SEASONAL DIETARY COMPOSITION OF THE EASTERN COYOTE (*Canis latrans*) ON THE BERRY COLLEGE CAMPUS IN NORTHWESTERN GEORGIA

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To the Graduate Council:

I am submitting a thesis written by Kathleen Owens entitled "Seasonal Dietary Composition of the Eastern Coyote (*Canis latrans*) on the Berry College Campus in Northwestern Georgia." I have examined the final paper copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Environmental Science.

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DEDICATION

This thesis is dedicated to my parents, Gary and Mary Lee Eady, who have always been great role models and friends, and to my husband Matt, for always believing in me, inspiring me, and encouraging me to reach higher in order to achieve my goals.

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Thanks to all of you!

ABSTRACT

Coyotes (*Canis latrans*) have progressively colonized eastern North America following wolf extirpation and the clearing of forested landscapes. The coyote has expanded its geographic range into Georgia during the past 50 years, and its impact as the top predator is potentially influencing community dynamics via competition and/or predation. Few studies have examined coyote food habits in the southeastern United States. Our objective was to determine prey items consumed by free-ranging coyotes living on Berry College lands in northwestern Georgia.

One hundred and twenty-seven coyote scats were collected from May 2005 through August 2006 along seven major service roads that transected the 28.55 mi^2 study area, and 270 prey items were identified. The four most frequently occurring prey items were Muridae rodents (26.3%), eastern cottontail rabbits (15.2%), white-tailed deer (13.7%), and eastern gray squirrels (10%). Fawn remains were slightly more frequent in coyote scats than adult deer (7.8% vs. 5.9%). Mammal remains (71.2%) comprised the largest prey category, followed by vegetation (10.7%), arthropods (7.4%), birds (3.3%), and reptiles (1.5%).

Significant seasonal fluctuations of prey items/prey classes were found ($P<0.0001$). Rodents (predominantly the Family Muridae) were most common in spring, vegetation (predominantly persimmons) occurred most frequently in fall, and arthropod consumption (predominantly grasshoppers) was constant throughout the year, except during winter months. Prey classes Artiodactyla and Lagomorpha were consumed year round, although fawns were an important prey item only in spring and summer months and eastern cottontails were most popular in the winter.

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INTRODUCTION

Before European settlement, coyotes (*Canis latrans*) were confined to the open plains and arid regions of the western half of North America (Moore and Parker, 1992). At that time the dominant canine predator in western North America was the gray wolf (*Canis lupus*) and in the southeast, the red wolf (*Canis rufus*) (Gompper, 2002).

Throughout the 18th and 19th centuries, the coyote dramatically expanded its geographical range. In the mid 1900s, massive landscape changes resulting from agricultural development, intensive logging, and urbanization allowed coyotes to extend their habitat northward and eastward (Parker, 1995). In addition to the unprecedented alteration of habitat, there was direct persecution of large predators such as the wolves and mountain lions that had previously competed for food resources with coyotes (Peterson, 1996). With all of its predators except adult black bears gone from most of eastern North America and the landscape now consisting of a patchwork of agricultural and forest lands, there was an opportunity for the adaptable and generalist coyote to move eastward and fill the unoccupied ecological niche.

There were two main waves of eastern coyote colonization—northern and southern. The northern wave occurred first as the coyote began to appear in northern New York in the late 1920s (Bromley, 1956). Most of the southeast was not colonized until the 1950s, with the first sighting of coyotes in northern Georgia not occurring until 1960 (Parker, 1995). The rate of coyote expansion has increased dramatically in the last decade and, according to Georgia's Department of Natural Resources, coyotes now occupy all of Georgia's counties (https://georgiawildlife.dnr.state.ga.us).

As coyotes have expanded throughout the East, they have proven that adaptability is one of the greatest strengths a species can have to ensure its survival. In fact, many biologists view the coyote as an exemplary specimen of adaptability. Research suggests that this adaptability is why coyotes are found in every southeastern state today, as well as in the many habitats (forests, farmlands, prairies, mountains, deserts, and swamplands) those states have to offer (Parker, 1995).

Colonization of the southeastern United States by the coyote should raise concerns because of unknown consequences for livestock, crops, native competing predators, and indigenous prey species. Previous studies from across western North America suggest that the ecosystem effects of increasing numbers of coyotes are likely to be multifaceted (Harrison, 1989), although how this new carnivore will affect Georgia's ecosystems is relatively unknown (Ray, 2000). To date, no detailed studies of coyote ecology have been conducted in Georgia, and information about coyotes in the eastern area of their range is extremely limited (Hernandez and Delibes, 1994).

The limited knowledge of coyote ecology in most of the eastern United States has not been perceived as a problem in the past, but further research should be considered critical for the production of effective management plans. In the coming years this generalistic/opportunistic top predator and scavenger is likely to dramatically influence animal and plant communities in the southeast (Gommper, 2002).

Food availability is widely recognized as a major population determinant for the coyote. Although landscape changes and extirpation of wolves opened a door for the coyote to move eastward, the availability and quality of prey was the main limiting factor in their survival and viability (Parker, 1995). Hence, there is little doubt as to the fundamental importance of the coyotes' food habits and feeding ecology.

For ecological and socio-economic reasons, knowledge of coyote food habits may be more important than the food habits of other taxa in a food chain. Theoretical models and empirical studies have shown that the foraging behavior of coyotes can have a large influence on community dynamics, especially regarding the ecological balance of predator and prey species (Henke and Bryant, 1999; Vander Wall, 1990). For instance, the absence of coyotes in fragments in southern California has resulted in mesopredator release—a sharp increase in the number of midsize predators—which has dramatically altered rodent and bird communities (Crooks and Soule, 1999).

Elsewhere in North America, altered coyote densities have been associated with increased nest success of ducks due to interference competition with and predation on red foxes (Sovada,1993; Sovada, 1995); increased diversity of songbird and rodent communities due to predation on domestic cats (Crooks and Soulé, 1999); increased nest success of ground-nesting song sparrows (*Melospiza melodia*) due to predation on raccoons (Rogers and Caro, 1998); decreased rodent species diversity and biomass and increased abundances of other mesocarnivores following experimental reduction of coyote populations by 48% (Henke and Bryant, 1999); and declines in burrowing owl (*Athene cunucularia*), partridge (*Perdix perdix*), and grouse (*Tympanuchus phasianellus*) populations following a decline in coyote and increase in red fox populations (Finley 1996).

Essentially, what research has shown is that predation does not have the same effect in all communities. Coyote predation has been found to increase the amplitudes of fluctuations in prey abundance (van Baalen, 2001), dampen fluctuations (Fryxell and Lundberg, 1994), increase the probability of prey extinctions (Holt, 1977), or decrease the probability of extinctions (Krivan and Eisner, 2003). Thus, management techniques can be directed at increasing, stabilizing, or decreasing food resources, depending on the objectives for the species.

Moreover, as a large carnivore, the coyote's potential for top-down direct and indirect influences on a broad array of organisms is great. The top-down effect occurs when relatively few individual predators have a large effect on other members of the community. For example, when predators suppress the number of herbivores, plants experience a release from grazing and flourish. If predators decrease, herbivores increase and plants decrease.

Critical to understanding how coyotes alter community structure may be our ability to assess the top-down effects of coyotes on other carnivores. Just as wolves in some regions limit coyotes by interference competition, coyotes can limit smaller carnivores (Henke and Bryant, 1999).

Foxes are competitors with coyotes and, in many regions, coyotes are principal sources of fox mortality (Ralls and White, 1995) or are responsible for altered fox spatial dynamics (Harrison, 1989). If an increase or decrease in coyote numbers influences the population dynamics of foxes and other carnivores, a cascade of ecosystem effects may occur, including alteration of rodent and rabbit communities and changing pressure on plant communities. Thus, the direct influence of coyotes on small mammals may indirectly influence plant community structure.

In addition, because coyotes are generalist predators, they can attain high densities relative to more specialized carnivores and, as a result, outcompete them. For instance, competition for resources occurs among coyotes, lynx (*Felis lynx*) and bobcats (*Felis rufus*). Research has shown that increased coyote densities may result in declines in these felids (Fox, 1990; Schmidt, 1986). Therefore, a better understanding of the ecology of current coyote populations is essential to predict coyote dynamics and to determine the consequences of increasing coyote populations on other taxa and habitats.

Socio-economically, the ability of coyotes to prey on domestic and game species has elicited a wide range of attitudes towards whether carnivores should be a viable component of some environments (Cain, 1971). If conflicts that result from such attitudes are to be objectively resolved, and if the role carnivores play in an ecosystem is to be understood, a sound knowledge of carnivore food habits is essential.

