

AN ANALYSIS OF THE HUMAN-COYOTE RELATIONSHIP IN METROPOLITAN ATLANTA, GA

By

Jeremy W. Hooper

Timothy J. Gaudin
Professor of Biology,
Geology and Environmental Science
Committee Chair

Thomas P. Wilson
Associate Professor of Biology,
Geology and Environmental Science
Committee Member

Christopher B. Mowry
Associate Professor of Biology
Committee Member

AN ANALYSIS OF THE HUMAN-COYOTE RELATIONSHIP IN METROPOLITAN ATLANTA, GA

By

Jeremy W. Hooper

A Thesis Submitted to the Faculty of the University of Tennessee at Chattanooga in Partial
Fulfillment of the Requirements of the Degree of Master of Science: Environmental
Science

The University of Tennessee at Chattanooga
Chattanooga, Tennessee

August 2016

Copyright © 2016

By Jeremy Wayne Hooper

All Rights Reserved

ABSTRACT

Human-coyote interactions are an increasing challenge for North American wildlife managers. My objectives were to: 1) provide data on the types and general spatial distribution of human-coyote interactions in metropolitan Atlanta; 2) identify landscapes associated with human-coyote interactions; and 3) investigate the validity of claims of coyote-pet attacks and the potential effects of assuming a coyote attacked a pet. Human-coyote interactions were positively correlated with open space landscapes. A change in scale led to differences in both how correlated a variable was with interactions and relationships among variables. Sixty-four percent of individuals who reported that a coyote attacked their pet did not actually witness it. I provide evidence that such assumptions led to more negative views towards coyotes, lethal removal of coyotes, and entered news media. I recommend managers conduct investigations to verify attacks to avoid unwarranted negative feelings towards coyotes, unnecessary management actions and inappropriate broadcast of risk messages.

DEDICATION

This work is dedicated to all those who have put their time, effort, and energy into my life. From my friends to my family, I would not be where I am today without every single one of you. Finally, I'd like to thank the coyote and the wolf for changing my life.

ACKNOWLEDGEMENTS

I would like to thank my committee members, Dr. Thomas P. Wilson, Dr. Timothy J. Gaudin and Dr. Chris B. Mowry for giving me the opportunity to expand my knowledge, skill set and life experience. I'd especially like to think Dr. Wilson for being the first person to recognize my potential before I began my graduate work and, subsequently, going to "bat" for me when I needed it the most. I'd like to thank the UT-Chattanooga GIS lab, especially Nyssa Hunt, for helping me when ArcMap would not tell me what to do!

TABLE OF CONTENTS

ABSTRACT	iv
DEDICATION.....	v
ACKNOWLEDGEMENTS.....	vi
LIST OF TABLES	xi
LIST OF FIGURES.....	xiii
CHAPTER	
I. INTRODUCTION	1
Study Organism	4
Study Area	5
General Methods.....	6
II. I THINK A COYOTE ATTACKED MY PET: POTENTIAL EFFECTS OF ASSUMPTION AND THE NEED TO VALIDATE HUMAN-COYOTE CONFLICT.....	8
Introduction	8
Unnecessary Management Actions, Misuse of Resources, and Ecological Effects.....	11
Pressuring of Officials	12
Social Amplification of Risk.....	13
Methods	16
Study Area	16
Survey	16
Initial Survey	16
Follow-up Survey	18
Classification of Evidence Used	19
Statistical Analyses	19
Search for News Articles.....	20
Results.....	21
Direct vs. Indirect Evidence	22
Attitudes.....	24

Risk Perception	26
Social Amplification of Risk in Atlanta	28
Discussion.....	28
Limitations and Biases.....	32
Conclusion	34
III. HUMAN-COYOTE INTERACTIONS IN AN URBAN ENVIRONMENT: THE IMPORTANCE OF LANDSCAPE CHARACTERISTICS AND SCALE	36
Introduction	36
Methods	40
Study Area	40
Data Acquisition	41
Survey Questions	41
Spatial Analyses	42
Predictive Models	43
Results.....	46
Predictive models	49
1.25 km	52
4 km	53
6 km	55
Discussion.....	57
Predictive Models: variable importance and the influence of scale.....	59
Comments about Wine et al. (2015)	62
Limitations and biases	65
Conclusion	65
IV. URBAN COYOTE MANAGEMENT: SUGGESTIONS, CONSIDERATIONS AND CONFLICT INVESTIGATION PROTOCOL.....	67
Who should conduct the investigations?.....	68
Considerations: If it wasn't a coyote, what was it?	69
Conflict Investigation Protocol.....	72
V. CONCLUSION	75
REFERENCES.....	77
APPENDIX	
A2. INITIAL SURVEY UTC IRB APPROVAL	89
A3. URBANIZED ATLANTA 2010 STUDY AREA BOUNDARIES	91

B2. INITIAL SURVEY BERRY COLLEGE IRB APPROVAL	93
B3. CITIES AND COUNTIES THAT FALL WITHIN OR OVERLAP THE URBAN ATLANTA 2010 STUDY AREA.....	95
C2. APPROVAL FOR CHANGE TO UTC IRB TO INCLUDE FOLLOW-UP SURVEY	97
C3. NATIONAL LAND COVER DATASET 2011 LAND COVER FOR URBANIZED ATLANTA 2010.....	100
D2. APPROVAL FOR CHANGE TO BERRY COLLEGE IRB TO INCLUDE FOLLOW-UP SURVEY	102
D3. MAPS ILLUSTRATING BUFFERED POINTS OVERLAYING NLCD 2011 LAND COVER LAYER PRIOR TO EXTRACITON AND BUFFERS WITH 2011 NLCD LAND COVER DATA EXTRACTED	104
E2. INITIAL SURVEY.....	106
E3. NATIONAL LAND COVER DATASET VARIABLE DEFINITIONS	114
F2. FOLLOW-UP SURVEY.....	117
F3. HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 1.25 KM SCALE	119
G2. EXPLORATORY SEARCH FOR NEWS ARTICLES ILLUSTRATING THE USE OF INDIRECT EVIDENCE IN DETERMINING A COYOTE ATTACKED A PET.....	121
G3. HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 1.25 KM SCALE MAGNIFIED WITH ARROW INDICATING DOWNTOWN ATLANTA	124
H2. SAMPLE SIZES OF REPORTED PET ATTACKS FROM VARIOUS STUDIES	126
H3. HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 4 KM SCALE	128
I2. SURVEY DISTRIBUTION MECHANISMS USED AND POTENTIAL POPULATION REACH.....	130
I3. HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 4 KM SCALE MAGNIFIED WITH ARROW INDICATING DOWNTOWN ATLANTA	132
J2. NEWS ARTICLES CLASSIFIED AS PRESENTING INDIRECT EVIDENCE.....	134

J3. HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 6 KM SCALE136

K2. SOURCES FOR NEWS ARTICLES CLASSIFIED AS PRESENTING INDIRECT
EVIDENCE138

K3. HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 6 KM SCALE
MAGNIFIED WITH ARROW INDICATING DOWNTOWN ATLANTA141

L2. SELECT EXCERPTS FROM NEWS ARTICLES THAT PRESENT INDIRECT
EVIDENCE143

L3. COMPARISON OF 1.25, 4, AND 6 KM SCALE PROBABILITY MAPS MAGNIFIED
WITH ARROW INDICATING DOWNTOWN ATLANTA148

VITA150

LIST OF TABLES

2.0 Mean Response of Individuals Who Used Indirect vs. Direct Evidence to Identify a Coyote-Pet Attack24

2.1 A Comparison of Individuals Who Reported a Coyote Attacked Their Pet, and Who Did or Did Not Participate in the Follow Up Survey25

2.2 Summary of Group Responses to the Statement “I Enjoy Seeing Coyotes in the Area Near My Home.”27

2.3 Summary of Group Responses to the Statement “People Need to Learn How to Coexist with Coyotes.”29

2.4 Summary of Group Responses to the Statement “Coyotes Pose a Threat to Pets in the Area Near My Home.”31

2.5 Summary of Responses to the Statement “Coyotes Pose a Threat to the Safety of Children in the Area Near My Home.”32

3.0 Dominant Land Cover in Urban Atlanta 2010 Study Area54

3.1 Mean Distance (m) from Human-Coyote Interactions or Random Points to Landscape Features56

3.2 Model Rankings Across the 1.25 and 4 km Spatial Scales.....58

3.3 AIC Scores for Ranked Models at the 1.25 KM Scale60

3.4 Model Averaged Coefficient at the 1.25 KM Scale61

3.5 AIC Scores for Ranked Models at the 4 KM Scale63

3.6 Model Averaged Coefficients at the 4 KM Scale.....64

3.7 AIC Scores for Ranked Models at the 6 KM Scale66

3.8 Model Averaged Coefficients at the 6 KM Scale.....67

3.9 Correlation of Variables with Human-Coyote Interactions Across Spatial Scales.....68

LIST OF FIGURES

3.0 DISTRIBUTION OF HUMAN-COYOTE INTERACTIONS ACROSS THE STUDY AREA. RED POINTS INDICATE A UNIQUE HUMAN-COYOTE INTERACITON AND LIGHT GREEN ILLUSTRATES THE EXTENT OF THE STUDY AREA53

CHAPTER I

INTRODUCTION

The fundamentals of wildlife management have been described as including, “wildlife, habitats, and humans.” (Decker et. al. 2012, p. 3). Humans have always been a basic component of wildlife management, the characteristics of which have continuously evolved. At a basic level, wildlife management stems from a fundamental human interest in wildlife. Throughout history, such interests (e.g., as a food resource or as a fellow sentient being) have co-evolved with societies. As societies and interests in wildlife have changed, so have the ways in which they are managed.

Urbanization has led to changes in the demands and interests in wildlife (Kellert 1984). As urban centers have grown and expanded, wildlife has been faced with the challenge of adapting to a predominately anthropogenic environment. Many species have adapted, with some even thriving. Subsequently, human-wildlife interactions have increased, which have the potential to influence human attitudes towards, perceptions of and acceptance of wildlife (Decker and O’Pezio 1989; Zinn, et al. 2000).

During the 19th and 20th centuries, the coyote (*Canis latrans*) dramatically expanded its range across North and Central America. Perhaps the most intriguing aspect of this territorial extension has been the coyote’s exploitation of urban environments,

which has inevitably led to an increase in human-coyote interactions (Wieczorek Hudenko et. al. 2008). The coyote appears to be on its way to challenging what is both ecologically feasible and sociologically acceptable in urban environments. Because of this, the human-coyote relationship will likely be significant to both researchers and wildlife managers for the foreseeable future.

To improve human-coyote relations, increasing attention is being directed towards understanding the spatiotemporal characteristics and human dimensions of human-coyote interactions. Understanding the spatiotemporal characteristics of human-coyote interactions, including pet attacks, may help reduce and prevent human-coyote conflict by providing wildlife managers with knowledge of where such interactions are more likely to occur. Understanding the human dimensions of human-coyote relations (e.g., under what circumstances do people support lethal management of coyotes?) can help managers anticipate and avoid conflict with their constituents. For example, negative experiences with coyotes, including coyote attacks on pets, have been found to result in more negative views towards coyotes, along with greater risk perceptions and increased support for lethal management of coyotes (Martinez-Espineira 2006; Wieczorek-Hudenko et al. 2008). Thus, reducing negative interaction may lead to less concern and greater acceptance of coyotes.

