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The effects of mesopredator presence on population abundances of Eastern Wild
Turkey (*Meleagris gallopavo silvestris*)

An Honors Thesis submitted in partial fulfillment of the requirements for Honors
Studies in Biology

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Abstract:

The eastern wild turkey (*Meleagris gallopavo silvestris*) has been an important game bird for the cultures and livelihood of peoples living in North America for centuries. Understanding how predation pressures affect wild turkey behavior can help us better manage turkey populations. I looked at three mesopredators: raccoons (*Procyon lotor*), gray foxes (*Urocyon cinereoargenteus*), and coyotes (*Canis latrans*) to see how they influence turkey presence at the White Rock Ecosystem Recreational Area, northwest Arkansas. I employed the use of 16 Moultrie trail cameras to enumerate wild turkey and mesopredators at 29 sites. I deployed the cameras during late winter and early spring during 2013 and 2014 and ran the cameras for one week each. I found no significant difference in the number of detections of turkeys between sites with coyotes or raccoons and those without. Raccoon and coyote presence apparently had little influence on population abundance of wild turkeys. There was however, a positive correlation between gray fox and turkey abundances. I found that mesopredator abundance had little to no relationship with wild turkey abundance at my study site. Based on my results, the need for mesopredator control to increase wild turkey populations appears unwarranted.

Introduction:

The eastern wild turkey (*Meleagris gallopavo silvestris*) has been an important game bird in the history and culture of North America. Even before Europeans had settled in North America, Native Americans hunted the bird for food, clothing and tools making it a staple in their lives (Kennamer et al. 1992). After colonization, the population of North American turkeys were substantially reduced due to over hunting and deforestation. Realizing that turkeys were diminishing quite rapidly, pioneers created limits on turkey hunting leading to the eventual restoration of the national turkey population by the end of World War II (Kennamer et al. 1992). Wild turkeys to this day remain a popular game bird for hunting and food for many people.

Wild turkey populations in the Ozark National Forest have varied over the last 40 years (Pittman 2014). Specifically, populations at White Rock Ecosystem Recreational Area (hereafter known as White Rock) have varied dramatically (Pittman 2014). Arkansas made significant restoration efforts from 1960 to 1990 causing an increase in population numbers (Widner 2007). Over the last 10-15 years however, turkey populations have been declining quite rapidly (Pittman 2014). Understanding potential causes of this decline is a main component of my research.

Wild turkeys inhabit much of the United States, and thus can use a wide variety of habitats. Primarily they desire a mix of forested land with trees, and open pastureland (Gustafson et al. 1994). Turkeys might prefer a hardwood

forest for its dense vegetation and variety of trees (Schorger 1966). Wild turkeys need trees to roost at night, and they prefer dense ground cover for protection against predators when laying eggs. Ideal roosting locations can affect how and where wild turkeys move throughout the day (Chamberlain et al. 2000). Open habitats are used for social and mating interactions (Schorger 1966). There are many other factors that may also play a role in a suitable habitat including size, water availability, elevation and soil composition (Schorger 1966).

The wild turkey breeding season can be anywhere from early spring to late summer (Dickson 1992). During the breeding season, hens prefer open habitats to survey the courtship behaviors of the males. After the breeding season, the hens return to the more forested areas to lay their eggs. Before the breeding season, wild turkeys can be seen at the edges between these two types of habitat (Dickson 1992, Holbrook et al. 1987). Home range sizes can increase during the breeding season as turkeys venture off for prime mating locations (Wigley et al. 1986). Larger home range sizes have been attributed to greater nesting success (Hubbard et al. 1999). Hens often choose nesting location based primarily on ground cover and woody and herbaceous undergrowth (Moore 1995). The amount of woody cover present in a habitat has also been directly linked to nesting success (Hubbard et al. 1999). Hens that had limited cover for their nest site relocated the following year (Badyaev and Faust 1996). Habitat quality is then likely a direct cause for reproductive success for hens (Everett et al. 1980). As important as habitat quality is, predation is thought to be the primary factor for influencing nesting success (Dreibelbis et al. 2008).