With the importance of coyote food habits in mind, and in order to better assess the eastern coyotes influence on animal and plant communities in the southeast, this baseline scat analysis study was designed to document the different foods consumed during various seasons by the eastern coyote on the Berry College campus in northwestern Georgia (34.256°N, -85.164°W).

Scat analysis was chosen over three other common carnivore food habit methods (direct observation of prey consumption, observation of prey remains along trails and at dens, and stomach content analysis) because scats are generally numerous, are easily collected, allow concurrent studies on the species to take place, and can be used to quantify individual food habits. Furthermore, scat analysis is a low-cost, non-invasive way of determining species present in the eastern coyote diet.

Biologists have been collecting carnivore feces for decades to study predator ecology (Litvaitis, 2000). While carnivores are notoriously difficult to observe directly, their feces are often abundantly available on roads and trails. Feces have been used to study foraging ecology (Putman, 1984), animal abundance (Harrision, 2004), parasitism (Gompper, 2003), hormone levels (Wasser, 1996), and individual identification (Taberlet, 1996).

Every animal or plant consumed by a coyote is imperfectly digested, so food habits can be determined by the identification of undigested fragments of prey species remaining in collected scats (Johnson and Hansen, 1978). Small seeds and fibers of plants, chitinous exoskeletons of invertebrates, and scales, nails, hairs, feathers, and bones of vertebrates are the main constituents of foods indigestible to coyotes (Litvaitis and Mautz, 1976).

Over the years, coyote food habits studies based on scat content analysis have progressed from simply reporting a list of what coyotes eat to evaluating coyote feeding strategies. Meanwhile, our understanding of what scat contents mean in terms of actual prey consumed has progressed very little. In fact, research suggests that before we can address topics such as functional feeding or competition among carnivores, it is imperative that we understand the relationship between prey remains recovered in scats and prey consumed (Kelly, 1991).

Scat analysis identifies the species consumed, but fails to measure the rate of carrion to killed prey, the biomass of each species consumed, the differential digestion rates of various foods, and the lack of presence of totally digested items, information vital to assess the predatory role of the coyote (Johnson and Hansen, 1978). Implicit in the use of mammalian prey components (hair, bone, teeth) to identify and quantify prey consumed is the assumption that recovery of such components remains constant. Researchers have shown this assumption to be untenable, as they have found recovery of bone and teeth from coyote scats varies with prey size, meal size, energy content of the meal, and the frequency with which prey is consumed (Weaver and Hoffman, 1979; Floyd, 1978; Meriweather and Johnson, 1980). Variation results from physiological mechanisms affecting how long prey is retained in the digestive acids of the stomach. Since hair is indigestible, it does not vary and therefore is the most common item used to identify prey items in scat (Kelly and Garton, 1997).

Although there has been much research on digestibility of prey items, little research has examined the field deterioration of coyote scats containing different prey as a result of degradation, decomposition, or dessication. If scats containing a specific prey item deteriorate at a faster rate in the field, that prey could be underestimated in the food habits of the coyote. It is important to recognize that scat does not have to completely deteriorate to be underrepresented in a food-habit analysis. Godbois (2005) found that coyote scat containing deer lost more mass in one day than scat containing smaller mammals. Larger prey items contain proportionately less indigestible material than smaller prey. Therefore, scats that contained deer had more residual material that could have been affected by decomposing organisms, rain, or drying, resulting in a faster rate of mass loss from the scats.

In addition to weather-related deterioration, scat analysis studies can also be biased by consumption of feces (coprophagy). One study found that rates of removal of coyote feces varied from 7% during the spring to 50% during the summer (Livingston, 2005). Opossums were identified as the most common species to remove coyote scat. Livingston (2005) suggested that coyote feces may actually be an important seasonal source of food for opossums and may provide seasonal dietary supplements for other species.

Distinguishing among the feces of sympatric, similar-sized carnivores can also be difficult and result in scat identification errors and biased data due to the inclusion of samples from non-target species (Farrell, 2000). Source species of a scat is normally determined by the shape, size, and smell of the scat (Ackerman, 1984). Most natural areas support several species of similar-sized carnivores, which add uncertainty to scat collection surveys. In Georgia, coyote scat could be easily confused with scat from the weasel family, or foxes (Kavanagh, 2000; Neale and Sacks, 2001).

Despite what may seem like a long list of limitations surrounding scat analysis, it continues to be the most common approach to study food habits. Researchers as early as the 1930s called scat analysis studies "one of the most fundamental phases of ecological research pertaining to wildlife management" (Errington, 1935). Today, researchers continue to prefer scat analysis studies over carnivore stomach analysis or feeding trials due to the many advantages scat analysis offers.

Following in the steps of past and present researchers, this baseline study used scat analysis to document the different foods consumed during various seasons by the eastern coyote on the Berry College campus in northwestern Georgia. Ultimately, by analyzing the scats of the eastern coyote over a 15-month period, we were able to provide the scientific world with an introduction to the foraging ecology of the eastern coyote in northwestern Georgia.

METHODS

Study Area

The study area was located on Berry College (34.256°N, -85.164°W), which is located in Floyd County in northwestern Georgia and encompasses the tip of the southern Appalachian Mountains.

Climate in the study area is humid subtropical with mild winters and hot moist summers. Monthly average temperatures range from a high of 92.2°F to a low of 32.6°F. Annual average precipitation is 54 to 56 inches. Elevation in the study area varies from 600 feet to 1,500 feet above mean sea level.

Fieldwork was conducted on 7,395 hectares (28.55 square miles) (Figure 1). Seven major access roads transect the study area (Figure 2). The seven major roads and a description of their location and topographical surroundings can be found in Table 1.

Only 7.1% of the study area is open to public use, while the remainder is restricted in access and managed for wildlife and timber. No special management activities are applied to coyote populations in the study area. In fact, there is no closed season for hunting or trapping coyotes in Georgia, although since the study area is located within a college campus, only a few hunts are allowed each year.

The study area is over 90% forested and consists of both a lowland and mountainous region. Non-forested areas contain cottages, permanent homes, roadways, and agricultural fields. The most abundant tree species throughout the study area is the loblolly pine (*Pinus taeda*). Other common trees in the area include the shortleaf pine

(*Pinus echinata*) and all of the Appalachian hardwoods: poplar (*Liriodendron tulipfera*), sweet gum (*Liquidambar styraciflua*), red oak (*Quercus rubra*), white oak (*Quercus alba*), hickory (*Carya ovata*), ash (*Fraxinus americana*), and maple (*Acer rubrum*).

Logging has been going on in the study area and has affected forest stand composition for the past 114 years. As a result of logging, the majority of the study area today is made up of planted loblolly pines, which are now harvested on a 45-year rotation. In order to aid in the logging process, underbrush is currently controlled by yearly burns throughout the study area. Together, the annual logging and burning pattern have resulted in the loss of many underbrush plants and a rather open forest over the past 25 years.

Large mammals in the study area include black bear (*Ursus americanus*), white-tailed deer (*Odocoileus virgianus*), bobcat (*Felis rufus*), red fox (*Vulpes vulpes*), and gray fox (*Urocyon cinereoarnenteus*). Small mammals in the study area include raccoon (*Procyon lotor*), woodchuck (*Marmota monax*), beaver (*Castor canadensis*), river otter (*Lutra canadensis*), muskrat (*Ondatra zibethicus*), eastern gray squirrel (*Sciurus carolinensis*), red squirrel (*Tamiasciurus hudsonicus*), fox squirrel (*Sciurus niger*), eastern chipmunk (*Tamias striatus*), striped skunk (*Mephitis mephitis*), eastern cottaintail (*Sylvilagus floridanus*), virginia opossum (*Didelphis virginiana*), northern short-tailed shrew (*Blarina brevicauda*), eastern mole (*Scalopus aquaticus*), water shrew (*Sorex palustris*), white-footed mice (*Peromyscus leucopus*), deer mice (*Peromyscus maniculatus*), house mice (*Mus musculus*), norway rats (*Rattus norvegicus*), meadow jumping mice (*Zapus hudsonius*), and cotton mice (*Peromyscus gossypinus*). These mammals, as well as several species of reptiles, amphibians, and birds form the coyotes potential prey base.

Food Habits

Coyote scat (N=127) was collected throughout the Berry College study area (Figure 1) along seven major access roads (Figure 2) and game trails visible from those access roads, as well as opportunistically twice a week from May 2005 through August 2006.

Scat collections were grouped by location (Table 1) and season. Dates for seasons were spring 2005 (2 May-30 May 2005), summer 2005 (2 June-19 August 2005), fall 2005 (6 September-29 November 2005), winter 2005/2006 (3 December 2005-25 February 2006), spring 2006 (3 March-29 May 2006), and summer 2006 (2 June-18 August 2006).

