occurring in >44.7% (composite average) of all samples.

White-tailed deer were the second-most important food item as determined by the annual composite averages (37.6% frequency of occurrence and 26.9% relative volume). The frequency of occurrence of deer was higher in fall than summer ($G = 8.64$, 1 df, $P = 0.0033$, and lower in spring than winter ($G = 8.49$, 1 df, $P = 0.0036$). Fawn remains were differentiated from those of adults by hair color, texture and size (Blanton 1988) and by size of toenails, teeth, mandibles and other bones found in scats. White-tailed deer fawns were the primary diet component in fall.

Lagomorphs were a third primary food item. The primary species represented was the eastern cottontail (*Sylvilagus floridanus*), although swamp rabbits (*S. aquaticus*) occur on the study site. Lagomorphs ranked second by each method in both spring and summer. The frequency of occurrence of lagomorph remains in scats decreased from summer to fall ($G = 7.31$, 1 df, $P = 0.0068$). This volume difference was not significant ($P > 0.01$). Lagomorph remains nearly doubled from fall to winter, *but the increase was not significant* ($G = 5.81$, 1 df, $P = 0.0160$).

Fruits were important during the warm seasons increasing significantly more from spring to fall ($G = 15.29$, 1 df, $P = 0.0001$) but decreased significantly in winter ($G = 12.69$, 1 df, $P = 0.0004$). In summer, remains of wild plum (*Prunus spp.*), muscadine grape (*Vitis rotundifolia*), and persimmon (*Diospyros virginiana*) each occurred in >10% of scats.

Insect remains increased nearly 4-fold by frequency of occurrence from spring to summer, but not significantly ($G = 6.77$, 1 df, $P = 0.0093$). All differences in volume were corrobrated by differences in frequency of occurrence.

Discussion and Management Implications

Our results were consistent with other southeastern studies of coyote food habits (Gipson 1974, Michaelson and Goertz 1977, Hall 1979, Smith and Kennedy 1983, Wooding et al. 1984, Lee 1986 and Blanton 1988). Coyotes fed primarily on rodents, lagomorphs, and white-tailed deer. Rodents were the most constant item in the diet, and in the 2 seasons when lagomorphs and white-tailed deer reached their respective lowest frequencies of occurrence in the scats, rodents were at their highest level. In spring when this deer population was at its highest per capita age and perhaps healthiest period, the remains of deer in scats were at their lowest level. The frequency of occurrence of rodents and/or lagomorphs in a spring scat was 93.1%.

Fruits are regularly consumed by coyotes and during certain seasons contribute measurably to their diet. The proliferation of fruits and insects in the warmer seasons adds variety to the diet, but may or may not relieve any predation pressure on fawns (Knowlton 1964).

The study area is managed to produce abundant food, cover, and interspersion

of habitat for game animals such that conditions for alternative food sources for coyotes is enhanced. The apparent heavy utilization by coyotes of fawns (primary individual fall food item) shows no negative effect on the deer population as measured by past and current hunting success and doe:fawn ratios recorded during fall and winter (M.K. Causey, unpubl. rep.). However, since this is a dynamic balance, conditions and population levels could change and alter the situation.

During our study coyotes made scant use of turkeys or bobwhites as food items although avian eggshells were found in 5.2% of spring scats and 2.9% of summer scats. Most fragments were of the thickness and contour suggestive of large eggs (turkey). However, we cannot be certain these fragments were not associated with a "dummy" nest predation experiment being conducted on the study area during our study period. Michaelson and Goertz (1977), Smith and Kennedy (1983), Wooding et al. (1984), and Blanton (1988) have shown game birds to be of little or questionable importance in the diet of southeastern coyotes.

Interestingly, a flock of 24 pinioned giant Canada geese (*Branta canadensis*) was released on the study site prior to initiation of our study. These geese regularly walk considerable distances overland traveling between several impoundments located about the property. Overland excursions by pinioned geese are almost exclusively diurnal. No geese at this study site were killed by any predator, coyote or other.

We recognize that short-term ($\leq$2 years) studies looking at dynamic predator/prey relationships do not allow for "conclusions." Only through careful and continued scientific observation and study can we begin to understand the developing role of coyotes in southeastern ecosystems. Coyotes, like many other opportunistic predators, defy our attempts to assign them to precise ecological niches. Coyotes might limit certain populations from time to time, but often might be beneficial to wildlife management objectives. Landowners directing wildlife management on the study area were concerned that coyotes were responsible for low bobwhite densities on their estate. Out study does not support this assumption, and bobwhite numbers, according to the landowners, have rebounded since our study began.

Landowners also questioned the extent of the coyotes' role in limitation of turkey numbers. Our results do not support that the coyotes' food habits had a significant impact on the turkey population. Coincidentally, as had occurred with the bobwhite numbers, landowners concluded that wild turkeys reached densities in 1990 and 1991 greater than any they could recall since acquiring the property.

Landowner management objectives for white-tailed deer lean toward quality versus quantity. Biologists for Alabama's Deer Management Assistance Program have recommended an annual harvest of 65 deer including 45 antlerless deer from the study area. Since hunting is restricted to a small number of family and friends who hunt primarily on week-ends, harvesting this many deer is an almost impossible task. Any contribution coyotes make toward limiting white-tailed deer numbers currently is considered a beneficial aspect of coyote presence and activity on the property.

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