In metro Atlanta, GA an increasing amount of attention is being focused on human-coyote relations. Coyotes are relatively new residents in Georgia, reportedly entering the state during the 1960s (Parker 1995). Since that time, they have expanded into every county in the state, and now generate the majority of public calls to the

Georgia Department of Natural Resources, with an average of over 139 calls a year in Fulton County alone during 2012-2013 (GA Department of Natural Resources, personal communication, Jan. 1, 2014). At least four cities within metropolitan Atlanta have information pertaining to coyotes on their websites, and numerous public meetings have been held throughout the metro area to address coyote concerns (Murchison 2013). A coyote advocacy group called “Coyote Coexistence” formed in recent years, focusing on coyote issues both in Atlanta and nation-wide (<https://coyotecoexistence.com>). Thus, information is needed on the human-coyote relationship in metropolitan Atlanta to improve and sustain a positive human-coyote relationship into the future.

This thesis is organized into five chapters, beginning with the current chapter, which serves as an overall introduction to the thesis. Chapter two is an investigation into the human dimensions of coyote attacks on pets. In this chapter, my objectives were to: 1) investigate the validity of claims of coyote-pet attacks; 2) compare the attitudes and risk perceptions of individuals who used direct and indirect evidence in concluding a coyote attacked their pet; 3) compare the attitudes and risk perceptions of individuals who have and have not experienced a coyote-pet attack; and, 4) identify the potential for social amplification of risk in the form of news articles that claim a coyote attacked a pet using indirect evidence.

In Chapter three, I investigate the spatiotemporal characteristics of human-coyote interactions. In this chapter, my objectives were to: 1) provide a baseline dataset and investigation into the types and general spatial distribution of human-coyote interactions in metro Atlanta; 2) identify important landscape characteristics associated with human-

coyote interactions in an urban environment; and, 3) investigate how scale affects predictive models in an urbanized environment.

In Chapter four, I discuss the management implications of my findings from chapters two and three. Specifically, I suggest a framework for managing human-coyote conflict that includes a proposed human-coyote conflict investigation protocol, and suggestions for entities that could conduct such investigations. Lastly, Chapter five is the overall conclusion of the thesis, which summarizes my work and makes suggestions for future research.

Study Organism

The coyote (*Canis latrans*), a member of the family Canidae, is a medium-sized predator weighing between 20-40 lbs. One of the most successful modern-day mammal species, the coyote is a flexible predator, thriving in the most extreme environments (e.g., Death Valley; National Park Service 2016). From a modern perspective, the coyote was originally found in the mid-western and southwestern United States. During the late 1800s, the coyote began a range expansion, crossing the Mississippi River and entering the southeastern U.S. around the 1960s (Parker 1995). Coyotes reportedly occupied roughly three-fourths of the counties in the state of Georgia by the mid 1980s (Parker 1995). This expansion occurred despite predator control programs that led to a decline in most other large mammalian predators in North America, including red (*Canis rufus*) and gray wolves (*Canis lupus*), mountain lions (*Puma concolor*) and bears (*Ursus sp.*).

Coyotes are opportunistic omnivores with a varied diet, of which is similar in composition in both rural and urban areas (Bekoff and Gese 2003; Gehrt and Riley 2010). Typical diet items include small mammals (e.g. rodents, lagomorphs), fruit, deer (*Odocoileus virginianus*), and human-associated trash (MacCracken 1982; Bekoff and Gese 2003; McClure et al. 2007; Morey et al. 2007). On average, urban coyotes have smaller home ranges than their rural cousins, suggesting resources are more abundant and available in higher densities (Grinder and Krausman 2001a; Grinder and Krausman 2001b; Way et al. 2002; Bekoff and Gese 2003; Gehrt and Riley 2010). Coyotes in urban environments have shifted their activity patterns, becoming increasingly nocturnal, illustrating a general avoidance of human activity (Gehrt and Riley 2010). Furthermore, urban coyotes generally prefer natural, undeveloped landscapes, avoiding areas associated with high human activity (Grinder and Krausman 2001; Way et al. 2004; Gehrt et al. 2009; Gehrt and Riley 2010).

Study Area

With a total population of 5.6 million people, metropolitan Atlanta is the ninth-largest metropolitan area in the United States (U.S Census Bureau 2014). Located in the state of Georgia, metropolitan Atlanta consists of 28 counties spanning 21,694 square kilometers (Georgia Power 2016). Metro Atlanta is a heavily urbanized landscape with 4.6 million (82%) of the total metropolitan population living in an urbanized environment as defined by the 2010 U.S Census Bureau. The median age and household income is 34.9

years and \$53,182, respectively. Thirty-four percent of the population age 25 years and older have a Bachelor's degree. The ethnicity of metro Atlanta consists of 50.7% white, 32.1% African American, 10.8% Hispanic and 4.7 % other (Alexander 2013).

General Methods

I used a 30 question online survey (modified from Don Carlos et al. 2013) to gain a better understanding of the human dimensions associated with coyote attacks on pets and the spatiotemporal characteristics of human-coyote interactions. In an attempt to reach as many people as possible, the survey was sent through City of Atlanta Neighborhood Planning Unit email list and posted on the Atlanta Coyote Project's Facebook Page. It was also publicized by various news media outlets, and placed on other websites. A list of the larger dissemination platforms used is attached, indicating the organization and estimated number of people who had the potential to receive or encounter the survey based on that platform's user statistics (See Appendix I2). As the survey was electronic, I assumed that all people who had Internet access had the potential to access the survey, receive an email from the NPU distribution list, or were made aware of the study via news media coverage and social networks. The 2010 U.S. Census indicates that 1,344,331 (+/-10,9920 SE) people in metro Atlanta have Internet access with a subscription and 72,924 (+/-4,371 SE) have Internet access without a subscription for a total, excluding standard error, of 1,417,255. This represents 30.38% of the total population frame.

Detailed methods for both the human dimensions and spatiotemporal sections can be found in their respective chapters.

CHAPTER II

I THINK A COYOTE ATTACKED MY PET: POTENTIAL EFFECTS OF ASSUMPTION AND THE NEED FOR HUMAN-COYOTE CONFLICT INVESTIGATIONS

INTRODUCTION

Human-coyote conflict has emerged as a prominent topic across North America (Lukasik and Alexander 2011; Poessel et. al. 2012). The major driver of such conflict is coyote predation on pets (hereafter referred to as “coyote-pet attacks”). It is fairly common to find reports of coyote-pet attacks in the news. However, studies investigating human-coyote conflict suggest coyote-pet attacks are relatively rare (Wieczorek-Hudenko et al. 2008; Lukasik and Alexander 2011; Poessel et al. 2012; Gehrt et al. 2013). Coyote diet studies have consistently found domestic dog and cat remains at relatively low levels (Gehrt and Riley 2010), although this may indicate that coyotes do not always consume predated pets (Gehrt 2007). Nonetheless, the loss of a pet may be traumatizing and influence an individual’s perception of and attitudes toward coyotes and, as a result, management efforts.

Personal experience with wildlife has been found to influence a person’s risk perception, attitudes toward, and acceptance capacity for wildlife (Decker and O’Pezio 1989; Zinn et al. 2000). Furthermore, experience type (e.g., negative vs. neutral) has been identified as an important factor influencing attitude and perception development,

behavior and response (Wieczorek-Hudenko et al. 2008). Non-negative experiences with black bears in New York State reduced public concern and the likelihood a stakeholder would contact a wildlife agency for assistance during an encounter (Siemer et al. 2009). Wieczorek-Hudenko et al. (2008) found that negative experiences generally led to increased expression of negative attitudes toward coyotes and greater risk perception, whereas neutral experiences generally resulted in less concern and more positive attitudes about coyote presence. The effects of experience type are further illustrated in the increased propensity for people to support lethal control of wildlife after a negative experience (Manfredo et al. 1998; Reiter et al. 1999; Martinez-Espineira 2006). Vaske and Needham (2007) found that the largest portion of their study sample found lethal management of coyotes acceptable in certain situations (e.g., when a pet was injured or killed by a coyote), but unacceptable in other situations (e.g., when they simply saw a coyote). Clearly, the type of interaction with wildlife has the potential to influence both an individual's response, as well as conservation and management efforts.

Studies have quantified reports of coyote-pet attack occurrence (Lukasik and Alexander 2011; Poessel et al. 2012) and investigated the attitudes toward and perceptions of coyotes in people who claim to have experienced a coyote-pet attack (Wieczorek-Hudenko et al. 2008; Draheim et al. 2013). However, no study has investigated whether such claims were valid, whether claims were based on direct evidence (i.e., an individual witnesses the attack) or indirect evidence (i.e., an individual does not witness the attack), or the potential impacts of using indirect evidence. Although no study investigated the validity of such claims, several have noted the use of indirect

evidence in concluding a coyote is the cause of a pet being injured, killed or disappearing. For example, Draheim et al. (2013) reported that in many cases, survey respondents who assumed a coyote was the cause of the disappearance of a pet had no direct evidence. In metropolitan Chicago, nearly half of the 10 cat attacks reported in news articles between 1990-2004 were in fact lost cats that were assumed to have been attacked by a coyote (Urban Coyote Research 2015). In 2011, twenty-four alleged coyote-pet attacks were reported to the Stanley Park Ecological Society in Vancouver, Canada, despite the fact that no one actually witnessed any of the purported attacks (Hooper and Straker, unpublished data). Evidence shows that such assumptions are not always correct. On at least one occasion, the present author has found the claim that a coyote killed a homeowner's pets to be invalid. Specifically, a Chattanooga, TN homeowner believed a coyote was the cause of attacks and disappearance of multiple pets, but upon investigation the only predators found in the area were gray foxes (*Urocyon cinereogenteus*) and red-tailed hawks (*Buteo jamaicensis*). Great-horned (*Bubo virginianus*) and/or Barred owls (*Strix varia*) were likely present in the area, as well. Way (2007) described a similar situation during his coyote research in Massachusetts, in which a woman whose cat had been killed believed coyotes to be the cause. Upon investigation, coyote tracks were found around the cat's body, but the cat was actually killed by shots from a paintball gun (Way 2007). A former gray wolf specialist for the Idaho Department of Fish and Wildlife and member of the Federal Gray Wolf Reintroduction Team, noted only 5 of approximately 100 reports of wolf depredations on livestock he investigated were legitimate (Niemeyer 2012). Prior to investigating such

reports in greater detail, a depredation was verified based solely on whether a rancher called it a predator “kill” (Niemeyer 2012).

Assumptions that a negative experience with a wildlife species has occurred may lead to unfounded concerns, including heightened risk perceptions, and, as a result, misguided attitudes toward the relevant species. Furthermore, as attitudes direct behavior (Vaske and Manfredi 2012), a chain of unwarranted events may occur, including: 1) unnecessary management actions, 2) misuse of money and other resources, 3) detrimental ecological effects, 4) pressuring of officials to act, and 5) social amplification of risk. Here I discuss some of the potential effects.