Scat was identified by characteristic morphology, including size, shape, and diameter. Coyote scats can be quite variable depending on the diet, but are usually large and strongly tapering, with their most distinguishing characteristic being the presence of hair (Figure 3).

Since a small coyote scat is almost identical to a large fox scat, the presence of associated tracks was also used to assure the scat was indeed deposited by a coyote. Coyote tracks are oval in shape and the toenail marks, when present, tend to hook inwards (Figure 4). Typical coyote tracks are 2 to 3 inches long and 1.5 to 2 inches wide with the front heel pad being larger than the rear. Often, only the middle two claws are present in the tracks.

Only relatively fresh scats were collected; those that appeared bleached, degraded, or desiccated were discarded. If there was ambiguity in the source species of the scat, or if there was a significant loss in the mass of the scat, it was discarded.

Upon collection, each scat was placed in a plastic Ziploc® bag, and the location, date, and a brief description of the scat were recorded. The description of the scat consisted of recording whether the scat was a whole or partial sample. Scats were determined partial if they did not have the typical tapered ends or if they appeared to have been disturbed by another animal. Scats that appeared to be of normal length and had tapered ends were recorded as whole samples.

Once scats had been collected and cataloged they were stored at $0^{o}C$ until further analysis. Stored scats were eventually placed in metal trays with a colored marble, which served as an identification marker throughout the cleaning process. Scats were then oven-dried at 60° C for 24 hours. This allowed a constant dry weight for each individual scat sample to be obtained and to kill eggs of the *Echinococcus* spp. After oven drying and obtaining a dry weight, each scat and its respective marble were secured in a ripstop nylon bag (approx. 18^{x} 18 cm) using two rubberbands. Nylon bags were sewn on 3 sides with a fine needle and stitch to insure against the loss of scat residue.

Groups of approximately 18 of these bagged scats were then soaked together in buckets of hot water for approximately 48 hours. After 24 hours, each bag was squeezed and kneaded to manually break up the fecal matrix, and the water was changed. After 48 hours of soaking, groups of bagged scat were washed in an automatic clothes washer until the rinse water ran relatively clear and no large solid masses remained. Bags and contents were then tumble dried in a clothes dryer.

Once the scat samples were completely dry they were removed from their ripstop nylon bag and placed into a plastic specimen cup. At this point the identification marble was discarded and the scat information was recorded on the lid of the specimen cup.

To facilitate the separation of hard materials such as bone fragments, teeth, seeds, etc., from hairs in which they were entangled, scat was then emptied from the specimen cup into a 2.5-mm sieve situated above a metal tray. Material that passed through and remained in the sieve was then hand separated into appropriate piles. If too much fecal matrix remained or enough vegetation did not wash out, the scat was then re-sifted through a 1-mm sieve so as to be able to identify diagnostic parts.

After all scat had been separated into holding containers, macroscopic and microscopic examination of the undigested residues of bones, teeth, hairs, and seeds was done to identify each diagnostic part recovered to its' respective species or family. Due to the variation in the recovery of bone and teeth caused by the digestion process and the lack of variation in the recovery of hair, I first used teeth and bone to try to identify the prey items present in the coyote scats, and then examined 5 sub-samples of hair, obtained randomly from each scat using a forceps, to apportion the scat to the items present and assure the identifications of teeth and bone were correct.

Undigested bones, teeth, feathers, bills, scales, seeds, and guard hair were all identified to the lowest possible taxonomic category based on comparison with reference collections of birds, mammals, reptiles, insects, and plant seeds housed at Berry College, the University of Tennessee at Chattanooga, and Georgia's Department of Natural Resources Education Center.

Hair was the most common item used to identify species present in the scat because unlike the other diagnostic parts, hair was the only item completely indigestible to the coyote, which made it the most reliable item to accurately identify. Each species of animal possesses guard hair with characteristic length, color, shape, root appearance, and internal microscopic features that distinguish one animal from another. Thus, guard hairs subject to light microscopy analysis at the 40x to 400x range of magnification were easily identified by comparing their physical characteristics such as size, shape, and medullar structure with a known guard hair sample from either an animal hair reference collection or a specific animal.

In addition to identifying different species by examining guard hairs, I was also able to distinguish between adult and juvenile white-tailed deer by closely examining the cortex and medulla of each guard hair. Fawns have a distinctive juvenile guard hair which displays white pigment in the cortex and medulla, unlike the adult guard hair which displays brown pigment. The gross distinction between fawn and adult pelage holds good until approximately September 1st, when the autumnal molt begins. The fawns then begin to assume their first winter coat, which is not conspicuously different from the winter coat of the adult.

Statistical Analysis

Frequency Analysis

Frequency of occurrence and relative frequency of occurrence were calculated for all prey items recovered from scats. Frequency of occurrence was calculated by dividing the number of occurrences of each prey type by the total number of fecal samples and multiplying by 100. Relative frequency of occurrence was calculated by dividing the number of occurrences of each prey type by the total number of all prey types and multiplying by 100.

For data summarization and statistical analysis purposes, all identified prey items were distributed into five main categories: Arthropoda, Aves, Mammalia, Reptilia, and vegetation (Table 2). Since Mammalia included so many prey items, it was further divided into five subcategories: Artiodactyla, Carnivora, Didelphimorphia, Lagomorpha, and Rodentia (Table 3). After categorization, the frequency of occurrence and relative frequency were calculated for each of the ten prey categories.

Seasonal and Yearly Analysis

Since scat was collected from May 2005 through August 2006 I was able to analyze both seasonal (fall, spring, summer, winter) and yearly (May 2005/May 2006, Summer 2005/Summer 2006) trends in the diet of the eastern coyote. To determine if the diet varied significantly among the four seasons or between years, I used contingency tables and chi square tests (under the null hypothesis that each prey item was equally frequent in scats each season/year).

RESULTS

Frequency Analysis

Analysis of 127 coyote scats collected throughout the study area from May 2005 through August 2006 revealed that small mammals from the Family Muridae (cotton mice, meadow jumping mice, deer mice, and house mice) were the most frequently eaten prey items, occurring in 26% of analyzed scat samples. Eastern cottontails (*Sylvilagus floridanus*; 15.2%), eastern gray squirrels (*Sciurus carolinensis*; 10%), and white-tailed deer (*Odocoileus virginianus*; 13.7%) were also important, with fawn remains occurring slightly more frequently than adult remains (7.8% vs. 5.9%) (Figure 5). A complete list of all prey items and their relative frequency/frequency of occurrence can be found in Table 4.

Mammal remains (72.2%), which were subdivided into five distinct categories (Rodentia, 39.6%; Lagomorpha, 15.2%; Artiodactyla, 13.7%; Carnivora, 2.6%; and Didelphimorphia, 1.1%), comprised the largest prey category (Figure 6), followed by vegetation (10.7%), Arthropoda (7.4%), unknown (4.8%), Aves (3.3%), and Reptilia (1.5%) (Figure 7). A complete list of all ten major prey categories and their relative frequency/frequency of occurrence can be found in Table 5.

One mammalian family and ten mammalian species comprised the 71.2% mammalian prey category. Those items in order of relative frequency of occurrence include the Family Muridae (26.3%), eastern cottontail (*Sylvilagus floridanus*; 15.2%), eastern gray squirrel (*Sciurus carolinensis*; 10%), fawns (*Odocoileus virginianus*; 7.8%), adult deer (*Odocoileus virginianus*; 5.9%), eastern chipmunk (*Tamias striatus*; 1.9%), raccoons (*Procyon lotor*; 1.5%), opossum (*Didelphis virginiana*; 1.1%), gray fox

(*Urocyon cinereoargenteus*; 1.1%), beaver (*Castor canadensis*; 0.7%), and muskrat (*Ondatra zibethica*; 0.7%).

Vegetation was the second largest prey category with a relative frequency of occurrence of 10.7%. Persimmon fruits (*Diospyros virginiana*) were the most common plant identified, present in 4.8% of analyzed scats. Other plants identified in order of relative frequency of occurrence included: blackberries (*Rubus fruticosus*; 2.6%), black cherry (*Prunus serotina*; 0.7%), paw paw (*Asimina triloba*; 0.7%), American plum (*Prunus americana*; 0.7%), pecans (*Carya illinoinensis*; 0.7%), and corn (*Zea mays*; 0.4%). Although corn does not naturally occur in the forests where scat was collected, the Berry Campus is home to both a dairy and beef farm where corn is fed regularly to cattle, so coyotes could have ingested it while feeding near cattle troughs or ingested a prey item that had previously fed on corn.

