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Diet Composition of Coyotes in the Cuyahoga Valley National Park, Ohio¹

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ABSTRACT. The diet and food habits of coyotes (*Canis latrans*) in Ohio's Cuyahoga Valley National Park (CVNP) were examined by analyzing 50 scat samples collected during coyote population surveys between February 1998–March 1999. The Cuyahoga Valley National Park, a 13,770-hectare public-use park surrounded by residential communities, is located between Cleveland and Akron, OH. The park had over 3 million visitors in 1999, and is suffering from the pressures of increased urbanization in surrounding areas. Coyotes were first documented in the CVNP during the 1980s, and since then public interactions with coyotes have increased. The coyote is the top predator in the CVNP, yet little is known about its diet in this area. Meadow vole (*Microtus pennsylvanicus*) was the predominant food item found in 28% of scats collected. Eastern cottontail (*Sylvilagus floridanus*) and white-tailed deer (*Odocoileus virginianus*) occurred in 20% of scats. Raccoon (*Procyon lotor*) was found in 18% of scats. Also identified were beetle (Coleoptera), muskrat (*Ondatra zibethicus*), grasshopper (Caelifera), woodpecker (*Picoides* sp.), seeds (*Panicum* sp.), and nuts (*Fagus grandifolia*) in coyote diet. It is important to note that though white-tailed deer occurred frequently in coyote diet, further investigation indicates that they are mainly scavenged as carrion.

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INTRODUCTION

The coyote (*Canis latrans*) is a recent addition to the fauna of the Cuyahoga Valley National Park (formerly named the Cuyahoga Valley National Recreation Area). National Park Service (NPS) personnel first saw coyotes in the Cuyahoga Valley National Park (CVNP) in the late 1980s (M. Benke, NPS, personal communication), with the first documented sighting in 1988. However, little has been learned about the ecology of the coyotes in this area since their first sightings. One aspect of their local ecology that is particularly important is diet. In particular, with their proximity to suburban communities, there has been public concern over coyotes preying on domestic animals.

The CVNP is a highly used park surrounded by urban and suburban residential communities. This situation offers abundant opportunity for human-coyote interactions. Coyotes have not only adapted to this urban park but have thrived in other urban areas as well (Howell 1982). The coyote is omnivorous and opportunistic as both a predator and a scavenger and can therefore respond to changing food availability or prey vulnerability (Bekoff 1982; Blanton and Hill 1989). For these reasons, diet analyses of coyotes have shown a broad range of food items. In urban areas, garbage, gardens, pet food, and in some cases domestic pets are readily available food sources. A study of urban coyotes in Washington identified 8% of diet items as house cat (*Felis catus*) (Quinn 1997). Energetically it is easier for a coyote to obtain these items than it is to find, chase down, and kill wild prey species.

Another issue in the CVNP is the high density of white-tailed deer (*Odocoileus virginianus*). There are

more than 35 deer per square kilometer in some areas of the CVNP (NPS 2002), and deer may begin to affect forest communities with densities as low as 10 deer per square kilometer (Adams 1994). Proposed management of white-tailed deer in the CVNP and surrounding areas has triggered local controversy. A point of contention has been that deer management in the CVNP will cause a prey shift in coyotes. Unfortunately, to what extent coyotes depend on deer in the CVNP is unknown. Diet of the coyote in the CVNP has not been studied previously and should be determined in order to identify key prey species and to examine the impact upon the CVNP coyote population if prey numbers change radically. For these reasons and because little is known about the coyote in the CVNP, my objective was to establish information on the diet of the coyote in the CVNP. As part of a study on coyote abundance and behavior in the CVNP (Cepek 2000), I collected coyote scat throughout the park from February 1998–March 1999. Because the public was becoming increasingly aware of coyotes and was concerned whether coyotes were preying upon domestic pets and deer, I used scat analysis to identify the general composition of the coyote's diet in the CVNP.

MATERIALS AND METHODS

Traditionally, coyote diet has been examined using scat analysis (Berg 1977; Parker 1986; Witmer and others 1995; Quinn 1997) and gut or digestive tract content (Smith and Kennedy 1983). Scat analysis is often preferred because obtaining, storing, and processing carcasses or digestive tracts makes gut content analysis a more expensive and time-intensive method (Lovell 1996). Identifying the frequency that diet items occur among scat samples is a widely used method to identify what, and relatively how much, is being eaten by carnivores (Corbett 1989).