Unnecessary Management Actions, Misuse of Resources, and Ecological Effects

The assumption that a coyote is the cause of a pet disappearing or sustaining an injury/death may lead to the unnecessary removal of the coyote(s). Indeed, studies indicate that support for lethal management of wildlife, including coyotes, is greater among individuals who had a negative experience with wildlife, e.g., through the loss of a pet or livestock (Manfredi et al. 1998; Reiter et al. 1999; Martinez-Espineira 2006; Vaske and Needham 2007). As trapping coyotes can be costly, the individual(s) may be spending a significant amount of money to resolve an issue with the wrong action (i.e., removal of an individual coyote or group of coyotes for an action they may or may not have committed). Additionally, the removal of coyotes, especially in large numbers, may lead to negative ecological effects. Although the effects of trapping coyotes in urban

systems is largely unknown, research in other habitats (e.g., rural western Texas) has shown negative consequences of lethal coyote removal. Intensive removal of coyotes led to increases in abundance and density of a few species (e.g., kangaroo rat, *Dipodomys ordii*), but a decline in overall small mammal diversity possibility due to mesopredator release (Henke 1992).

Pressuring of Officials

Assumptions that a coyote(s) is the cause of an injury, death or disappearance of a pet may lead to pet owners pressuring wildlife managers and political officials to act or “do something.” Siemer et al. (2009) found that people who had a negative experience with black bears were more likely to contact authorities. While this does not necessarily mean that they pressured the authorities to act, the tendency to contact authorities after a negative experience may indicate that such individuals are indeed more likely to pressure authorities to act. Moreover, people have been found to resort to administrative appeals, court cases, and ballot initiatives when they feel their concerns, or calls for action, are not addressed (Manfredo et al. 1997; Williamson 1998; Burnett 2007). Thus, if coyotes are assumed to be the cause of injury, death or disappearance of pets, and an individual or group of people feel that nothing is being done to resolve the issue, they may result to one of the aforementioned actions. For example, the present author was contacted in 2012 by a political office contender in Chattanooga, TN to address coyote issues raised by constituents, primarily regarding impacts on pets. This is

not to imply that these concerns were unfounded, but rather, that they had not been investigated and, thus, were unconfirmed by a wildlife expert. Other cities have been pressured by their citizens to take action to resolve human-coyote conflict. Pressure from the citizens of the city of Laguna Beach, CA resulted in officials allocating \$30,000 in taxpayer money to trap and euthanize coyotes year-round, in part to protect pets (Adelson 2016). Again, this serves as an example of citizen pressure resulting in action, and not necessarily an example of unjustified management actions. Investment of funds in coyote research and management is generally a positive step for governmental officials to take, although actions need to be based on objective evidence.

Social Amplification of Risk

Kasperson et al. (1988) proposed a framework suggesting that information about risk and risk events are transmitted through two primary communication networks, the news media and informal personal networks (e.g., conversations with friends). The social amplification of risk framework (SARF; Kasperson et al. 1988; Pidgeon et al. 2003) hypothesizes that an individual's risk perceptions can be influenced by receiving information on risk events that have been attenuated or amplified by intermediate stations, like interpersonal networks or mass communication channels. Thus, an assumption that a negative interaction or event with a wildlife species has occurred may lead to an individual unnecessarily amplifying a risk message that is transmitted through

their social network or mass media. Here, the primary concern is that such a message may be unjustified if the negative experience has not been validated.

Studies have indicated the importance of the media as a source of wildlife-related public information (Corbett 1995). In many instances, media coverage of wildlife topics likely represents an individual's primary source of information (Barua 2010; Allgaier 2011; Jacobson et al. 2011). The social amplification of risk framework (SARF) model suggests that media can serve to attenuate or amplify risk messages (Kasperson et al. 1988; Pidgeon et al. 2003). As such, the media has the potential to influence public attitudes and risk perceptions (McComas 2006; Uscinski 2009; Antilla 2010; McQuail 2010) and, consequentially, conservation and management efforts (Zucker 1978; Manfredo et al. 1998; Reiter et al. 1999; Martinez-Espineira 2006). Assumptions about negative interactions or events with wildlife can and have been transmitted through mass communication channels. An exploratory search through the Google News (search term "coyotes") platform for coyote related news articles found 16 articles between May-November 2015 with coyotes presented as the known, likely, or suspected cause of pet injury, death or disappearance (See Appendix G2). All of these articles use some form of indirect evidence in justifying the coyote's role in the event. For example, on January 22, 2015, police in Framingham, MA, issued a warning to residents about coyotes and the death of a German Shepherd. A January 23, 2015 news article, "Framingham Police Issue Coyote Warning," in the Framingham, MA, *Patch*, reported on the coyote warning and ways to reduce human-coyote conflict (Petroni 2015). Following SARF, the Framingham Police and *Patch* may have served as an amplification station that may have amplified a

risk event. However, in this case, the risk message was based on an assumption later determined to be incorrect. A necropsy found the cause of death was not attributable to coyotes. Fortunately, these findings were then published in the *Framingham Tab* on January 24, 2015, potentially serving to attenuate the previous risk message (Miller 2015). Although the flawed assumption was corrected in this instance, this is likely not always the case.

Why people assume a wildlife species, such as a coyote, is the cause of a negative event is not understood. Additionally, no data exists on the potential effects such an assumption has on an individuals' perceptions and attitudes. Therefore, I investigated the validity of claims that a coyote attacked a pet and the potential effects of using indirect evidence (i.e., uncorroborated interactions) to form conclusions. I also searched for evidence that mass media in metropolitan Atlanta, GA was reporting on injured, dead or missing pets as victims of coyote encounters based on indirect evidence. My objectives were four fold: 1) to investigate the validity of claims of coyote-pet attacks; 2) to compare the attitudes and perceptions of individuals who used direct and indirect evidence in concluding a coyote attacked their pet; 3) to compare the attitudes and perceptions of individuals who have and have not experienced a coyote-pet attack; and 4) to identify the potential for social amplification of risk in the form of news articles that claim a coyote attacked a pet using indirect evidence.

Methods

Study Area

The ninth largest metropolitan in the United States, metropolitan Atlanta consists of 28 counties that span across the state of Georgia. Of the 5.6 million people living in metro Atlanta, 4.6 million live in an urbanized environment as defined by the 2010 U.S. Census Bureau. For a more detailed description, see Chapter 1 (p.4).

Survey

An initial survey was conducted to identify people who believed they had experienced a pet being injured or killed by a coyote in the past 3 years; and, to measure their attitudes, risk perceptions and beliefs (See Appendix A2-E2). Individuals who responded to the initial survey were asked if they could be contacted for additional questions. Individuals who reported that a pet had been attacked by a coyote and agreed to answer additional questions were then contacted and given a follow-up survey.

Initial Survey

The initial survey was a web-based survey instrument (modified from the Metro Denver Coyote Study; Don Carlos et al. 2013) containing 30 questions addressing the human-coyote relationship. The survey used a 5-point scale, ranging from 1 = strongly disagree to 5 = strongly agree, to assess individuals' attitudes, beliefs and risk perceptions

regarding coyotes. The objective was to compare the effects of using direct vs. indirect evidence in determining a coyote attack on an individual's pet, so I strove for a sample large enough to provide us with the best possibility to acquire subsamples from each group (i.e., direct and indirect) for statistical analyses. However, research suggests that coyote-pet attacks are relatively rare (Wieczorek-Hudenko et al. 2008; Lukasik and Alexander 2011; Poessel et al. 2012; Gehrt et al. 2013; Don Carlos et al. 2013; Hooper and Straker unpublished data) and random samples have produced few reports of coyote-pet attacks (Wieczorek-Hudenko et al. 2008; Don Carlos et al. 2013; see Appendix H2). Thus, since my focus was a target population of unknown size, I believed a combination of convenience sampling and a purposive based snowball sampling approach provided the best opportunity to acquire a large enough sample to do a basic statistical comparison between indirect and direct evidence groups. Convenience sampling is a non-probability technique in which survey respondents are chosen based on accessibility to the researcher (Etikan et al. 2016). This approach is useful for obtaining data that a researcher determines would be unlikely or impossible to acquire using standard probability techniques (Etikan et al. 2016). Snowball sampling is an approach often used when a specific group of unknown population size is the target (Sommer 2006). It is used when the sample population of interest is rare or hard to locate through traditional randomized methods (Atkinson and Flint 2001). Specifically, snowball sampling relies on study participants to suggest and pass on information about the study to potential participants. In the present study, I used social media, news interviews, websites, radio and newspapers to serve as starting points. Each dissemination mechanism served as a

transmission seed that started a network through which the studies' existence was passed. Within this network, target individuals were found who had the ability to respond to the survey. Target and non-target individuals could then continue passing on the study through their network. In recognition of this approach, the statistical analyses were not extrapolated to a larger area and should not be treated as definitively representative of the larger population.

Follow up Survey

A follow up survey was conducted of respondents who responded "yes" to the question, "In the past 3 years, have you experienced a pet being injured or killed by a coyote?" and gave contact information and consent. The survey was a 5 question, open-ended survey designed to determine if individuals used indirect or direct evidence (See Appendix F2). That is, did the respondents see or hear the attack, or were they assuming a coyote was the cause of the attack or disappearance of their pet? Respondents were provided the option of taking the survey over the phone or online. I attempted to contact all individuals who provided contact information and consent in the original survey. The Institutional Review Boards at Berry College (2014-15-004) and the University of Tennessee at Chattanooga (FWA00004149) approved this research project #14-134 (Appendix A2-D2).

Classification of Evidence Used

Respondents who completed the follow-up survey were separated based on the evidence they used to determine whether or not a coyote was the cause of a pet incident. I defined a coyote-pet attack as physical contact between a coyote and a pet. Evidence was categorized as either direct or indirect. Direct evidence consisted of an actual sighting of the coyote-pet attack. Indirect evidence consisted of any evidence used other than aforementioned direct evidence.

Statistical Analyses

My independent variable was based on responses to the question, "In the past 3 years, have you experienced a pet being injured or killed by a coyote." Answer choices included yes, no and I'm not sure. Individuals who responded yes were then separated based on the evidence used (i.e., indirect vs. direct). Individuals who used indirect evidence were compared to those who used direct evidence to determine whether they could be combined for additional analyses. Where small sample sizes were present and homogeneity of variance was violated, the Mann-Whitney U nonparametric test was used to test for differences between the two groups. The "pet attack" group was then compared to individuals who reported yes to the pet attack question but did not participate in the follow-up survey. A one-way ANOVA with bootstrapping was used to test for differences between the "pet attack," "no pet attack" and "I'm not sure" groups. To do this, the ordinal, Likert-scale data was treated as interval data (Glass et al. 1972;

Manfredo et al. 1998; Carifio and Perla 2007; Bruskotter et al. 2009; Norman 2010). Likert-scale data is used to measure attitudes as a function of the degree to which an individual agrees or disagrees with a statement (Sullivan et al. 2013). Where a one-way ANOVA was significant and homogeneity of variances was not significant, as determined by the Levenes Test (McDonald 2014), a Tukey-Kramer post-hoc test was used to determine specifically which groups were statistically different (McDonald 2014). Where homogeneity of variances was violated a Games-Howell post-hoc test was used to make pair-wise comparisons (Ruxton and Beauchamp 2008).