Arthropod remains were the third largest prey category with a relative frequency of occurrence of 7.4%. Identified arthropod remains included grasshoppers (Orthoptera; 4.8%) and beetles (Coleoptera; 2.6%). Both insect remains were typically present in small quantities within individual scats, with the exception of one scat collected along Viking Trail, which was made up entirely of beetles.

Bird remains were the fourth largest prey category with a relative frequency of occurrence of 3.3%. Identified bird remains include ruffed grouse (*Bonasa umbellus*; 1.1%), northern bobwhite quail (*Colinus virginianus*; 1.1%), wild turkey (*Meleagris gallopavo*; 0.7%), and a Canada goose (*Branta canadensis*; 0.4%). The amount of feathers in a given sample were highly variable, with some scats containing very few feathers while others contained large quantities. In most cases, bird residues were too scant or highly degraded by the digestive process to permit identification.

Reptilian remains were the least common prey category identified, with a relative frequency of occurrence of only 1.5%. Scales were the most common form of reptilian remains identified, but in a few cases entire limbs were found.

Although the five prey categories discussed above fit the vast majority of prey identified, there was also an unknown category that accounted for 4.8% of all prey that was examined. The entire percentage of the unknown category was represented by hair that did not match any reference hairs. Since the unknown category consisted of 100% hairs, it is likely the unknown hairs belonged to a species or family present in the mammalian family, since all other hairs identified led to a mammalian classification.

Seasonal and Yearly Analysis

After examining the relative frequency of occurrence of all prey identified throughout the study, I analyzed both seasonal (fall, spring, summer, winter) and yearly (May 2005/May 2006, Summer 2005/Summer 2006) trends in the diet of the eastern coyote. Since most of my prey items were found in only a small portion of my scat samples, in order to reduce errors associated with using small sample sizes in chi square tests, I only analyzed the most frequently identified prey items. The eight most frequently identified prey items and the number of times they were identified per season are listed in Table 6.

Chi-square tests comparing these major prey items and season found a significant association (x^2=1256.1, df=203, P<.0001), indicating there are seasonal trends of major prey items in the diet of the eastern coyote. Consumption of grasshoppers occurs throughout every season, except winter. Fawn are an important prey item only in spring and summer months, Murids tend to be most popular in spring, eastern cottontails tend to be more popular in winter, and persimmon consumption peaks during fall months.

Chi square tests comparing the five major prey classes (Table 7) and season also found that the occurrence of the major prey classes varied significantly among seasons (x^2=735.1, df=76, P<.0001). Supporting my previous results comparing major prey items and season, consumption of prey class Rodentia was found to be most common in spring, while consumption of vegetation occurred most frequently in fall. Arthropod consumption was constant throughout the year, except during winter months, and prey classes Artiodactyla and Lagomorpha were consumed year round.

Although I concluded from my chi-square analysis that major prey items and major prey classes are associated with specific seasons, my sample sizes were small and observation intervals in each season were not equal. Therefore, I also used weighted seasonal prey items and prey classes (by calculating the occurrence of each prey item/prey class per observational day) to verify my results (Tables 8 and 9).

For yearly trends a chi-square analysis was not performed because the sample size was extremely small and I concluded that the chi square test would not be valid. Instead, I once again weighted major prey items and major prey classes by calculating the occurrence of each prey item/prey class per observational day, and drew my conclusions (Tables 10 and 11).

From Table 10, a yearly comparison of the eight major prey items, I concluded that fawns seemed to be a staple food in May 2006 compared to May 2005 and persimmons were not consumed at all during either May 2005 or May 2006.

To support my results from the yearly comparison of my eight major prey items, I once again examined a yearly comparison of the five major prey classes (Table 11). From Table 11 I concluded that vegetation was absent in the coyote's diet both during May 2005 and May 2006.

DISCUSSION

My findings concur with previous studies indicating mammals are a vital part of the coyote diet (Koehler and Hornocker, 1991; Cypher, 1994; Sanabria, 1996; Hidalgo-Mihart, 2001). At least ten mammalian genera were identified, ranging from small mice and voles to adult deer, and accounting for 72.2% of all identified prey in collected scats.

Rodents from the Family Muridae (hereafter referred to as Murids) were the most common mammalian prey item identified, with a 26.3% frequency of occurrence. The preponderance of small mammal remains such as those of Murids indicate the family plays a key role in the diet of the eastern coyote on the Berry College campus. The importance of Murids has been reported for most of the different habitats where they coexist with coyotes, such as grasslands (Brillhart and Kaufman, 1994), pine-oak forests (Servin and Huxley, 1991), and tropical forests (Janzen, 1983). Other studies (Holle, 1978; Cypher, 1993; Cypher et al, 1993) have also documented Murids as being a key dietary component for coyotes.

Murids such as cotton mice (*Peromyscus gossypinus)*, meadow jumping mice (*Zapus hudsonius*), and deer mice (*Peromyscus maniculatus*) readily invade areas where the original vegetation has been cleared, such as when forests are converted into grasslands, or when large tracts of forest are clearcut (Flemming, 1970). In my study area the northern and southern boundaries consist of both agricultural fields and grasslands, while all remaining land is managed for timber. Thus, my study area is prime Murid habitat, and it is very likely that they are abundant on all of the agricultural lands, human-induced grasslands, and areas where forest has been harvested. Moreover, since grasslands and recently cut timber are also favorable habitats for coyotes, it is not surprising that Murids were documented as a key dietary component.

Although the diet of the eastern coyote consisted primarily of Murids, fluctuations in the frequency of these prey items did occur. Coyotes in my study area mainly preyed upon Murids in the winter and spring. Variation in the consumption of Murid species among seasons could be related to interseasonal species fluctuations (Holle, 1978). Another contributing factor to increased Murid consumption could be the poor physical condition of rodents due to prolonged dryness and the lack of vegetation cover during the winter (Flemming, 1970). The reduced consumption of Murids during the fall and summer seasons could be attributed to the availability of fruits during the fall and the abundance of fawns, insects, and fruits during the summer. Windberg and Mitchell (1990) reported that the proportion of rodents in the coyote diet is directly related to their abundance, and inversely related to the abundance of alternative food sources such as fruits and insects, which are available only during certain seasons (Andelt, 1987).

While Murids accounted for almost half of the small mammal prey identified, eastern cottontail and eastern gray squirrel were also a very important part of the coyote diet. In fact, these species were the two most frequently identified prey items after Murids. The high percent occurrence of small mammals such as rodents, rabbits, and squirrels indicates the efficiency of the eastern coyote in searching, locating, and capturing small mammals within the study area. A predominance of small mammals in the diet of coyotes living in both agricultural and forested landscapes has also been observed in other food habit studies of eastern coyotes (Lapierre, 1985; Person, 1988).

The consumption of white-tailed deer throughout the 15-month study was unexpectedly high given the abundance of other small prey items identified within the study area. Predator-prey relationships between the white-tailed deer and the coyote have been studied extensively, and most research suggests that elevated consumption of white-tailed deer is probably due to the presence of fawns during late spring/early summer and the availability of carrion primarily during the winter (Harrison and Harrison, 1984; Floyd, 1975; Andelt, 1985; Cypher, 1993; Niebauer and Rongstad, 1977; Prugh, 2005). Given the temporal distribution of deer occurrence in collected coyote scat samples (peaked during spring and winter), my data support the contention that most deer consumption within the study area was of carrion or fawns.

Studies across the United States have found the coyote's diet consists of as much as 70% fawns during April, May, June and July (Andelt, 1985). The elevated consumption of fawns has generally been attributed to the fact that coyotes raising pups specifically seek out fawns as a source of food. Studies suggest that fawns constitute an energetically efficient item to bring to pups for three main reasons. First, by selecting large items such as fawns, fewer trips back to the den are required to meet pup food requirements (Harrison and Harrison, 1984). Second, larger items have a greater proportion of digestible biomass than do smaller items, which have a higher proportion of indigestible materials (Floyd, 1975). Thus, larger items likely provide more calories per unit weight than smaller items. The hypothesis that smaller items may be suboptimal for supplying food to pups is supported by a study which found that small mammals occurred in over 50% of adult scats versus only one pup scat (Cypher, 1993). Third, fawns are relatively abundant in April, May, and June and are vulnerable due to small size and inexperience. Thus, they are easily obtained prey for adult coyotes (Andelt, 1985; Cypher, 1993).