I collected scats opportunistically when encountered

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throughout the CVNP. Initially I focused on identifying any positive sign of coyote presence in the parks because this was the basis of my graduate research. Surveys were therefore not catered to collecting scat but rather to finding evidence of coyote presence in an area. I walked all public trails and utility rights-of-way in the CVNP surveying for coyote sign such as tracks or scat. I identified coyote scat by its location along a coyote trackline, or by physical characteristics such as size, shape, and composition (Murie 1954). Only scat over 16 mm in diameter was characterized as coyote to reduce the chances of collecting fox scat (Danner and Dodd 1982; Green and Flinders 1981a). If coyote-sized scat was encountered, independent of coyote prints, the composition of the scat was then examined to differentiate from domestic dog or other non-coyote mammal. Coyote scat tends to be long and ropelike with tapered ends. Also, coyote scat usually contains large amounts of fur, bone, claws, and teeth. Because domestic dog diet does not consist entirely of wild prey, its feces can easily be distinguished from coyote based on the lack of the above-mentioned items.

Identifying some coyote scat during months when fruit and vegetation is available for food is difficult due to lack of fur, bones, teeth and claws. This problem is compounded by the lack of tracks that can be used to positively identify scat in snow. To prevent non-coyote bias, I did not collect samples that contained mainly plant matter and had no accompanying coyote sign. Therefore, diet analysis for this study was based mainly on animal food items, with a bias toward non-summer food items.

I placed coyote scats in plastic zip lock bags labeled with each location and date (Ozoga and Harger 1966). Samples were then refrigerated until further analysis. For preparation, each scat was placed in a nylon stocking and washed in a 5-gallon bucket by repeated spraying and rinsing with water from a garden hose (Bowyer and others 1983). Washed samples were then air dried in a lab, and individually examined. I separated items found in each sample and used distinguishing characteristics of teeth, claws, bones, or other non-hair materials to identify food items. Mammalian diet items were categorized into items that could be identified to species, and then into large or small mammal classification based on the size of bone fragments. Items from animals estimated to be smaller than an adult eastern cottontail were grouped into the small mammal classification. If bone fragments were too small or damaged, and no other distinguishing items could be found in the sample, hair then was compared to known references and hair identification guides (Stains 1958; Adorjan and Kolenosky 1969; Moore and others 1974) to identify prey species. If an item was identified as mammalian based on hair but could not be further classified by size or other distinguishing traits it was grouped into a general mammal category.

Scat analysis in relatively small study areas can be used to determine seasonal diet by clearing areas of scat and collecting scat of known age at intervals through the season. Since scat was collected opportunistically

through all seasons, it was not possible to positively establish the age of scat samples in this study (Witmer and others 1995). Additionally, with the previously mentioned difficulties of identifying some scat in summer, a seasonal analysis was not conducted for this study. I did not measure volume or mass of samples due to the washing method. Quantifying the number of each species found in each scat was possible in only a few cases; therefore only general species composition and not species abundance could be established in each sample. In conclusion, this study should be considered a compilation of the general diet composition of coyotes in the CVNP from February 1998–March 1999.

RESULTS

Seventy-six total diet items were found in 50 scat samples collected while walking and skiing trails, utility rights-of-way, and coyote tracklines. These items were categorized into 15 classifications: 9 mammalian, 3 plant, 2 insect, and 1 avian (Table 1). Diet composition was identified by looking at the number of times an item was found among all scat samples (frequency of occurrence, $n = 50$) (Table 1).

Eighty percent of food items were mammalian ($n = 61$). The species found most frequently in scat was the meadow vole (*Microtus pennsylvanicus*), which was found in 28% of scat samples ($n = 14$) (Table 1). Eastern cottontail (*Sylvilagus floridanus*) and white-tailed deer were the next most common diet items (20% each). Raccoon (*Procyon lotor*) was identified in 18% of scat samples. Diet items classified as beetle, unknown small mammal, and unknown large mammal each occurred in 12% of scat samples. Plant material was found in 10% of scats. Other identified diet items found in less than 10% of coyote scats collected were: muskrat (*Ondatra zibethicus*), beech nut (*Fagus grandifolia*), grass seeds (*Panicum* sp.), grasshopper (*Caelifera*), and woodpecker (*Picoides* sp.). No evidence of domestic pets or livestock in the diet of coyotes was found.