Search for News Articles

The search platform “Google News” was used to look for news articles about coyotes in metropolitan Atlanta. Google News is “a computer-generated news site that aggregates headlines from news sources worldwide, groups similar stories together and displays them according to each reader’s personalized interests” (Google 2013). I used the search terms “coyotes Atlanta” and “Atlanta coyotes” to search for articles. There was not a date constraint on the search; thus, any article found was a candidate regardless of date of publication. Search results were then prescreened using keywords (i.e., Atlanta, coyotes) in the title of the articles and brief summaries provided in the search results. Articles found were then analyzed for content regarding pets disappearing or being injured and/or killed as a result of an encounter with a coyote(s). These articles were then analyzed for the type of evidence used (i.e., indirect vs. direct; see above for

definitions) in concluding that a coyote was the cause of a pet being injured, killed, or disappearing. I only included articles that used phrases or statements that clearly indicated that an individual was using indirect evidence to conclude that a coyote was responsible for pet attacks. While the potential for additional analyses exists, this exercise was not meant to be an exhaustive analysis of article content. The goal was to identify the use of indirect evidence in the determination that a coyote-pet attack had occurred, and whether the media framed the interaction or event as a known or a potential coyote encounter. In addition, I noted the mention of any management actions undertaken as a result of using indirect evidence.

Results

In total, 1,954 people responded to the initial online survey question “In the past 3 years, have you experienced a pet being injured or killed by a coyote?” Of these, 216 answered “yes” (10.9%), 91 responded “I’m not sure” (4.6%) and 1,647 responded “no” (83.6%). One hundred of the 216 “yes” respondents subsequently gave consent for the follow-up survey. This effort resulted in 79 responses (36.6% of 216) of which 51 (64.5%) were classified as having used indirect evidence of a coyote attack, whereas 28 (35.9%) were classified as having used direct evidence. Thirty-two (62.7%) of the pets assumed to have been attacked by coyotes via indirect evidence had actually disappeared and never returned to their owner (i.e., no pet remains were ever found). Thirteen respondents reported bodies were found with varying degrees of remains left. Three people

experienced both pets disappearing and bodies being found. The majority of respondents reported that a cat (n=60; 75.9%) was the victim of a coyote attack. Forty-two (70%) of these 60 used indirect evidence to conclude that a coyote was the reason for a cat disappearing or sustaining an injury or death. Thirty-two (76%) of these 42 were cats that disappeared.

The most commonly used indirect evidence for determining that a coyote was the cause of a pet injury, death or disappearance was that coyotes had been seen or heard in the area at some point in time (n=44). Eight respondents reported coyotes being seen or heard in the area at the time of the supposed attacks. The “sounds” of the attack were mentioned seven times. Six people cited the appearance of pet remains and/or puncture wounds as evidence of a coyote attack, and the presence of scat and/or tracks was mentioned four times. Two people stated that a vet had either mentioned coyotes being in the area or suggested that the bite marks were from a coyote. Three individuals mentioned that other people told them coyotes attacked their own pets and one person mentioned that a news report on coyotes occurred around the time the pet was attacked.

Direct vs. Indirect Evidence

A Mann-Whitney U test found no significant differences among individuals who used direct evidence (n=28) versus those who used indirect evidence (n=51) across the four statements (p=0.320; p=0.606; p=0.126; p=0.546; Table 2.0). Therefore, these two groups (direct and indirect evidence) were combined to represent the “pet attack” group.

The “pet attack” group was then compared to individuals who reported “yes” to the pet attack question in the original survey, but who did not participate in the follow up survey. A significant difference was found between the two groups’ responses to 3 of the original survey questions ($p=.02$; $p<.001$; $p=.002$; Table 2.1). As such, these two groups were not lumped together for further analyses. The follow-up survey provided further support for this finding, as 29 of the 79 individuals mentioned that they did not blame the coyote(s), did not have a bad view of coyotes, or expressed that they did not want the coyotes trapped. These statements were given in response to the question, “If it were found that a coyote did not attack your pet do you believe it would change your view at all about coyotes?”

Table 2.0 Mean Responses of Individuals Who Used Indirect Evidence vs. Direct Evidence to Identify a Coyote-Pet Attack

Statement	I enjoy seeing coyotes in the area near my home	Coyotes pose a threat to the safety of my children in the area near my home	Coyotes pose a threat to pets in the area near my home.	People need to learn to coexist with coyotes.
Indirect	1.96	2.61	4.63	3.33
Direct	2.36	2.5	4.93	3.50
Sig.	.320	.606	.126	.546

Mann-Whitney U Test Asymptotic significances are displayed. $\alpha = .05$
 Responses on 5-point Likert Scale with respondents asked to rate agreement on a 1-5 scale, with 1 = strongly disagree and 5 = strongly agree

Table 2.1 A comparison of Individuals Who Reported a Coyote Attacked Their Pet, and Who Did or Did Not Participate in the Follow Up Survey.

Statement	I enjoy seeing coyotes in the area near my home	Coyotes pose a threat to the safety of my children in the area near my home	Coyotes pose a threat to pets in the area near my home.	People need to learn to coexist with coyotes.
Follow up	2.10*	2.57*	4.73	3.39*
No Follow up	1.69*	3.31*	4.81	2.76*
Sig.	.02	<.001	.424	.002

*Mean significantly different at the $\alpha=.05$

Responses on 5-point Likert Scale with respondents asked to rate agreement on a 1-5 scale, with 1 = strongly disagree and 5 = strongly agree

Attitudes

I found a significant difference between the groups' mean response (pet attack $\bar{x}=2.10$; I'm not sure $\bar{x}= 2.18$; no pet attack $\bar{x}=2.63$) to the statement, "I enjoy seeing coyotes in the area near my home" ($F_{2,1799}=9.716$, $p<.001$). Tukey-Kramer post hoc analysis revealed that group "no pet attack" ($\bar{x}=2.63$, $SD=1.38$) was significantly different ($p<.05$) than "pet attack" ($\bar{x}=2.10$, $SD=1.33$) and "I'm not sure" ($\bar{x}= 2.17$, $SD=1.22$; Table 2.2). However, "pet attack" and "I'm not sure" were not significantly different. Groups "pet attack" and "I'm not sure" were more likely to disagree with the statement than the "no pet attack" group.

Table 2.2 Summary of Group Responses to the Statement “I Enjoy Seeing Coyotes in the Area Near my Home.”

Group	N	Mean Response*	SE	Lower	Upper
Pet Attack ¹	78	2.10 ^A	.15	1.83	2.42
I’m not sure ²	91	2.18 ^A	.13	1.92	2.43
No Pet Attack ³	1642	2.63	.03	2.57	2.70

One-way ANOVA results = $F_{2,1799}=9.716$; $p<.001$

*Means followed by the same letter are not significantly different at the $\alpha=0.05$ level comparison wise using Tukey-Kramer. Responses on 5-point Likert Scale with 1 = strongly disagree and 5 = strongly agree

1= Individuals who reported a coyote attacked their pet

2= Individuals who reported that they were not sure if a coyote attacked their pet

3= Individuals who reported that a coyote has not attacked their pet.

A significant difference was found in the mean response between the groups (pet attack $\bar{x}=3.39$; I’m not sure $\bar{x}= 3.54$; no pet attack $\bar{x}=3.82$) to the statement, “People need to learn how to coexist with coyotes” ($F_{2,1799}=5.598$; $p=.004$). Tukey-Kramer post hoc analysis indicated a significant difference between groups “pet attack” ($\bar{x}=3.39$, $SD=1.30$) and “no pet attack” ($\bar{x}=3.82$, $SD=1.27$) with the “no pet attack” group more likely to agree with the statement (Table 2.3). No other significant differences were detected.

Table 2.3. Summary of Group Responses to the Statement “People Need to Learn How to Coexist with Coyotes.”

Group	N	Mean Response*	SE	Lower	Upper
Pet Attack ¹	79	3.41 ^A	.14	3.14	3.69
I’m not sure ²	90	3.54 ^{A,B}	.14	3.26	3.83
No Pet Attack ³	1643	3.82 ^B	.03	3.76	3.88

One-way ANOVA results = $F_{2,1799}=5.598$; $p=.004$

*Means followed by the same letter are not significantly different at the $\alpha=0.05$ level comparison wise using Tukey-Kramer. Responses on 5-point Likert Scale with 1 = strongly disagree and 5 = strongly agree

1= Individuals who reported a coyote attacked their pet

2= Individuals who reported that they were not sure if a coyote attacked their pet

3 = Individuals who reported that a coyote has not attacked their pet.

Risk perception

A significant difference was found in the mean response between the groups (pet attack $\bar{x}=4.73$; I’m not sure $\bar{x}= 4.40$; no pet attack $\bar{x}=4.01$) to the statement, “Coyotes pose a threat to pets in the area near my home” ($F_{2,1799}=18.979$; $P<.001$). A Games-Howell post hoc test revealed a significant difference in all pair-wise comparisons (pet attack $\bar{x}=4.73$, $SD=0.78$; I’m not sure $\bar{x}= 4.40$, $SD=1.06$; no pet attack $\bar{x}=4.01$, $SD=1.18$) with the “pet attack” group more likely to agree that coyotes pose a threat to pets in the area near their home (Table 2.4).

Analysis of variance indicated that the mean response between the groups (pet attack $\bar{x}=2.57$; I’m not sure $\bar{x}= 2.70$; no pet attack $\bar{x}=2.52$) to the statement, “Coyotes pose a threat to the safety of children in the area near my home,” were not significantly different ($F_{2,1799}=0.814$, $p=.443$; Table 2.5).

Table 2.4. Summary of Group Responses to the Statement “Coyotes Pose a Threat to Pets in the Area Near my Home.”

Group	N	Mean Response*	SE	Lower	Upper
Pet Attack ¹	79	4.73 ^A	.09	4.53	4.89
I’m not sure ²	91	4.43 ^B	.10	4.22	4.62
No Pet Attack ³	1644	4.01 ^C	.03	3.96	4.07

One-way ANOVA results = $F_{2,1799}=18.979$; $P<.001$

*Means followed by the same letter are not significantly different at the $\alpha=0.05$ level as determined by a Games-Howell post-hoc analysis. Responses on 5-point Likert Scale with 1 = strongly disagree and 5 = strongly agree

1= Individuals who reported a coyote attacked their pet

2= Individuals who reported that they were not sure if a coyote attacked their pet

3 = Individuals who reported that a coyote has not attacked their pet.

Table 2.5. Summary of Group Responses to the Statement “Coyotes Pose a Threat to the Safety of Children in the Area Near my Home.”

Group	N	Mean Response	SE	Lower	Upper
Pet Attack ¹	79	2.56	.16	2.26	2.90
I’m not sure ²	91	2.70	.14	2.44	2.96
No Pet Attack ³	1644	2.53	.03	2.46	2.59

One-way ANOVA results = $F_{2,1799}=0.814$; $p=.443$

Responses on 5-point Likert Scale with 1 = strongly disagree and 5 = strongly agree

1= Individuals who reported a coyote attacked their pet

2= Individuals who reported that they were not sure if a coyote attacked their pet

3 = Individuals who reported that a coyote has not attacked their pet.