With the above studies in mind, one could make the assumption that the elevated consumption of fawns within my study area during the spring of 2006 suggests that adult coyotes were specifically preying upon fawns in order to feed pups. This assumption is supported by the fact that at least one pregnant coyote was captured and radio collared early in the spring of 2006. This same female coyote was tracked throughout the spring and summer of 2006. She always stayed on the western half of my study area, primarily traveling on Old Redmond Gap Road and Beaver Pond Road, where the vast majority of scat with fawn was collected.

However, another possible explanation for the high consumption of fawns is that my study area is home to an extremely large number of white-tailed deer, which are only subjected to hunting pressure two or three weeks out of each year, leaving the population prone to exceeding its carrying capacity. Thus, the removal of fawns by coyotes may be related to the density of the local deer population.

The same carrying capacity theory could explain why adult deer remains were often found in coyote scat. In study areas such as mine, where deer populations are abundant, coyote predation may actually benefit deer health by reducing the deer herd and providing more nutrients for the remaining deer. However, a more likely explanation is that increasing occurrences of deer as prey items were likely the result of coyotes scavenging deer carcasses, rather than direct predation (Niebauer and Rongstad, 1977). This theory is also more likely considering deer carcasses were available almost year round in the northwestern corner of my study area, primarily as a result of deer-vehicle collisions on nearby roads. In addition, a male coyote was captured and radio collared at a carcass site within my study area, suggesting that coyotes within my study area routinely fed on available deer carcasses.

Moreover, past studies have found that carrion availability is vital to maintaining coyote populations (Todd and Keith, 1976; Weaver, 1979). The strong selection for carrion by coyotes suggests that carrion has a high intrinsic and net profitability (Prugh, 2005). Carrion does not need to be pursued and hunted down, so its handling costs as a prey item are low. After a carcass is discovered, coyotes return to it repeatedly since it is a reliable food source that requires little search time. Given the relatively high occurrence of adult deer in scat collected in my study area, it is extremely likely coyotes were consistently feeding on available carrion.

Fruits were another important part of the coyote's diet within the study area. Coyotes consumed large quantities of persimmons and blackberries relative to other prey items during late summer and throughout the fall. Seasonal consumption of large quantities of fruit is a common trend for coyotes living in southern latitudes (Hidalgo-Mihart, 2001; Neale, 2001; Willson, 1993; Hoerath, 1991). Chamberlain (2000), Caturano (1983), and Person (1988) all observed an increased consumption of fruits in late summer and early fall and suggested that fruit might be a preferred food over mammalian prey when it is available. Locating and consuming fruits may require less energy costs relative to searching for alternative prey; hence, coyotes likely improve foraging efficiency by shifting prey selection when fruits are abundant. Other researchers considered animal prey as the preferred food source for coyotes, with other items being consumed when animal prey became scarce (Cypher et al., 1993; Hernandez and Delibes, 1994). Data on food availability are necessary to determine if the high consumption of fruits during late summer and throughout the fall is related to prey scarcity or to the energetic efficiency of exploiting concentrated fruit sources.

Reptiles and arthropods both comprised a small percentage of the coyote diet in the study area, most likely because they provided little energetic award due to their small size (Delibes, 1997). However, the lack of reptiles and arthropods in this study could also be attributed to digestive acids in the coyote's stomach completely breaking down the prey item, resulting in the lack of presence of that item (Johnson and Hansen, 1978). More research needs to be done to examine reptile and arthropod consumption and effects of the coyote's digestive system on remains.

While no livestock was found in the analysis, predation on sheep, chickens, and cattle probably does occur within the study area, albeit at a low rate. The most surprising species identified in the study was a gray fox. The identification of the gray fox as a coyote prey item is significant because no previous research addresses competition between coyotes and gray foxes in Georgia. Although coyotes and foxes share a common range throughout much of North America, there appears to be an inverse relationship between the densities of coyotes and that of foxes (Gese, 1996). High densities of coyotes tend to limit the distribution of fox territories and their numbers. In other areas of the United States, biologists have noted the decline of foxes following the colonization of coyotes into an area (Cypher, 1998). Foxes apparently avoid core home ranges of coyotes to avoid contact with the stronger predator. Most studies concluded that foxes are not eliminated but become less common when coyotes invade their territory (Major, 1987). However, at least one study has found otherwise. Neale and

Sacks (2001) reported that despite similarities in diet between foxes and coyotes, space use by foxes did not suggest avoidance of the larger predator. Future studies need to examine the degree of overlap in resource use between the coyote and gray fox in Georgia.

Although the data from my study provide a good baseline of the food habits of the eastern coyote in northwest Georgia, limitations were encountered that could potentially have biased the study. First, the study was based entirely upon the observers' ability to accurately identify coyote scat. Although proper scat identification is a fundamental assumption of studies that use fecal samples to investigate the ecology or distribution of carnivores, the accuracy of observers rarely has been tested. Fortunately, a recent study by Prugh (2005), which used DNA analysis to identify coyotes, found that observers were able to identify coyote scats with >90% accuracy, despite the fact that coyote scats could be easily confused with numerous other species. In addition, the study found that observers did not vary in their ability to identify feces and that experience level did not influence accuracy. Since all researchers in my study area had at least some training on identifying coyote scat, I assumed that the potential for bias caused by misidentification of scat was extremely low.

Another limitation from my study is that the data only quantifies frequency of occurrence of prey, meaning the exact number of prey consumed is not known. Quantifying the number of small mammals consumed is very difficult as the amount of bone and teeth digested by coyotes varies with prey size, meal size, meal composition, and the frequency with which prey are ingested. Small meals and meals with higher caloric content tend to stay in the stomach longer than larger meals, which results in variable recovery rates (Kelly and Garton, 1997). It is also not possible to determine the mass of larger prey items ingested, such as deer. Thus, the importance of large prey items may be underestimated due to their lower frequency of occurrence.

While correct identification of feces and frequency of occurrence could have introduced some bias into the study, the major limitation encountered was the inability to locate scats from late May through August. Out of 127 total scat samples collected during the 15-month study, only 21 were found during the summer months, 9 during 2005 and 12 during 2006, which made statistical analysis of seasonal and yearly prey data very difficult. I initially hypothesized that the lack of scat during the first summer (2005) was due to the inability to locate appropriate roads and game trails used by coyotes, which is why the study ran through the summer of 2006. Unfortunately, I ran into the same problem in the summer of 2006, despite having multiple researchers looking for scat and regularly tracking four radio-collared coyotes within the study area. Since researchers looked for scat multiple times during the week I do not think that weather played a factor in the inability to locate coyote scat because of degradation.

At this time I can only speculate as to why researchers were unable to locate scat during summer months. However, two possible explanations include summer changes in the coyote's behavioral patterns and coprophagy. Little is known about the movement habits of the coyote in Georgia. Although four radio collared coyotes were tracked within the study area during the summer of 2006 further research needs to be done to compare the home ranges of coyotes in the summer compared to other seasons. It is very likely coyote scat was difficult to find in the summers because coyotes were more or less active, thus resulting in coyote scat being left in different places. Another possible behavioral explanation could be related to coyote pups. Since mating has already taken place before the summer and adult coyotes are busy raising pups there is a possibility that they are not being as active territorially, so scat is less abundant. This assumption is supported by the fact that once pups had left the den in the study area scat was once again abundant.

Two coprophagy theories that could explain the lack of scat found during summer months in my study are 1) intraspecific coprophagy among carnivores and 2) coprophagy as a result of nutritional imbalances. Rich and Hurst (1998) found that intraspecific coprophagy among carnivores could be important in mate selection and territory defense. Removing scent markers by consuming competitor's feces may suggest that a resident carnivore has the ability to defend its territory. Coprophagic behavior might, therefore, be indicative of an individual's fitness as a potential mate. It has also been suggested that coprophagy results from nutritional imbalances and that certain species experience nutritional gains from eating feces that are not otherwise available (Chilcotte and Hume, 1985; Ebino, 1989). Most animals practice coprophagy, and there is an inverse relationship between adequacy of diet (in terms of nutrients normally synthesized by the microflora of the intestinal tract) and the extent to which coprophagy is practiced (Giovannetti, 1982).

Retention time and level of digestion in carnivore digestive tracts vary according to prey size, and the relationship between prey size and digestibility may be a factor influencing protein content in feces. Studies suggest that tissue from larger prey might be less completely digested than tissue from smaller prey, as a result of the larger prey being affected less by digestive enzymes (Meriwether and Johnson, 1980; Alred, 1982). Given the tendency of coyotes to rapidly consume large quantities of tissue, it is likely that portions pass through the digestive tract without being completely digested. Thus, higher protein concentrations in coyote feces stemming from incomplete digestion of larger prey (e.g., fawns and lagomorphs versus rodents) may have resulted in increased coprophagy during the summer months within my study area. Livingston (2005) found that opossums removed 50% of feces during the summer months at an experimental feeding station in Kansas, and that opossums were likely attracted to high protein concentrations in the feces.