DISCUSSION

The majority of diet items identified in coyote scats collected in the CVNP from February 1998–March 1999 were mammalian. This is in part due to my collection criteria in which only samples that could be positively identified as coyote were collected. Scat containing only plant matter, with no other accompanying sign, could not be positively identified as coyote and was therefore not collected. However, it is important to note that seasonally, plant matter can be an important part of coyote diet (Witmer and others 1995). Common diet items of coyotes in the CVNP are meadow voles, white-tailed deer, and eastern cottontail, which is similar to results from other coyote diet studies in the eastern US (Smith and Kennedy 1983; Witmer and others 1995). While the diet of western coyotes has been well documented (Green and Flinders 1981b; Bowyer and others 1983; Todd 1985; Leopold and Krausman 1986; Gese and others 1988; Towell and Anthony 1988; Crabtree and Sheldon 1999), comparatively less is known about the diet of the eastern coyote, especially in Ohio. No diet

TABLE 1

Items found in coyote scat collected in the Cuyaboga Valley National Recreation Area, OH, from February 1998-March 1999.

Name	Number of Occurrences	Frequency of Occurrence (%) in Total Scats (N = 50)
Meadow vole (<i>Microtus pennsylvanicus</i>)	14	28
Eastern Cottontail (<i>Sylvilagus floridanus</i>)	10	20
White-tailed deer (<i>Odocoileus virginianus</i>)	10	20
Raccoon (<i>Procyon lotor</i>)	9	18
Beetle (Coleoptera)	6	12
Unknown Small Mammal	6	12
Unknown Large Mammal	6	12
Plant Material	5	10
Unidentified hair (Mammalia)	3	6
Muskrat (<i>Ondatra zibethicus</i>)	2	4
Beech Nut (<i>Fagus grandifolia</i>)	1	2
Criticidae* (Muridae)	1	2
Grasshopper (Caelifera)	1	2
Seeds (<i>Panicum</i> sp.)	1	2
Woodpecker (<i>Picoides</i> sp.)	1	2

*Formerly known as Criticidae in Moore and others (1974) hair identification key, now known as Muridae.

studies of coyotes in Ohio have been published, but there have been some published studies of coyote diet in nearby states. A coyote summer diet study in Pennsylvania showed that white-tailed deer occurred in 55.2% of scat, plant 52.3%, insect 18.1%, mice and voles (*Peromyscus* spp./*Microtus* spp.) 14.8%, bird 11.9%, and eastern cottontail 9.4% (Witmer and others

1995). A winter scat analysis in northern Michigan found that white-tailed deer comprised over 89% of food items that occurred in coyote scats (Ozoga and Harger 1966). Other common occurrences in the Michigan study were snowshoe hare (*Lepus americanus*), woodland deer mouse (*Peromyscus maniculatus*), muskrat, red-backed vole (*Clethrionomys gapperi*), grouse (*Bonasa umbellus*), and apples (*Pyrus malus*) (Ozoga and Harger 1966). Coyote scat analysis in the Adirondacks region of New York State identified mammals in 78% of samples, with snowshoe hare being the most common item, found in 40% of samples (Whitaker and Hamilton 1998). Other eastern coyote diet studies in Minnesota (Berg 1977) and Wisconsin (Huegel and Rongstad 1985) reported that white-tailed deer and snowshoe hare were the most common coyote diet items. Parker (1986) also showed similar results with snowshoe hare and white-tailed deer comprising most of the coyote diet in New Brunswick.