Social Amplification of Risk in Atlanta

A total of 141 articles about coyotes in metro Atlanta were found between 2006-2015. Twenty-six (18.4%) of these 141 were found to include the use of indirect evidence to conclude that a coyote attacked a pet (See Appendix J2). Twelve of these 26 mentioned coyotes as the reason for pets disappearing with three reporting that a trapper was hired to remove a coyote(s). Additionally, five articles mentioned that a trapper “may be hired” and/or that “something needed to be done.” Thirteen articles used indirect evidence in determining that a pet had been injured or killed. However, six of these articles spoke in part about the same pet. Nonetheless, they were usually written by different news agencies and were likely reaching unique individuals to some degree. Therefore, there is the potential for a risk message being broadcast to unique individuals.

Discussion

“Circumstantial evidence is a very tricky thing,” answered Holmes thoughtfully. “It may seem to point very straight to one thing, but if you shift your own point of view a little, you may find it pointing in an equally uncompromising manner to something entirely different.” (Doyle 1892, p.208)

Negative experiences with carnivores have been found to result in more negative views towards and greater risk perceptions of carnivores than among individuals who’ve had positive or neutral experiences (Ericsson and Heberlein, 2003; Naughton-Treves et al.

2003; Wieczorek-Hudenko et al. 2008; Kretser et al. 2009a; Kretser et al. 2009b; Siemer et al. 2009). Moreover, negative experiences have been linked to greater support of lethal management (Manfredo et al. 1998; Loker et al. 1999; Martinez-Espineira 2006; Vaske and Needham 2007) and less support for conservation and management efforts (Manfredo et al. 1998; Reiter et al. 1999; Martinez-Espineira 2006; Kretser et al. 2009a). Research has illustrated that an individual's interpretation of an interaction with a carnivore can influence their attitudes towards a carnivore (Bjurlin and Cypher 2005; Kretser 2008). For example, Bjurlin and Cypher (2005) noted that individuals who had more encounters with San Joaquin kit foxes (*Vulpes macrotis mutica*) were more likely to incorrectly perceive this endangered kit fox as common or abundant. Thus, to improve human-wildlife relations, and, subsequently, management and conservation efforts, wildlife managers must not only reduce actual negative human-wildlife interactions, but also "interactions" misattributed to certain species.

The results of my study are consistent with previous research indicating that, in general, negative experiences with wildlife, including coyotes, lead to more negative attitudes towards wildlife (Kellert 1985; Ericsson and Heberlein, 2003; Naughton-Treves et al. 2003; Martinez-Espineira 2006; Vaske & Needham 2007; Wieczorek-Hudenko et al. 2008; White and Gehrt 2009). However, in my study, even individuals who assumed that they had a negative experience with a coyote had more negative views than individuals with neutral experiences. I found no significant difference in the attitudes towards or perceptions of coyotes between individuals who assumed (i.e., used indirect evidence) or knew for certain (i.e. they saw the attack) that a coyote was the cause of a pet being

injured or killed, suggesting that it affects them to the same degree. These individuals were more likely to agree that coyotes posed a threat to the safety of their pets around their home, more likely to disagree with the statement that they enjoy seeing coyotes near their home, and less likely to agree that people needed to learn how to coexist with coyotes than individuals who had not experienced a pet being injured or killed by a coyote. My findings are especially noteworthy as these views may be unwarranted, since a coyote may have not actually attacked the pet. Moreover, it raises the possibility that if an investigation demonstrating that a coyote did not injure or attack an individual's pet it might improve that individual's attitude towards and perceptions of coyotes.

Sixty-four percent of individuals who reported a pet attack in the present study did not see the attack. Instead they used indirect evidence in forming the conclusion that a coyote was the cause. Of these, the majority (63%) were actually pets that had disappeared and never returned home; thus, their fate is unknown. The most common form of indirect evidence used was knowledge that coyotes had been seen and/or heard in the area at some point in time. Evidence shows that individuals who assume that a negative interaction or event has occurred with a predator are not always correct (Hooper, unpublished data; Way 2007; Niemeyer 2012). As such, if investigations are not conducted, individuals who are left to assume a coyote attacked their pet may unnecessarily have negative views about coyotes, which might in turn affect their behavior. Indeed, I found evidence that coyotes were lethally removed (i.e., trapped or shot) based on the assumption that they caused the disappearance or death of pets. This was reported at least 3 times in both the survey and in news articles in Atlanta.

Additionally, five news articles made mention that a trapper “may be hired” and/or that “something needed to be done.” The concern here is three-fold: 1) an individual coyote or group of coyotes is removed for an action they may or may not have committed; 2) an individual or group of people might be spending significant amounts of money to resolve an issue with the wrong action (i.e., trapping coyotes who did not actually “commit the crime”); and 3) trapping coyotes, especially in large numbers, may result in negative ecological effects. Wildlife managers should strive to avoid using lethal control simply as an easy way to satisfy stakeholders (Hoare 2001). Rather, lethal control should be used selectively when it has been objectively determined to be the best action (Treves and Karanth 2003). Such an approach reduces the likelihood that coyotes or other species are unnecessarily removed, and protects individual persons or groups from unnecessarily spending money.

The present study shows that news articles on coyote-pet attacks in Atlanta were being published regardless of whether the attack was corroborated by direct evidence. Moreover, little to no emphasis was placed on the fact that these reports were based on scant evidence. Following the Social Amplification of Risk Framework (SARF) these articles may be sending risk messages that influence individual’s risk perceptions (Kasperson et al. 1988; Pidgeon, Kasperson, and Slovic 2003). Here, the primary concern is that such a message may be unjustified, as the negative experience has not been validated. While I do not have data on whether these news articles served to amplify risk regarding coyotes, the fact that a risk message based solely on indirect evidence was potentially amplified and transmitted is concerning. The media has the potential to

influence public attitudes and risk perceptions (McComas 2006; Uscinski 2009; Antilla 2010; McQuail 2010) and, as a result, conservation and management efforts (Zucker 1978; Martinez-Espineira 2006; Manfredo et al. 1998; Reiter et al. 1999; Martinez-Espineira 2006). As such, it is crucial that news media clearly distinguish between known and assumed coyote-pet attacks. Wildlife managers and researchers should strive to create an understanding with news media of the importance of such a distinction. Future research should look to understand what effect such unwarranted risk messages may have on people.

Limitations and Biases

Because my target population, individuals who used both indirect and direct evidence in concluding that a pet had been attacked by a coyote, was of unknown size, I determined a purposive based snowball sampling approach would provide the best possibility for obtaining a large enough sample to conduct basic statistical analyses. Thus, it must be emphasized that my study does not represent a random sample. In recognition of this approach, the statistical analyses were not extrapolated to a larger area and my results are not necessarily representative of the larger population. Nonetheless, my results are consistent with previous studies that found that negative experiences with coyotes generally lead to more negative views towards them (Ericsson and Heberlein, 2003; Naughton-Treves et al. 2003; Wieczorek-Hudenko et al. 2008; Kretser et al. 2009b; Kretser et al. 2009a; Siemer et al. 2009). Moreover, field experience and studies from other geographic areas and with other carnivore species, including gray

wolves, support my findings that individuals sometimes claim to have had negative experiences with wildlife on the sole basis of indirect evidence (Way 2007; Niemeyer 2012; Draheim et al. 2013; Urban Coyote Research 2015; Hooper unpublished data; Hooper and Straker unpublished data).

The few random samples available indicate that coyote-pet attacks are rare. Given that only a small number of people are involved, does it matter if individuals base their purported negative experiences on assumption? I believe it does matter, due in large part to the potential for social amplification of risk. One individual assuming a coyote attacked their pet can lead to a news article that reaches thousands to millions of people, potentially influencing their attitudes towards and perceptions of coyotes. Nevertheless, future research should consider trying to obtain a random sample that could be used for extrapolation and more detailed statistical analyses.

It must be noted that survey respondents who had a more negative view of coyotes may have already had a negative view of coyotes before their presumed coyote-pet attack. Indeed, I have no data that represents survey respondents attitudes, risk perceptions, or beliefs prior to the presumed coyote-pet attack. The present study focused on pet attacks as the type of experience analyzed, so I cannot say for certain whether other wildlife experiences, negative or neutral, affected our results. Indeed, it is possible that some survey respondents have had multiple experiences they interpret as negative, and thus may have more negative views towards coyotes as a result. It is also important to note that assumptions that a predator was the cause of a pet or livestock death have been confirmed correct by investigation in some instances (Niemeyer 2012;

Hooper unpublished data). Moreover, I found at least one news article in which a pet owner believed a human killed their pet, but a subsequent necropsy demonstrated that a coyote was responsible.

Conclusion

Individuals may incorrectly perceive that an interaction with a coyote has occurred. Without conflict investigations, individuals are left to make assumptions regarding the cause of pet injuries, killings or disappearances. As negative experiences with wildlife have been found to result in more negative views toward wildlife, I believe identifying whether people use indirect evidence in making such conclusions is important. Our results suggest an individual who believes they had a negative experience with a coyote is not distinguishable from one who had a verified negative interaction. These negative assumptions may lead to presumed interactions/experiences that may lead to incorrectly perceived impacts, risk and, as a result, unnecessary management actions.

My study provides evidence that coyotes are at times assumed to be the cause of a negative interaction or event with a pet based on little evidence. Moreover, I provide evidence that such assumptions may lead to more negative views towards coyotes, unnecessary management actions and broadcasting of risk messages. I recommend wildlife managers conduct conflict investigations to determine the true cause of a negative interaction or event and to avoid unwarranted negative feelings towards coyotes, unnecessary management actions and risk messages being broadcasted. Moreover, entities should consider hiring urban wildlife managers/specialists that could

address human-coyote conflict. Conflict investigation protocols should be developed and individuals should be trained to conduct investigations. Additionally, the public should be educated about all potential risks to domestic pets and the options that should be considered if a pet is missing, including checking animal shelters early and often.

CHAPTER III

HUMAN-COYOTE INTERACTIONS IN AN URBAN ENVIRONMENT: THE IMPORTANCE OF LANDSCAPE CHARACTERISTICS AND SCALE

Introduction

In 2008, the world's human population was described as more urban (i.e., census block > 50,000 people) than rural for the first time in history (United Nations 2007). In the United States, roughly 80% of the population is now considered urban (U.S. Census Bureau 2010). Coupled with the fact that less than 10% of Earth's land is protected in some form (World Conservation Union 2000), human-wildlife interactions have and are likely to continue to increase. Such an increase is ultimately leading to a greater probability for conflict. Indeed, Woodroffe et al. (2005) reported human-wildlife conflict as a global problem.

Adams and Lindsey (2010) define urbanization as a process of transforming wild lands to better meet the needs and desires of humans. An urban ecosystem is influenced by human attitudes, behaviors, regulatory processes, resource control and infrastructure (U.S. Department of Agriculture 1995). As such, wildlife has had to adjust to an environment dominated by human activities (i.e., "synurbization;" Adams et al. 2005). Some species have adjusted to such a degree that they have been labeled as synanthropic

(e.g., raccoon [*Procyon lotor*] Prange et al. 2004; and red fox [*Vulpes vulpes*] Baker and Harris 2008; Soulsbury et al. 2010); that is, a species that lives near and benefits from human activities (Johnston 2001; Withey and Marzluff 2009; Gehrt 2011). During the 19th and 20th centuries, the coyote (*Canis latrans*) dramatically expanded its range across North and Central America, including urban environments (Parker 1995). Gehrt et al. (2011) suggested coyotes appeared behaviorally misanthropic (i.e., exhibiting a general avoidance of human activity) but demographically synanthropic. Indeed, coyotes have demonstrated a consistent avoidance of human activities through shifts in activity patterns (Grinder and Krausmen 2001; Way et al. 2004; Gehrt et al. 2009), but have been found at slightly higher population densities in urbanized areas, with pup survival 5 times higher than conspecifics in rural populations in Illinois (Gehrt et al. 2011). Despite this apparent avoidance behavior, the mere presence of coyotes in urban systems has ultimately led to an increased probability of human-coyote interactions.