Further research is needed to determine if coprophagy is contributing to the paucity of coyote scat samples found during the summer months in Georgia. In addition, a three to five-year dietary study should be implemented in order to provide adequate scat numbers to compare seasonal and yearly prey data.

This study was an important first step in examining the frequency of occurrence, as well as the seasonal and yearly variation of prey items consumed by the eastern coyote on the Berry College campus. The long list of prey items identified makes it clear that the coyote is now an important predator throughout southeastern North America. In addition, my results show that the coyote is highly adept at exploiting edge habitat created by the patchwork of wooded and open areas within the study area, suggesting human activity (e.g., agriculture and forestry) has an important effect on the availability and abundance of coyote prey items (Brillhart and Kaufman, 1994; Quinn, 1997). As the study area continues to be harvested for timber and more edge habitat is created, an increase in coyote populations due to the abundance of prey items is possible. This finding has long-term implications not only for my study area, but also for all of North

Georgia where edge habitat is increasing rapidly as a result of deforestation for development.

While my study provides an introduction into the natural history and ecology of coyotes in the region, there are still several significant gaps in our knowledge base, and these gaps make it difficult to make informed conservation decisions. In particular, I suggest two aspects of coyote ecology as priorities for future research in the study area: coyote demographics and the role of coyotes as keystone predators. We know coyote populations have colonized the entire Southeast. It is unclear whether the population has peaked or if population sizes will continue to increase. Until this issue is resolved, it will be difficult to assess how common coyote-human interactions will become, and what impact coyotes will have on other species. Future studies also need to examine the role of the eastern coyote in structuring communities. Coyotes have the potential to significantly influence the population sizes of a broad array of species, some of which may be of significant concern to conservation and wildlife biologists. How community structure will change as a function of the colonization of the southeast by coyotes has not yet been adequately addressed.

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TABLES

Table 1. Description of the seven major access roads/trails where coyote scat was collected on the Berry College campus in northwestern Georgia

Access Road/Trail	Location/Description
Old Redmond Gap Road (ORGR)	The most western road in the study area; begins in the southwestern corner of the study area and runs northwest until you hit the base of Lavender Mountain; surrounded by 40-45 year old timber.
Beaver Pond Road (BPR)	Located directly northeast of ORG road at the 2.5 mile mark coming from main campus; runs northeast from ORG road towards the base of Lavender Mountain; surrounded by a 15 year old wetland and 35-40 year old timber.
Viking Trail (VT)	The second most westerly trail in the study area; begins in the southwestern corner of the study area and runs northwest until you hit the base of Lavender Mountain; runs directly parallel to ORG road but is located about 4 tenths of a mile to the east; surrounded by 65-70 year old timber.
Old Stretch Road (OSR)	Begins just east of Victory Lake and continues to run northwest until you hit the base of Lavender Mountain; runs directly parallel to Viking Trail about a half mile to the east; surrounded by 30-35 year old timber.
Rollins Road (ROR)	Begins in the southeastern corner of the study area at the Dairy and Beef Centers and continues northeast until you hit the base of Lavender Mountain; runs parallel to Old Stretch Road about ¾ of a mile to the east; surrounded by 45-50 year old timber.
CCC Road (CCCR)	Juts off to the southeast 2 tenths of a mile before the intersection of RO Road and OCG Road; Continues southeasterly until it dead ends into Old Summerville Road; surrounded by 60-65 year old timber.
Old Central Grove Road (OCGR)	Juts off to the northeast from Rollins Road right before Rollins Road begins up Lavender Mountain. Runs directly parallel to Lavender Mountain until it dead ends into Old Summerville Road; surrounded by 55-60 year old timber.

Table 2. Major prey categories for all prey items identified in coyote scat

Prey Category	Prey Items Within Each Category
Arthropoda	Coleoptera (Beetles)
	Orthoptera (Grasshoppers)
Aves	*Bonasa umbellus* (Ruffed Grouse)
	Branta canadensis (Canadian Goose)
	Colinus virginianus (Northern Bobwhite)
	Meleagris gallopavo (Wild Turkey)
Mammalia	*Odocoileus virginianus* (White-tailed Deer)
	Castor canadensis (Beaver)
	Sciurus carolinensis (Eastern Gray Squirrel)
	Tamias striatus (Eastern Chipmunk)
	Muridea Family (Mice, Rats, Voles)
	*Ondatra zibethica (*Muskrat)
	Procyon lotor (Raccoons)
	Urocyon cinereoargenteus (Gray Fox)
	Sylvilagus floridanus (Eastern Cottontails)
	Didelphis virginiana (Virginia Opossum)
Reptilia	Squamata (Snakes)
	Squamata (Lizards)
Vegetation	*Rubus fruticosus* (blackberry)
	Diospyros virginiana (persimmon)
	Prunus serotina (blackcherry)
	Asimina triloba (pawpaw)
	Prunus americana (American plum)
	Zea mays (Corn)
	Carya illinoinensis (Pecan)

Table 3. Mammalian subcategories for all mammalian prey identified in coyote scat

Mammalia Subcategory	Prey Items Within Each Subcategory
Artiodactyla	*Odocoileus virginianus* (Whitetail Deer)
Rodentia	*Castor canadensis* (Beaver)
	Sciurus carolinensis (Eastern Gray Squirrel)
	Tamias striatus (Eastern Chipmunk)
	Muridae Family (Mice, Rats, Voles)
	Ondatra zibethica (Muskrat)
Carnivora	*Procyon lotor* (Raccoons)
	Urocyon cinereoargenteus (Gray Fox)
Lagomorpha	*Sylvilagus floridanus* (Eastern Cottaintails)
Didelphimorphia	*Didelphis virginiana* (Virginia Opossum)

Table 4. Relative frequency of occurrence and frequency of occurrence of all prey items identified in coyote scat

Prey Item	Relative Frequency of Occurrence	Frequency of Occurrence
Muridae Family	26.3%	55.9%
Sylvilagus floridanus-Eastern Cottaintails	15.2%	32.3%
Sciurus carolinensis- Eastern Gray Squirrel	10.0%	21.3%
Odocoileus virginianus (2)- Fawn	7.8%	16.5%
Odocoileus virginianus (1)-Adult Deer	5.9%	12.6%
Diospyros virginiana-Persimmon	4.8%	10.2%
Unidentified	4.8%	10.2%
Orthoptera-Grasshoppers	4.8%	10.2%
Coleoptera-Beetles	2.6%	5.5%
Rubus fruticosus- Blackberry	2.6%	5.5%
Tamias striatus- Eastern Chipmunk	1.9%	3.9%
Procyon lotor- Raccoon	1.5%	3.1%
Reptilia	1.5%	3.1%
Bonasa umbellus-Ruffed Grouse	1.1%	2.4%
Colinus virginianus-Northern Bobwhite	1.1%	2.4%
Didelphis virginiana- Opossum	1.1%	2.4%
Urocyon cinereoargenteus- Gray Fox	1.1%	2.4%
Meleagris gallopavo-Wild Turkey	0.7%	1.6%
Castor canadensis-Beaver	0.7%	1.6%
Ondatra zibethica- Muskrat	0.7%	1.6%
Prunus serotina- Blackcherry	0.7%	1.6%
Asimina triloba-Paw paw	0.7%	1.6%
Prunus americana- American Plum	0.7%	1.6%
Carya illinoinensis-Pecan	0.7%	1.6%
Zea mays- Corn	0.4%	0.8%
Branta canadensis- Canada Goose	0.4%	0.8%

Table 5. Relative frequency of occurrence and frequency of occurrence of major prey categories identified in coyote scat

Major Prey Categories	Relative Frequency of Occurrence	Frequency of Occurrence
Arthropoda	7.4%	15.7%
Aves	3.3%	7.2%
Artiodactyla	13.7%	29.1%
Rodentia	39.6%	84.3%
Carnivora	2.6%	5.5%
Lagomorpha	15.2%	32.3%
Didelphimorphia	1.1%	2.4%
Reptilia	1.5%	3.1%
Vegetation	10.7%	22.9%
Unidentified	4.8%	10.2%

Table 6. Number of major prey items identified in coyote scat each season

Prey Item	Spring05	Summer05	Fall05	Winter05/06	Spring06	Summer06
Grasshoppers	3	3	2	0	2	3
Adult Deer	1	1	4	5	4	2
Fawn	4	4	0	0	9	4
Eastern Gray Squirrel	2	2	5	10	6	2
Muridae Family	4	2	10	18	33	4
Eastern Cottontails	3	1	7	14	13	3
Persimmon	0	1	9	0	0	3
Unidentified	2	0	4	1	5	1

Table 7. Number of major prey classes identified in coyote scat each season

Prey Class	Spring05	Summer05	Fall05	Winter05/06	Spring06	Summer06
Arthropoda	4	5	2	0	4	5
Artiodactyla	5	5	4	5	12	6
Rodentia	7	5	16	30	41	8
Lagomorpha	3	1	7	14	13	3
Vegetation	0	5	18	1	0	5

Table 8. Weighted seasonal trends of major prey items identified in coyote scat

Prey Item	Spring	Summer	Fall	Winter
Grasshoppers	0.267	0.324	0.125	0
Adult Deer	0.177	0.153	0.25	0.333
Fawn	0.523	0.432	0	0
Eastern Gray Squirrel	0.301	0.216	0.313	0.667
Muridae Family	1.154	0.307	0.625	1.2
Eastern Cottaintails	0.556	0.199	0.438	0.933
Persimmon	0	0.199	0.563	0
Unidentified	0.274	0.045	0.25	0.067

*Note: The numbers in the table reflect the occurrence of each item per observational day.