There are many animals that are thought to predate on wild turkeys. Specifically I wanted to focus on three mesopredators: raccoons (*Procyon lotor*), gray foxes (*Urocyon cinereoargenteus*), and coyotes (*Canis latrans*). Mesopredators are any mammalian carnivorous or omnivorous vertebrate that is not a top predator (Roemer et al. 2009). Many studies have hypothesized that mesopredator predation on wild turkeys influences nesting success (Kurzejeski et al. 1987, Lovell et al. 1995, Nguyen et al. 2003, Palmer et al. 1993). Most predation occurs on eggs at the nesting site since adult wild turkeys are rarely attacked by mesopredators (Houchin 2005).

Raccoons are ubiquitous in the southeastern United States (US) (Melville 2012). Their diet consists of a wide range of food including vegetation, fruits, small mammals, and insects (Melville 2012). Raccoons have been noted in a number of research studies taking eggs from wild turkey nests. They have been found near live turkey nest sites (Houchin 2005) and artificial nest sites (Melville 2012). Raccoons are thought to be a primary nest predator on wild turkey nests (Davis 1959, Dreibelbis et al. 2008). However, Melville (2012) found that raccoon scat samples included only small mammals, vegetable material, and insects but no turkey remains.

Gray foxes inhabit much of the south and east portions of the US. They can be found in a wide range of habitats, but prefer forested areas due to their arboreal nature (Cunningham et al. 2006). Their diet is similar to that of raccoons consisting of vegetation, fruits, small and large mammals, and insects (Cunningham et al. 2006). Gray foxes have been noted as prevalent predator on

wild turkeys in some studies (Dreibelbis et al. 2008, Wagner and Hill 1994) while others state that gray foxes have a minimal effect on turkeys (Dalke and Spencer 1946). Many other studies do not even mention the presence of gray fox around turkeys or nests. It is unclear what role gray foxes play in wild turkey predation.

Coyotes have been found in many habitats and thus are found in much of the United States. Coyote diets include primarily vegetation and small mammals, but can also include large mammals and birds (Houchin 2005, Melville 2012). Many studies have noted the lack of coyote predation on turkeys or their nests (Dalke and Spencer 1946, Wagner and Hill 1994). A review of scat samples in a number of studies revealed that there was little to no turkey material in the diets of coyotes (Houchin 2005, Korschgen 1957, Melville 2012, Wagner and Hill 1994). Coyotes appear to exert little influence on wild turkey populations, but do readily predate domestic turkeys (Schorger 1966).

Predation events can often happen in the presence of other predators (Dreibelbis et al. 2008). Gray fox home range and food habits often overlap with coyotes (Neale and Sacks 2001). No evidence was shown that gray foxes avoid bobcats or coyotes at any time (Neale and Sacks 2001). Coyote home range sizes can also vary seasonally and cause an overlap in feeding areas (Melville 2012). Multiple predators around a nesting site can make it difficult for researchers to determine the cause of predation (Dreibelbis et al. 2008).

Bobcats (*Lynx rufus*), skunks (*Mephitis mephitis*), hogs (*Sus scrofa*), and armadillos (*Dasypus novemcinctus*) can also be found around turkeys and turkey nests. A review of scat samples from bobcats revealed no remains of wild

turkeys (Melville 2012). Armadillos, hogs, skunks, and snakes have been found to have only a small effect on nest predation (Dreibelbis et al. 2008). Avian predators are also thought to have a substantial impact on turkey population. Specifically, the American crow is thought to contribute greatly to nest predation (Schorger 1966). Crows preyed on artificial nests the most out of any animal observed (Melville 2012). Other instances of avian predators have been recorded, but these happen rarely and are thought not to be a highly contributing factor (Schorger 1966). Snakes have been found to contribute to nest predation, but not to the extent of other predators (Schorger 1966).

My study was intended to look at how mesopredator presence correlates with turkey presence by studying three main variables: 1) gray fox presence, 2) raccoon presence, 3) coyote presence. I based my hypotheses primarily from Melville (2012), Houchin (2005), and Wagner and Hill (1994).