Understanding variables that influence human-coyote interactions and conflict might allow managers to prevent or at least reduce negative interactions. Moreover, identifying where human-coyote interactions are more likely to occur spatially provides a focus for management and educational efforts. Magle et al. (2014) found that the absence of prairie dogs, habitat fragment size and age were associated with greater rates of human-coyote conflict. Poessel et al. (2012) found that human-coyote conflict occurred more often than expected in developed and open space land cover types and less often than expected in natural and agricultural lands. Lukasik and Alexander (2011) found that conflict occurred at a greater frequency in communities in central Calgary with

high human densities and in close proximity to a river with shrubby, riparian habitat. Such information can be used to produce models that improve management efforts. Predictive logistic regression models are commonly used in wildlife management to improve decision-making (Gude et al. 2009). However, models are often created using different ecological scales, methodologies and predictor variables. Such variation can lead to dramatic differences in results and, as such, affect the value of a model. To produce useful models, consideration must be given to factors such as ecological scale, study site characteristics, methodology and predictor variables (Murray et al. 2008). For example, ecological scale has been identified as a central problem in ecology (Levin 1992), as it is known to influence ecological phenomena like species distribution (Bradter et al. 2013) and occupancy (Martin 1998; Doligez et al. 2004), and how results and patterns are interpreted (Levin 1992); Patterns that occur at one scale may not persist at a different one (Hewitt et al. 2010). Thus, to produce meaningful models consideration must be given to such factors (Murray et al. 2008).

Only two previous studies have developed human-coyote interaction predictive models (but see Magle et al. 2014). Weckel et al. (2010) used straight-line distance measurements from points representing presence or absence of a coyote encounter, and correlated these to landscape variables to generate a probability map for a study area that consisted of the most rural and most urban parts of Westchester County, New York. Wine et al. (2015) generated buffers around points, representing known encounters and random points, to analyze landscape and socioeconomic characteristics associated with encounters in mostly urbanized Mecklenberg County, North Carolina. Due to differences

in methodologies and landscape characteristics, it is currently unknown how well the results of such studies can be extrapolated to other cities.

In metropolitan Atlanta, GA, human-coyote relations have become a relatively new controversial topic. It was not until the mid 1980s that coyotes reportedly occupied three-fourths of the state (Parker 1995). Since that time they have expanded into every county in the state, and now generate the majority of public calls to the Georgia Department of Natural Resources, with an average of over 139 calls a year in Fulton County alone during 2012-2013 (GA Department of Natural Resources, personal communication, Jan. 1, 2014). Moreover, media stories about coyotes appear common, with 141 news articles found online since 2006 (Hooper unpublished data). Thus, information is needed to better understand the current status of human-coyote relations and to provide a framework from which wildlife managers can improve and sustain a positive human-coyote relationship into the future.

I investigated the importance of landscape characteristics and scale in predicting human-coyote interactions in an urbanized landscape. My objectives were three-fold: 1) to investigate the types and general spatial distribution of human-coyote interactions in metro Atlanta; 2) to identify important landscape metrics associated with human-coyote interactions in an urban environment; and 3) to investigate how scale affects predictive models in an urbanized environment.

Methods

Study Area

With more than 5.3 million people, metropolitan Atlanta is the ninth-largest metropolitan statistical area in the United States (U.S Census Bureau 2014). As the focus of this study was on the human-coyote relationship in an urbanized landscape, the study area was defined as the U.S. Census Bureau's 2010 Atlanta, Georgia Urbanized Area (hereafter referred to as Urban Atlanta). The Census Bureau defines an urban area based primarily on residential population density measured at the census tract and census block levels of geography. For the 2010 Census, an urban area comprises a densely settled core of census tracts and/or census blocks that meet minimum population density requirements, along with contiguous territory containing nonresidential urban land uses, as well as territory with low population density included to link outlying densely settled territory with the densely settled core. An urbanized delineation consists of two types of classifications, including Urbanized Areas (Uas) and Urbanized Clusters (Ucs). Uas are defined as an urban area consisting of 50,000 or more people. Ucs are defined as an urban area consisting of at least 2,500, but less than 50,000 people. The total population of Urban Atlanta in 2010 was 4,665,943. The Urbanized Atlanta 2010 geographic information system layer developed by the Atlanta Regional Commission (ARC) was obtained from ARC's website (Atlanta Regional Commission 2016) and the 2011 National Land Cover Dataset (NLCD) (Homer et al. 2015) was used to determine the land cover of the study area.

Data Acquisition

To obtain data on human-coyote interactions, I included several questions within a human dimensions survey asking for information on types of interactions with coyotes and their associated locations. Additionally, any interactions reported in news media with spatial information were also used.

Survey Questions

In the survey, individuals were asked if they had experienced any of the following interactions with coyotes in the past 3 three years: 1) have you seen or heard a coyote near your home; 2) have you seen a coyote eating food found at or near your residence; 3) have you had a pet injured or killed by a coyote?; 4) have you or a family member or themselves been bitten or attacked by a coyote?; and 5) have you had any other experiences not mentioned in the previous questions? If an individual had experienced any of the aforementioned interactions, they were asked them to identify the one they remembered the most clearly. Individuals were then asked to indicate where and when this interaction occurred. Additionally, individuals were asked to provide any other locations within metro Atlanta where they had observed coyotes in the past 3 years, other than their home.

Spatial Analyses

Human-coyote interactions were mapped in ArcMap 10.3.1 (ESRI 2016) using addresses and descriptions provided by respondents. Only those that fell within the study area were included in analyses. An equal number of random points were generated using the Generate Random Points tool in ArcMap 10.3.1. Buffers were built around known and random points at three different spatial scales, 1.25, 4, and 6 km, to represent the span of resident and transient coyote home ranges (Gehrt and Riley 2010). Land cover was then extracted for each buffer (Fig. 4) using the 2011 National Land Cover Dataset (NLCD 30 meter resolution) and exported to an Microsoft Excel file, to acquire buffer specific landscape data (Hunt, unpublished tool, 2016). Extracting land cover from each buffer allowed models to be built using all samples. It should be noted that a formal assessment of the classification accuracy of the 2011 NLCD has not been completed; thus, the United States Geological Survey considers this dataset to be provisional and does not guarantee either its correctness or completeness (Homer et al. 2015).

Distance from each human-coyote interaction and random point to the nearest habitat feature was calculated using the Near tool in ArcMap 10.3.1. This tool determines the straight-line distance from each point in the Input Features (i.e., interactions and random points) to the nearest point of polyline in the Near Features (i.e., land cover). Mean distances were then calculated for each representative habitat type, including forest, open space, grassland, and three different development intensities (i.e., low, medium and high; see below for detailed description and Appendix E3 for variable definitions). A paired samples t-test was run to test for statistical differences between

known interactions and random points (McDonald 2014; SAS 2016). Though distance measures were not used in models, they were analyzed to explore differences among the present study and Weckel et al. (2010) resulting from differing levels of urbanization.

Predictive Models

A binary logistic regression was initially used to explore relationships between predictor variables and human-coyote interactions. This method assessed model fit and whether the variables chosen for model building improve predictive ability (Burnham and Anderson 2002). Logistic regression was only run for the global model at each spatial scale. The global model consists of every possible variable available at a respective spatial scale. Where a global model fits the data, then the best model, as determined by Akaike Information Criteria, will also fit the data (Burnham and Anderson 2002). Model fit is a measure of the discrepancies between model predictions and observed values (Burnham and Anderson 2002). Models were built *a priori* based on theory grounded in urban coyote ecology and human-coyote interactions. Only variables available in the NLCD land cover layer were considered for model use. Any land cover categories that made up less than 1% of the study area and were not combined with another category were not included in the analyses. All forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub) were lumped together to represent “Forest.” This decision was based on the fact that studies have highlighted coyote preference for natural, undeveloped landscapes in urban environments and that no apparent preference for any

one type of forest (e.g., deciduous vs. evergreen) has been reported (Grinder and Krausmen 2001; Way et al. 2004; Gehrt et al. 2009; Gehrt and Riley 2010). Thus, it was assumed that coyote use of forest types was equal. Because the study area was considered highly urbanized (U.S. Census 2010), I believed it was important to measure differences among the different development intensities. As such, I initially measured each level of development (low, medium, and high) separately. Model fit was evaluated using the Hosmer and Lemeshow goodness-of-fit test (Hosmer et al. 1997). This procedure is sensitive to sample size, however, and may report a model as a significantly ($\alpha < 0.5$) poor fit due to small differences in the predicted and observed outcomes when sample size is large (Hosmer et al. 1997; Paul et al. 2013). Thus, I further assessed models using Area Under Curve (AUC), Somer's D and percent correct classification statistical methods. AUC is a discriminatory analysis indicating how well a model can distinguish between two or more groups (e.g., coyote presence vs. absence; Burnham and Anderson 2002). Somer's D is a nonparametric measure commonly used in logistic regression to illustrate the strength and direction of the relationship between ordinal variables (Somers 1962). Values range from -1 (complete discordance between pairs) to +1 (complete concordance between pairs), with concordance indicating greater agreement between pairs of observations (Newson 2002). For example, a value of 0.73 indicates a strong, positive correlation between two variables. Moreover, this suggests that there is a 73% reduction in prediction errors when these variables are present. Percent classification indicates how often a null model correctly classifies cases (Peng and So 2002). For example, if the overall percentage is 50%, then the null model is only 50% accurate. I

checked for collinearity between predictors using Pearson Correlation and excluded any variables > 0.70 (Magle et al. 2014).

Akaike Information Criterion (AIC) values were calculated to determine the best model among the candidates at each scale (Burnham and Anderson 2002). For comparisons among models, the delta AIC and Akaike weights were calculated for each model. The delta AIC value represents each model's performance relative to the best model (Burnham and Anderson 2002). In general, a delta AIC < 2 suggests substantial support for a model's predictive value. Akaike weight is a probability measure that indicates the degree to which the indicated model is the best among the candidate models (Burnham and Anderson 2002). Akaike weights were then compared using evidence ratios to indicate a model's relative strength or the extent to which one model is better than another (Burnham and Anderson 2002). For example, an evidence ratio of 1.25 indicates that the better of the two models is 1.25 times better. Specifically, I was interested in the degree to which the best model was better than models with a delta AIC < 2 . Models that have an evidence ratio < 5 were considered competitive for the top model (Burnham and Anderson 2002). Competition for top model indicates a high degree of uncertainty regarding the best model and suggests the best model might change if I was to take a series of independent samples of identical size under nearly identical conditions (Burnham and Anderson 2002). Moreover, recognition of model uncertainty is even more important when considering that future data may or may not be gathered through the same process. Thus, a multi-model inference approach, or model averaging, is used as a means to address this uncertainty (Burnham and Anderson 2002).