Although coyotes take down live deer as prey in some areas (Cook and others 1971; Stout 1982), findings from my study indicate that primarily deer carrion is being used and not live deer. During my study, I conducted snow tracking and followed over 35 individual coyote track lines on over 25 occasions (Cepek 2000). Only once during snow tracking did I find evidence of coyotes feeding on a deer carcass that was not near a roadway. Whether or not coyotes actually killed this fawn is unknown. I did witness over 10 occurrences of coyotes feeding on deer that had been hit by vehicles along the many roads that pass through the CVNP. This was determined through evidence found during snow tracking and from personal observations at other times in the study. Ozoga and Harger (1966) found that coyotes in northern Michigan are opportunists that seem better at finding carrion than capturing live prey. They also reported that a healthy deer is likely to escape coyote predation (Ozoga and Harger 1966). Haroldson (1981) found that 89% of deer consumed in a Minnesota coyote study were carrion. Berg (1977) also noted that adult deer were mainly consumed as carrion. Todd (1985) stated that coyotes in Alberta had a strong reliance on carrion during the winter, except in years when the snowshoe hare was abundant. Findings from these studies, combined with the results from my diet analysis, indicate that the abundant carrion along roadways is an easy food source that may support coyotes in the CVNP.

Most diet studies have focused on wilderness and rural habitat (Witmer and others 1995; Berg 1977; Parker 1986; Ozoga and Harger 1966; Huegel and Rongstad 1985) with little research examining the diet of urban and suburban coyotes (Quinn 1997). Coyotes in urban and suburban habitat show different food habits as might be expected due to the variation in prey availability. Quinn (1997) performed a study of annual coyote diet in urban habitat in Washington State that resulted in 43.6% of food items being fruit, 15.9% vole, 7.8% house cat, and 4.6% squirrel (*Sciurus* spp. and *Tamiasciurus* spp.). I did not find evidence of domestic animals during scat analysis. However, 12% of diet

items were from unidentified large mammals. I also did not find evidence of coyotes feeding on any domestic animals during any of my surveys in the CVNP. I did however find evidence of squirrels, eastern cottontail, small mammals, and white-tailed deer being fed upon by coyotes in the CVNP.

During my study, I found raccoon in 12% of coyote scat samples. This seems proportionately high, as most coyote diet studies have found that raccoon is not typically found to be a large percentage of the diet. A study of urban coyotes in Washington State reported that raccoon made up less than 3% of the diet (Quinn 1997). Korschgen (1957) recorded that raccoon occurred in 1.3% of the coyote diet in Missouri. Bowyer and others (1983) showed similar results with raccoon making up less than 2% of total items found in coyote scats in a state park in California. Witmer and others (1995) found that on average raccoon occurred in 5.5% scats sampled statewide in Pennsylvania in 1991-92. However raccoon did occur in 11.8% of scats sampled in one area of south central Pennsylvania in 1991 (Witmer and others 1995). This is similar to the frequency of occurrence of raccoon in my results. Raccoons are common in the CVNP, but a raccoon is substantial prey in comparison to eastern cottontail, and small mammals. Therefore, raccoons also may be eaten primarily as carrion, as they are frequently found dead on roads in the CVNP.

MANAGEMENT IMPLICATIONS

Coyote diet in the CVNP should continue to be monitored and further examined. Snow tracking or additional monitoring should also be used to identify what coyotes are actually killing and what they are using as carrion. This is important because of what I witnessed in this study. Scat analysis only shows what coyotes have eaten. Without additional monitoring it is not possible to determine how coyotes are obtaining their food, whether by taking live prey or feeding on carrion.

A seasonal diet analysis should also be conducted to identify seasonal variation in diet items. During this study I noticed that coyotes regularly marked areas with scat. Seasonal analysis of diet can be conducted by identifying park access roads, utility rights-of-way, trails, or drives that coyotes are regularly using. Existing scat could be cleared from these areas and then regular collections can be conducted to gain a temporal aspect of scat deposition. Through regular sampling, a seasonal analysis of diet items can then be determined.

The relative abundance of potential coyote prey species should also be monitored. Meadow voles, white-tailed deer, and eastern cottontail were the most common coyote diet items found in this study. It is unknown what would happen if common prey numbers should change drastically. Specific prey species and their availability are important factors in a coyote population's size. This is because food is the major factor regulating coyote abundance (Knowlton and others 1999). A decline in primary prey species numbers may cause coyotes to use alternative food sources as reported in other areas (Todd and Keith 1983). In contrast, increases in prey numbers may also precede an increase in coyote reproduction,

resulting in future effects on the CVNP and surrounding communities. Monitoring prey species may forewarn wildlife managers of conditions that may lead to coyote damage, and help to prevent human-coyote conflicts.

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