Study Area:

My study site was White Rock, which consists of 16,380 hectares (40,476 acres) of federally managed land in northwest Arkansas, USA. It lies in the Boston Mountain Ranger District in the Ozark-St. Francis National Forest (Figure 1). White Rock is a mixed hardwood and pine ecosystem (Pittman 2014).

Methods:

I used the trail camera photographs from Pittman (2014) as my data. Pittman (2014) deployed 16 Game Spy LX-50IR Moultrie trail cameras across White Rock on wildlife openings using a sampling method derived from Damm 2010 (Damm 2010, Pittman 2014). The selected wildlife openings were stratified based on burn history to model abundance as a function of management history (Pittman 2014). About half of the sites had been burned previously, while the rest had not been burned. The cameras were set to take photographs upon movement or up to every 1 minute with active movement.

The trail cameras were deployed during late winter and early spring (January - April) of 2013 and 2014 for one week, slightly before the wild turkey breeding season. There were 22 sites surveyed in 2013 and 17 in 2014. There were a total of 29 different sites surveyed over both years because some sites were duplicates. All sites were monitored for one week for signs of recent turkey activity (tracks, droppings, visual observations, etc.) to determine if they had been used by turkeys or not. The sites were then baited using a 3 gallon mixture of whole corn and chopped corn to prevent rapid consumption by other species (deer, crows, etc.)(Pittman 2014). The cameras were then allowed to run for one week. After one week, the cameras were taken down, moved to another site, and allowed to run for another week. Cameras are an effective method to enumerate raccoons, gray fox, and coyotes (Kelly and Holub 2008). The presence of

cameras does not alter the behavior of turkeys or mesopredators (Dreibelbis et al. 2008).

For each site, I counted the maximum number of turkeys or mesopredators detected at each site during one photographic session during a particular day (12:00am - 11:59pm). This was done to try and eliminate double counting the same animal. I then added the maximum counts of each day together to estimate the total abundance of animals at a particular site (Appendix 1). As I recognized that detecting targets was confounded by double counting, I tried to limit any detection issues and outliers by categorizing the data into ranks. Mesopredator data were placed into two ranks: 0 (absent) or 1 (present). Turkey data were placed into three ranks: 0 ($n = 0$, none), 1 ($1 \leq n \leq 10$, few), or 2 ($n > 10$, many).

I used a categorical regression tree (CART) in program JMP to explore the relationship between turkey counts and mesopredator counts. I ran CART analyses by year.

Results:

During both years, the counts of turkeys were typically low (median = 1), but in a few cases ranged up to 66. When detected, the typical mesopredator count was 1 (Appendix 2).

I found that only a single relationship was supported in explaining turkey abundance across both years. There was a positive relationship between turkey

and gray fox abundance ($p = 0.005$, $df = 1$, Figure 2). More turkeys were observed at sites with gray foxes present than without, however, the relationship between these abundances was very low ($r^2 = 0.03$).

Discussion:

Gray Fox

That gray fox and wild turkey abundances were positively associated at my study site contradicts the findings by Wagner and Hill (1994) and Dreibelbis et al. (2008) who suggested that gray fox predation was quite high on wild turkey nests. Dalke and Spencer (1946) however stated that gray foxes had little to no impact on wild turkeys. It is possible that previous research has misattributed gray fox abundance with predation events (Dreibelbis et al. 2008).

As I found a positive correlation between gray fox and wild turkey abundances, there is likely another variable that could be attracting both gray foxes and turkeys. Gray foxes and turkeys could be attracted to similar habitats, primarily for tree cover and abundance (Chamberlain et al. 2000, Cunningham et al. 2006, Gustafson et al. 1994, Schorger 1966). Home range size for wild turkey generally increases during the breeding season (Wigley et al. 1986); my study was conducted slightly before breeding had started. This expanding home range size could overlap with gray fox home range sizes and thus lead to more sightings of them in the same area. Another factor could be that gray foxes and turkeys are avoiding the same thing, predator or human. This could lead them to

inhabit the same area not by choice but by necessity. Whatever the cause may be, it appears that wild turkeys and gray foxes are attracted to similar habitats but without negative consequences on the other species presence in those habitats.