Table 9. Weighted seasonal trends of major prey classes identified in coyote scat

Prey Class	Spring	Summer	Fall	Winter
Arthropoda	0.355	0.590	0.125	0
Artiodactyla	0.628	0.646	0.25	0.333
Rodentia	1.516	0.757	1	2
Lagomorpha	0.530	0.229	0.438	0.933
Vegetation	0	0.590	1.125	0.067

*Note: The numbers in the table reflect the occurrence of each item per observational day.

Table 10. Weighted yearly trends of major prey items identified in coyote scat

Prey Item	Summer05	Summer06	May2005	May2006
Grasshoppers	0.375	0.273	0.429	0.4
Adult Deer	0.125	0.182	0.143	0.2
Fawn	0.5	0.364	0.571	1
Eastern Gray Squirrel	0.25	0.182	0.286	0.2
Muridae Family	0.25	0.364	0.571	0.8
Eastern Cottaintails	0.125	0.273	0.429	0.6
Persimmon	0.125	0.273	0	0
Unidentified	0	0.091	0.286	0.2

*Note: The numbers in the table reflect the occurrence of each item per observational day.

Table 11. Weighted yearly trends of major prey classes identified in coyote scat

Prey Class	Summer 2005	Summer 2006	May 2005	May 2006
Arthropoda	0.625	0.556	0.5	0.8
Artiodactyla	0.625	0.667	0.625	1.2
Rodentia	0.625	0.889	0.875	1
Lagomorpha	0.125	0.3339	0.375	0.6
Vegetation	0.625	0.556	0	0

*Note: The numbers in the table reflect the occurrence of each major prey class per observational day.