A predictive map was created in ArcMap 10.3.1 using top model partial coefficients or model-averaged coefficients to illustrate the probability of a human-coyote interaction within the study area. Specifically, Raster Calculator was used to create suitability surfaces using the following equation:

$$1 / (1 + (\text{Exp}(- (\beta + (b_1 * \text{"Independent Raster Variable"}) + (b_2 * \text{Independent Raster Variable}) + (b_3 * \text{"Independent Raster Variable"}))))))$$

where β and b represent the model-averaged coefficients of the constant and predictor variables, respectively. Raster Calculator is a Spatial Analyst tool that “builds and executes a single Map Algebra expression using Python syntax in a calculator-like interface” (ESRI 2016). This equation generates a map with landscape variables weighted by their coefficient values. All statistics were run in SAS® 10.2 (SAS 2016) and SPSS 10.3 (SPSS 2016).

RESULTS

The study area consisted of a mixture of developed and natural landscape types. Specifically, it was comprised of 32% forests, 24% open space, 21% low intensity development, and 12% medium and high intensity development (table 3.0). The online survey resulted in 1,969 responses. Of these, 1,615 (82%) reported that they had seen or heard a coyote near their home in the past three years. Five hundred forty-three (33.6%) reported that such sightings and/or sounds occurred frequently. A total of 1,436 responses were accompanied by geospatial data that could be used for mapping. Only

245 respondents indicated time of year in which an interaction occurred. Of these, 46 (19%) occurred during coyote breeding season (1 Jan-30 April), 58 (24%) occurred during pup-rearing (1 May-31 Aug) and 141 (58%) occurred during dispersal (1 Sep-31 Dec) (Morey et al. 2007).

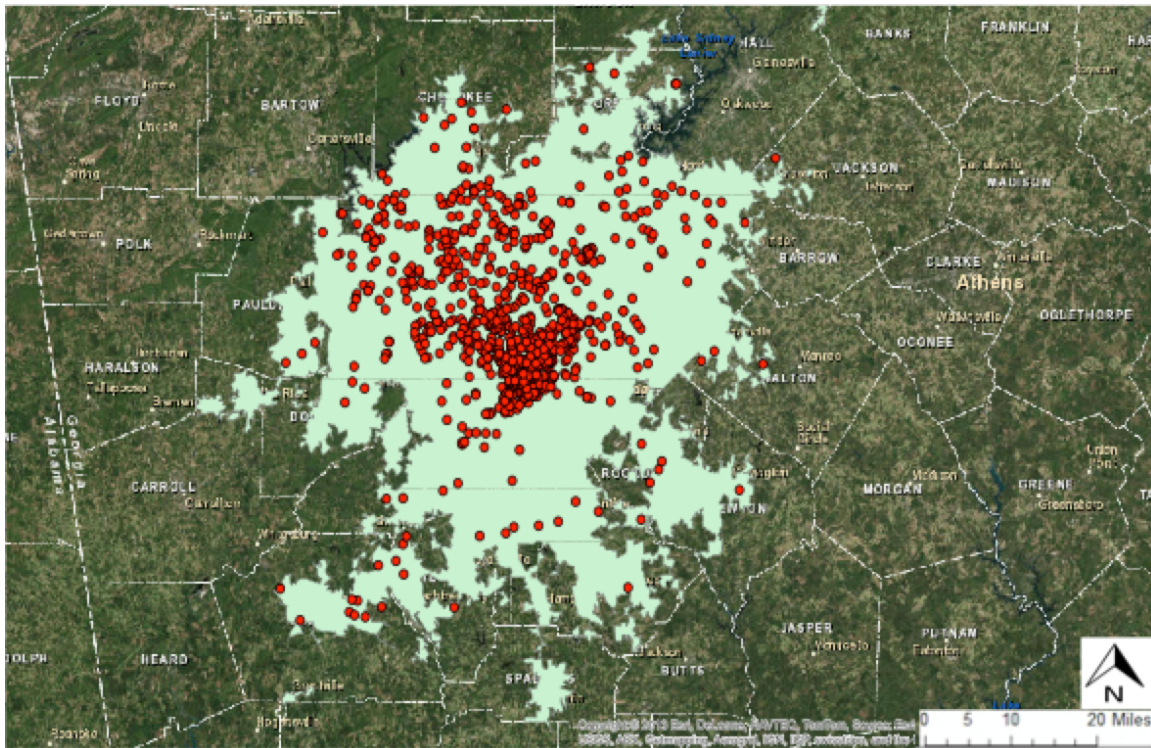


Fig 3.0 Distribution of Human-Coyote Interactions Across the Study Area. Red Points Indicate a Unique Human-Coyote Interaction and Light Green Illustrates the Extent of the Study Area.

Table 3.0 Dominant Land Cover in Urban Atlanta 2010 Study Area

NLCD 2011 Land Cover	Developed Open Space ^A	Developed Low Intensity ^B	Developed Med_High Intensity ^C	Forest ^D
% Study Area	24%	21%	12%	32%

*Based on 2011 National Land Cover Dataset

Total Area of Urban Atlanta 2010: 6,851,428,985 m²

A: Areas with a mixture of some constructed materials, but mostly vegetation. Impervious surfaces account for less than 20% of total cover.

B: Low intensity development consists of areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover.

C: Combination of medium and high intensity development. Medium intensity development consists of a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of total cover for medium intensity development. High intensity development consists of highly developed areas where people reside and work in high numbers. Impervious surfaces account for 80% to 100% of total cover.

D: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

Compared to the random points, human-coyote interactions were 60% farther from forested areas [$t_{-24.322}=6754, p < .001$]; 54% farther from grassland [$t_{30.350}=2701, p < .001$]; 57% closer to open space development [$t_{-11.3170}=1350, p < .001$]; 52% closer to low intensity development [$t_{-11.41}=1350, p < .001$]; 27% closer to medium intensity development [$t_{-7.097}=1350, p < .001$]; and 35% closer to high intensity development [$t_{9.741}=1350, p < .001$].

Table 3.1 Mean Distance (m) from Human-Coyote Interactions or Random Points to Landscape Features

	Open space ^A	Low ^B	Medium ^C	High ^D	Forest ^E	Grass ^F
Known ¹	70.17 (+/- 134.27)	97.90 (+/-150.26)	507.50 (+/-510.50)	1257.18 (+/-1083.38)	2899.33 (+/-3764.42)	4112.89 (+/-3202.23)
Random ²	163.36 (+/-271.77)	207.22 (+/- 317.26)	696.14 (+/-835)	1935.39 (+/-2318.66)	1813.13 (+/-2193.92)	1877.67 (+/-2111.48)

1=Human-coyote interactions reported in survey by respondents.

2=Random points generated for comparing with human-coyote interactions.

A: Areas with a mixture of some constructed materials, but mostly vegetation. Impervious surfaces account for less than 20% of total cover.

B: Low intensity development consists of areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover.

C: Medium intensity development consists of a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of total cover.

D: High intensity development consists of highly developed areas where people reside and work in high numbers. Impervious surfaces account for 80% to 100% of total cover.

E: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

F: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

Predictive Models

Only the global model at the 1.25 km ($\chi^2=14.51$, $df=8$, $sig=.069$) scale met the Hosmer and Lemeshow criteria for a fit model (6km: $\chi^2=66.486$, $df=8$, $sig=.000$; 4km: $\chi^2=18.699$, $df=8$, $sig=.017$). Area-under-curve (AUC) tests were significant with area values of 0.836 ($p < .001$), 0.853 ($p < .001$) and 0.842 ($p < .001$) for the 1.25, 4, and 6 km scales, respectively. Somer's D for global models at the 1.25, 4, and 6 km scale were 0.67, 0.71 and 0.68, respectively. Percent classification for global models also supported these findings, with 75%, 77% and 76% correct classifications, respectively. Medium Intensity and high Intensity development were highly correlated at each scale, and thus were combined. Collinearity changed across scales, thus models at the 6 km scale consist of

slightly different predictor variables. Open space and low Intensity development were highly correlated at the 6 km scale, and therefore they were combined.

The top model at the 1.25 km scale was the second best model at the 4 km scale (Open Space + Low Intensity Development+ Medium-High Intensity Development + Forest + Grass; Table 3.2). The model Open Space + Low Intensity Development + Medium-High Intensity Development + Forest was the best model at the 4 km, but was ranked as the 4th best model at the 1.25 km scale. Several models were competitive for best model at the 4 and 6 km scales; these were averaged to obtain coefficients and unconditional variances.

Table 3.2 Model Rankings Across the 1.25 and 4km Spatial Scales

1.25km	4km	Model
1	2	Open_Space ^A + Low ^B + Med_High ^C + Forest ^D + Grass ^E
2	6	Open_Space + Med_High + Forest + Grass
3	3	Open_Space + Low + Med_High
4	1	Open_Space + Low + Med_High + Forest
5	5	Open_Space + Med_High + Forest
6	4	Open_Space + Med_High
7	7	Open_Space + Low + Forest + Grass
8	8	Open_Space + Low + Forest
9	9	Open_Space + Low
10	10	Low + Med_High + Forest + Grass
11	12	Low + Med_High + Forest
12	11	Low + Med_High

A: Areas with a mixture of some constructed materials, but mostly vegetation. Impervious surfaces account for less than 20% of total cover.

B: Low intensity development consists of areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover.

C: Combination of medium and high intensity development. Medium intensity development consists of a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of total cover for medium intensity development. High intensity development consists of highly developed areas where people reside and work in high numbers. Impervious surfaces account for 80% to 100% of total cover.

D: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

E: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

1.25 km

The model Open Space + Low Intensity Development + Medium-High Intensity Development + Forest + Grass was the best model at the 1.25 km scale ($W_i = 0.97$). Open Space ($\beta=0.0023 \pm 0.00021$ SE) had the strongest effect of all variables in the model, followed by Medium-High Intensity Development ($\beta=0.00079 \pm 0.00018$ SE; Table 9). These two variables were the only ones that were positively correlated with human-coyote interactions.

Table 3.3 AIC Scores for Ranked Models at the 1.25 KM Scale

Model	AIC ¹	Δ_i^2	W_i^3	Evidence Ratio ⁴
Open_Space ^A Low ^B Med_High ^C Forest ^D Grass ^E	1378.95	0	0.97	-
Open_Space Med_High Forest Grass	1386.51	7.56	0.02	43.73
Open_Space Low Med_High	1389.18	10.23	0.006	166.42
Open_Space Low Med_High Forest	1391.16	12.21	0.002	447.87
Open_Space Med_High Forest	1392.83	13.88	0.0009	1034.84
Open_Space Med_High	1396.46	17.51	0.0002	6332.81
Open_Space Low Forest Grass	1401.35	22.4	1.33E-05	73093.85
Open_Space Low Forest	1454.88	75.93	3.15E-17	3.08E+16
Open_Space Low	1528.75	149.8	2.87E-33	3.37E+32
Low Med_High Forest Grass	1558.69	179.75	9.01E-40	1.08E+39
Low Med_High Forest	1798.46	419.51	7.78E-92	1.25E+91
Low Med_High	1819.84	440.89	1.77E-96	5.46E+95

1: Akaike Information Criteria, with the lowest value indicating the best of the candidate models.

2: Delta AIC equals the difference between a select model and the best model.