Raccoon

Although many studies have found that raccoon predation has a substantial impact on turkey populations (Davis 1959, Dreibelbis et al. 2008, Schorger 1966), I found no relationship between raccoon and wild turkey abundances. However, when studying raccoon scat samples, Melville (2012) found no evidence of wild turkey having been eaten. Raccoons have been found near artificial nests (Melville 2012) and live nests (Houchin 2005). Raccoons might be seen near wild turkey nests, but not actually have a large impact of predation. It is possible that past research has misattributed raccoon abundance with predation acts. It is likely that although raccoons and wild turkeys might inhabit similar areas, the predation effect is small.

Coyote

Many studies have noted that coyote predation is actually a small factor for turkey survival (Dalke and Spencer 1946, Houchin 2005, Korschgen 1957, Melville 2012, Schorger 1966, Wagner and Hill 1994). My findings show no relationship between coyotes and turkeys, which agrees with much of the previous research. Scat samples of coyotes have revealed little to no wild turkey material (Houchin 2005, Korschgen 1957, Melville 2012, Wagner and Hill 1994).

It is very likely that coyotes pose no serious threat to wild turkey populations at most sites.

Detecting the actual cause of predation can be difficult for a number of reasons. Observing a mesopredator in the area does not always correlate with an act of predation (Dreibelbis et al. 2008). Multiple mesopredators are likely to be found interacting around each other (Neale and Sacks 2001) as well as at the nesting sites of wild turkeys (Dreibelbis et al. 2008). Having multiple predators around can make it difficult for researchers to accurately determine the cause of predation. This has possibly led to conflicting research about how much influence mesopredators have on wild turkeys. It is likely that mesopredators have less influence than previous research has suggested.

I suggest that mesopredator control at White Rock is not necessary for aiding the growth of wild turkey populations there. Controlling the abundance of mesopredators will likely not have an effect on wild turkey survival. Efforts to keep turkey populations thriving should focus on other factors. More research should be done to further understand the complexity of mesopredator presence on wild turkeys.

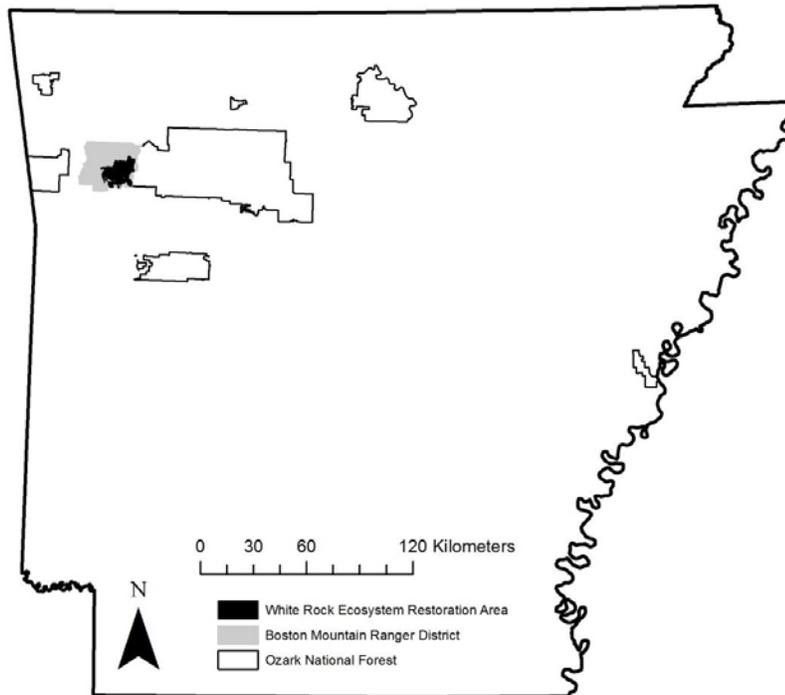


Figure 1: This figure shows the White Rock Ecosystem Restoration Area (White Rock) along with the Boston Mountain Ranger District and Ozark National Forest in Arkansas, USA (Pittman 2014).