FIGURES

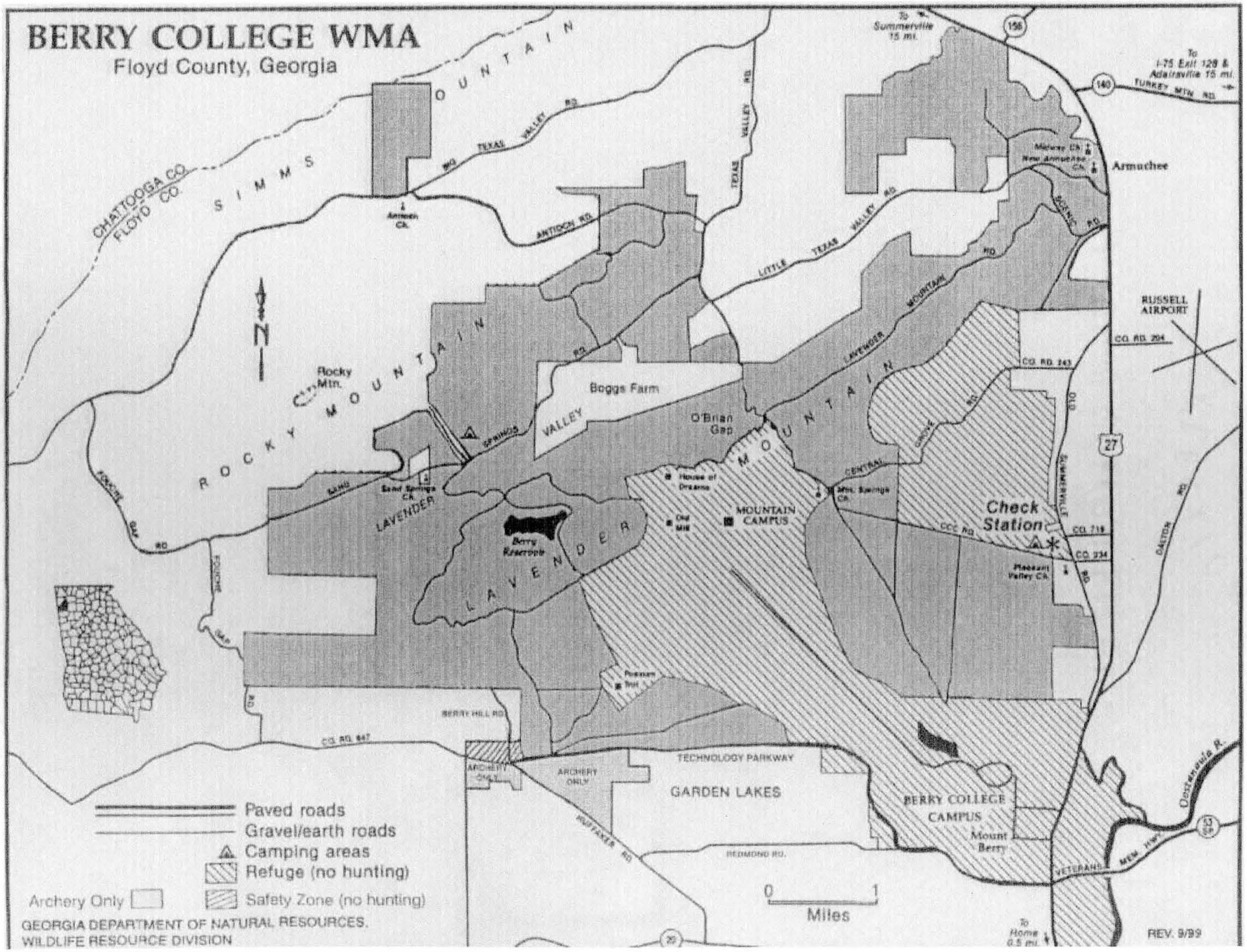

Figure 1. Berry College study area

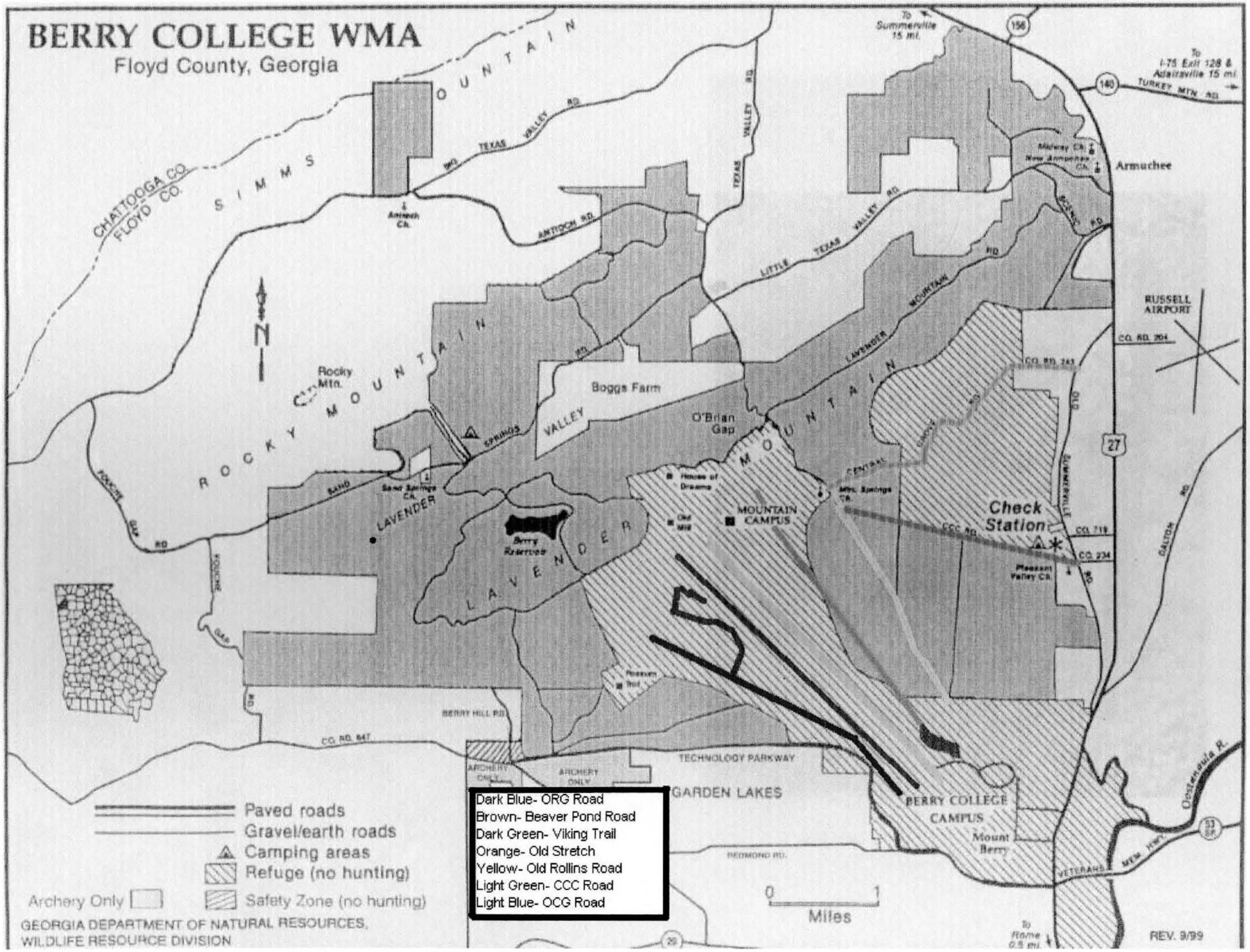

Figure 2. Seven major roads within the study area where coyote scat was collected

Figure 3. Coyote scat on the Berry College campus with a six inch rule for size comparison

Figure 4. Illustration of coyote tracks on the Berry College campus

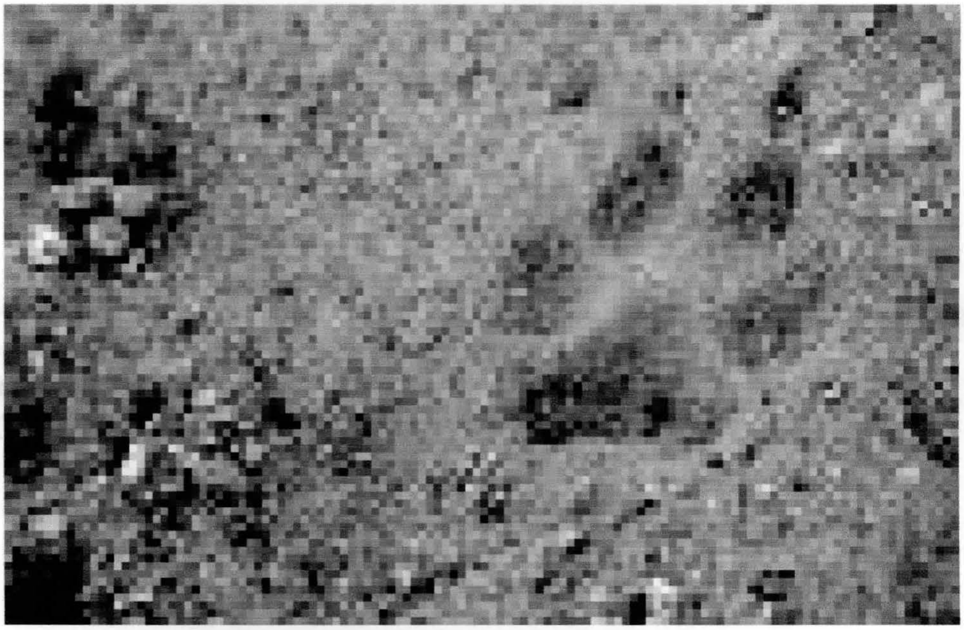

Figure 5. The top five most frequently occurring prey items identified in coyote scat

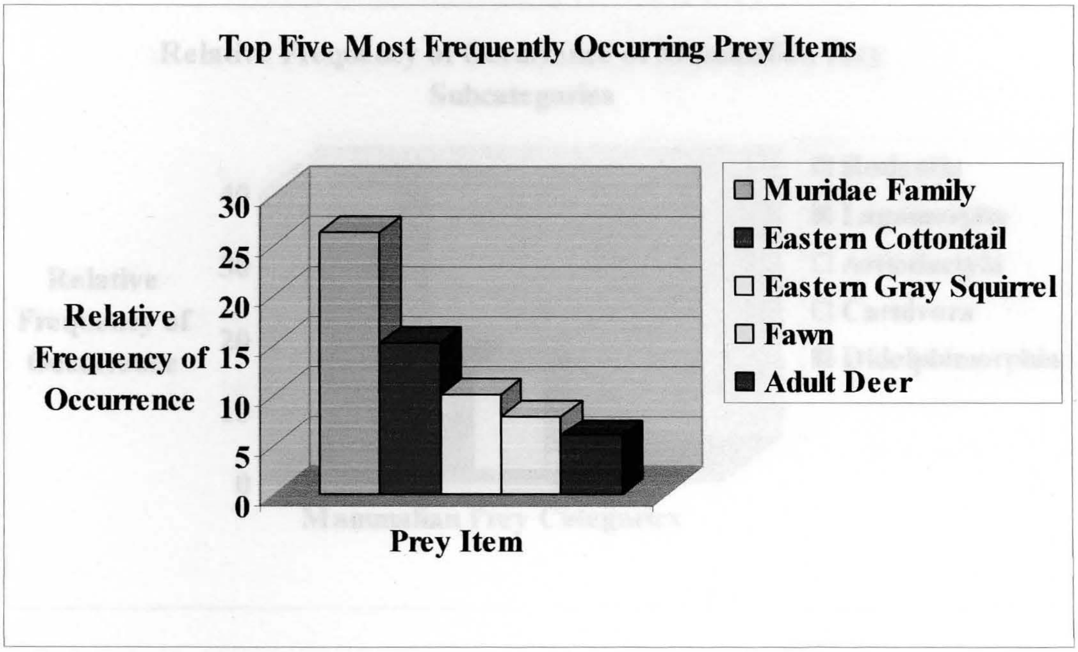

Figure 6. Relative frequency of occurrence of mammalian prey subcategories identified in coyote scat

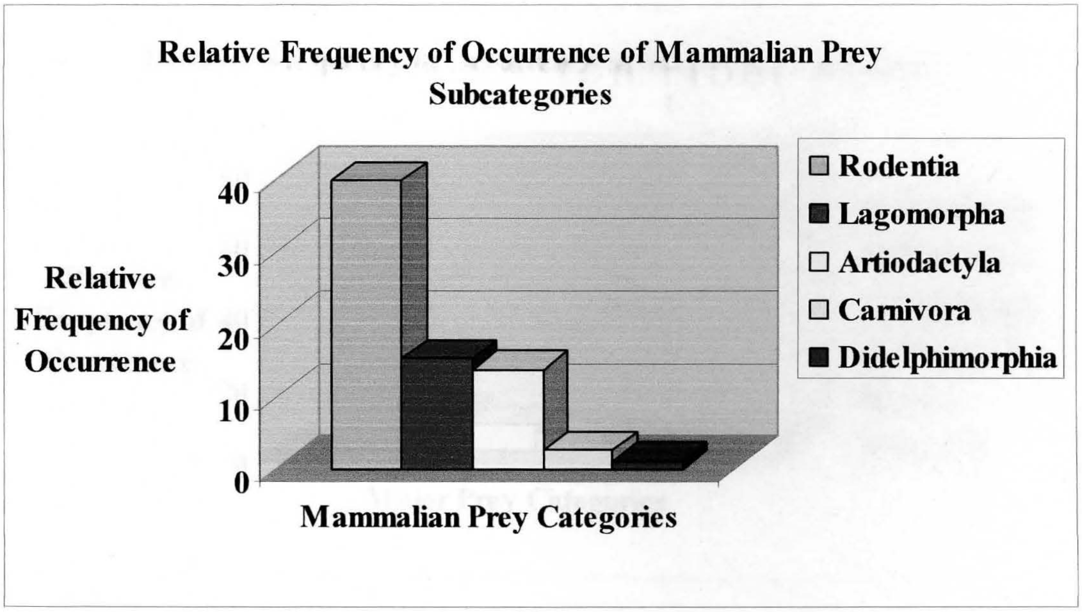

Figure 7. Relative frequency of occurrence of major prey categories identified in coyote scat