Partition for Turkeys – both years combined

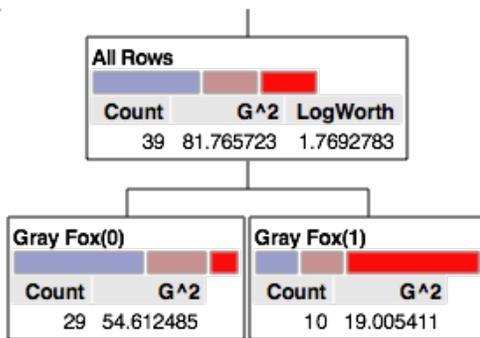
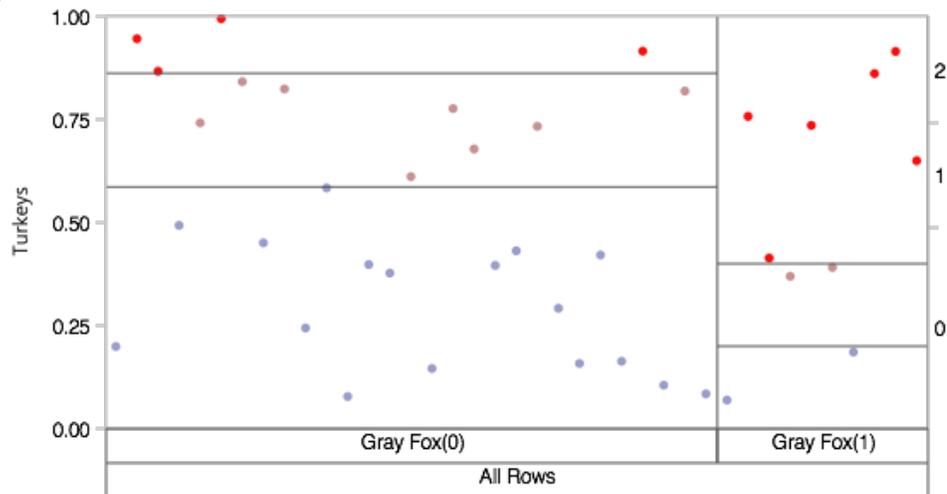


Figure 2: This figure shows dots which correspond to sites surveyed over both years (2013 & 2014). They were plotted to show abundances of turkeys (right y-axis) against abundances of gray fox (x-axis). Light blue dots and bars denote no turkeys, light red dots and bars denote few turkeys, and dark red dots and bars denote many turkeys. Relative frequencies are given on the left y-axis. This figure also shows a CART analysis. This was the only significant split in explaining turkey abundance and suggests that high turkey abundance was related to gray fox presence.

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Appendix 1: Counts of turkeys, raccoons, coyotes, and gray fox from game cameras at White Rock in Arkansas, USA during Spring 2013 and 2014.

Site	2013			
	Turkey	Raccoon	Coyote	Gray Fox
Alexander Mnt		11	2	
Apple Tree	43			3
Bliss Ridge	2			
Burr Ridge	57			
Chimney Rock				
Cove Creek	15			1
Fane Creek	50		1	
Fern Springs	1	1	2	2
Fugit Springs				
Gobbler Plot			1	8
Jackson Ridge	1	1		1
McGlendon				3
Mill Creek	2		2	
Mineral Hill	1			
Perry Curve	47		1	1
Phips	66	27	1	10
Sam Patrick				
SawMill	63	4		
Shores Lake	4			
Three Rocks	11			2
Trap 125	53	1		
Turner Fields			1	
2014				
Alexander Mnt		2		
Apple Tree	33			2
Bliss Ridge	6			
Bowles Gap			1	
Burr Ridge	6			
Burrel Pipeline	3		2	
Cove Creek				
Deer Trap				
Fern Springs			1	
Fly Gap East			2	
Fly Gap West		1	2	
Graham				
Jackson Ridge			1	
Mineral Hill	10			
Mullens Gap				
Shores Lake				
Trap 125			2	

Appendix 2: This table shows summary statistics for all data in Appendix 1

	Turkey	Raccoon	Coyote	Gray Fox
Mean	12.15	1.23	0.56	0.84
Median	1	0	0	0
Range	66	27	2	10