3: Akaike weight equals the probability that a model is the best among the candidate models.

4: Evidence ratio indicates a model's relative strength or the extent to which it is better than another model

A: Areas with a mixture of some constructed materials, but mostly vegetation. Impervious surfaces account for less than 20% of total cover.

B: Low intensity development consists of areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover.

C: Combination of medium and high intensity development. Medium intensity development consists of a mixture of constructed materials and vegetation. Impervious surfaces = 50% to 79% of total cover for medium intensity development. High intensity development consists of highly developed areas.

D: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

E: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

Table 3.4 Model Averaged Coefficient at 1.25 km Scale

Variable	β^1	SE ²	Lower 95% CI	Upper 95% CI
Intercept	-2.91	0.85	-3.76	-2.07
Open Space ^A	0.0023	0.00021	0.0021	0.0025
Low ^B	-0.00074	0.00023	-0.00097	-0.00051
Med_High ^C	0.00079	0.00018	0.00062	0.00098
Forest ^D	-0.00022	0.00019	-0.00042	-0.000025
Grass ^E	-0.0016	0.00044	-0.002	-0.0012

Upper and lower 95 % confidence intervals (CI) were calculated using unconditional variances (Burnham and Anderson 2002).

1: Beta coefficient indicates the correlation between a variable and interaction. A positive or negative number indicates a positive or negative correlation, respectively.

2: Standard error calculated using unconditional variances.

A: Areas with a mixture of some constructed materials, but mostly vegetation. Impervious surfaces account for less than 20% of total cover.

B: Low intensity development consists of areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover.

C: Combination of medium and high intensity development. Medium intensity development consists of a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of total cover for medium intensity development. High intensity development consists of highly developed areas where people reside and

D: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

E: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

4 km

Of the 12 models at the 4 km scale, Open Space + Low Intensity Development + Medium-High Intensity Development + Forest and Open Space + Low Intensity Development + Medium-High Intensity Development + Forest + Grass were considered competitive for the top model ($W_i = .69$ and $W_i = .29$, respectively). Models were averaged, resulting in average partial coefficients and unconditional variances for each predictor variable. Both Open Space ($\beta = 0.00035 \pm 2.41E-05$ SE) and Medium-High Intensity Development ($\beta = 0.00012 \pm 2.11E-05$ SE) were positively correlated with human-coyote interaction, with open space having the strongest effect.

Table 3.5 AIC Scores for Ranked Models at the 4 km Scale

Model	AIC ¹	Δ_i^2	W_i^3	Evidence Ratio ⁴
Open_Space ^A Low ^B Med_High ^C Forest ^D	1307.01	0	0.69	-
Open_Space Low Med_High Forest Grass ^E	1308.76	1.75	0.29	2.4
Open_Space Low Med_High	1314.25	7.24	0.019	37.24
Open_Space Med_High	1328.28	21.27	1.66E-05	41543.67
Open_Space Med_High Forest	1329.49	22.48	9.1E-06	76267.37
Open_Space Med_High Forest Grass	1330.43	23.42	5.69E-06	121722.66
Open_Space Low Forest Grass	1335.58	28.56	4.34E-07	1593590.95
Open_Space Low Forest	1341.18	34.17	2.64E-08	26245378.79
Open_Space Low	1423.11	116.1	4.26E-26	1.62E+25
Low Med_High Forest Grass	1492.28	185.27	4.07E-41	1.70E+40
Low Med_High	1649.26	342.24	3.33E-75	2.08E+74
Low Med_High Forest	1649.98	342.97	2.32E-75	2.99E+74

1: Akaike Information Criteria, with the lowest value indicating the best of the candidate models.

2: Delta AIC equals the difference between a select model and the best model.

3: Akaike weight equals the probability that a model is the best among the candidate models.

4: Evidence ratio indicates a model's relative strength or the extent to which it is better than another model

A: Areas with a mixture of some constructed materials, but mostly vegetation. Impervious surfaces account for less than 20% of total cover.

B: Low intensity development consists of areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover.

C: Combination of medium and high intensity development. Medium intensity development consists of a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of total cover for medium intensity development. High intensity development consists of highly developed areas where people reside and

D: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

E: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

Table 3.6 Model Averaged Coefficient at 4 km Scale

Variable	β^1	SE ²	Lower 95% CI	Upper 95% CI
Intercept	-3.57	0.69	-4.26	-2.88
Open Space ^A	0.00035	2.41E-05	0.00033	0.00037
Low ^B	-0.00015	3.00E-05	-0.00018	-0.00012
Med-High ^C	0.00012	2.11E-05	0.000099	0.00014
Forest ^D	-6.99E-05	2.30E-05	-0.000093	-0.000047
Grass ^E	-3.00E-05	5.60E-05	-0.000086	0.000026

Upper and lower 95 % confidence intervals (CI) were calculated using unconditional variances (Burnham and Anderson 2002).

1: Beta coefficient indicates the correlation between a variable and interaction. A positive or negative number indicates a positive or negative correlation, respectively.

2: Standard error calculated using unconditional variances.

A: Areas with a mixture of some constructed materials, but mostly vegetation. Impervious surfaces account for less than 20% of total cover.

B: Low intensity development consists of areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% of total cover.

C: Combination of medium and high intensity development. Medium intensity development consists of a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of total cover for medium intensity development. High intensity development consists of highly developed areas where people reside and

D: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

E: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

6 km

At the 6 km scale, Open Space-Low Intensity Development + Medium-High Intensity Development + Forest + Grass ($W_i = .77$) and Open Space-Low Intensity Development+ Forest + Grass ($W_i = .23$) were competitive for the top model (Table 12). Open Space-Low Intensity Development ($\beta=0.00005 \pm 6.87E-06$ SE) and Medium-High Intensity Development ($\beta=0.00002 \pm 9.99E-06$ SE) were both positively correlated, with the combination variable, low intensity and open space development, having the strongest independent effect (Table 3.7).

Table 3.7 AIC Scores for Ranked Models at the 6 km Scale

Model	AIC ¹	Δ_i^2	W_i^3	Evidence Ratio ⁴
Low_Open ^A Med_High ^B Forest ^C Grass ^D	1386.668	0	0.77	-
Low_Open Forest Grass	1389.082	2.41	0.23	3.34
Low_Open Med_High	1412.259	25.59	2.13E-06	360591.2
Low_Open Med_High Forest	1413.051	26.38	1.44E-06	535791.39
Med_High Grass	1446.88	60.21	6.48E-14	1.19E+13
Med_High Forest Grass	1447.471	60.80	4.82E-14	1.6E+13
Forest Grass	1479.827	93.16	4.54E-21	1.7E+20
Med_High Forest	1564.575	177.91	1.8E-39	4.29E+38

1: Akaike Information Criteria, with the lowest value indicating the best of the candidate models.

2: Delta AIC equals the difference between a select model and the best model.

3: Akaike weight equals the probability that a model is the best among the candidate models.

4: Evidence ratio indicates a model's relative strength or the extent to which it is better than another model

A: Combination of open space and low intensity development.

B: Combination of medium and high intensity development. Medium intensity development consists of a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of total cover for medium intensity development. High intensity development consists of highly developed areas where people reside and

C: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

D: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

Table 3.8 Model Averaged Coefficient at 6 km Scale

Variable	β^1	SE ²	Lower 95% CI	Upper 95% CI
Intercept	-2.58	0.69	-3.27	-1.89
Low_Open ^A	0.00005	6.87E-06	0.00004313	0.000057
Med_High ^B	0.00002	9.99E-06	0.00001001	0.000029
Forest ^C	-1.19E-05	1.13E-05	-2.32E-05	-6.07E-07
Grass ^D	-0.00014	2.81E-05	-0.00017	-0.00011

Upper and lower 95 % confidence intervals (CI) were calculated using unconditional variances (Burnham and Anderson 2002)

1: Beta coefficient indicates the correlation between a variable and interaction. A positive or negative number indicates a positive or negative correlation, respectively.

2: Standard error calculated using unconditional variances.

A: Combination of open space and low intensity development.

B: Combination of medium and high intensity development.

C: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

D: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

Table 3.9 Correlation of Variables with Human-Coyote Interactions Across Spatial Scales

Variable	1.25 km		4 km		6 km	
	β^1	SE ²	β	SE	β	SE
Intercept	-2.91	0.85	-3.57	0.69	-2.58	0.69
Open Space ^A	0.0023	0.00021	0.00035	2.41E-05	-	-
Low ^B	-0.00074	0.00023	-0.00015	3.00E-05	-	-
Low Open ^C	-	-	-	-	0.00005	6.87E-06
Med_High ^D	0.0008	0.00018	0.00012	2.11E-05	0.00002	0.000029
Forest ^E	-0.00022	0.0002	-6.99E-05	2.30E-05	-1.19E-05	1.13E-05
Grass ^F	-0.0016	0.00044	-3.00E-05	5.60E-05	-0.00014	2.81E-05

Upper and lower 95 % confidence intervals (CI) were calculated using unconditional variances (Burnham and Anderson 2002)

1: Beta coefficient indicates the correlation strength between a variable and interaction. A positive or negative number indicates a positive or negative correlation, respectively.

2: Standard error calculated using unconditional variances.

A: Areas with a mixture of some constructed materials, but mostly vegetation. Impervious surfaces account for less than 20% of total cover.

B: Low intensity development consists of areas with a mixture of constructed materials and vegetation.

C: Combination of open space and low intensity development

D: Combination of medium and high intensity development.

E: Consists of all forest types (i.e., deciduous, evergreen, mixed, woody wetlands and shrub/scrub)

F: Consists of grassland, herbaceous, pasture and hay vegetation and habitat types.

Discussion

Interactions between humans and wildlife are complex, having the potential to influence both attitudes toward (Zimmerman et al. 2001; Williams et al. 2002; but see Casey et al. 2005) perceptions of (Bjurlin and Cypher 2005; Roskaft et al. 2003; Siemer 2008; Wiczorek-Hudenko et al. 2008) and acceptance (Lischka et al. 2008) for wildlife

species. As such, human-wildlife interactions have the potential to influence management and conservation efforts (Bjurlin and Cypher 2005, Krester 2008). Subsequently, increasing attention is being directed towards understanding the dynamics of human-wildlife interactions. Indeed, human-wildlife interactions were identified as a top priority in the United States by state fish and wildlife agency directors in 1997 (Responsive Management 1997).

Prior studies have investigated human-coyote interactions and conflict (Poessel et al. 2012; Weckel et al. 2010). However, no study has focused on interactions in a completely urbanized landscape. Thus, previous studies may have underestimated the role that human activities and development play in human-coyote interactions. The vast majority of interactions (89%) in Urban Atlanta were sightings, with 11% of individuals reporting that they have had a pet injured or killed by a coyote in the past three years. However, nearly a quarter of these individuals were found to have no direct evidence that a coyote actually attacked their pet. Due to this, I focused my analyses on reports of sightings only. Temporal results should be interpreted with caution due to small sample size and because the survey started during the month of October. Since the survey began at this time, sightings during the dispersal season may be inflated.

Only one other study (Weckel et al. 2010) has measured distance of human-coyote interactions from landscape variables. A comparison of the present study with Weckel et al. (2010) provides a glimpse into potential differences between sites with varying levels of development. While my study site is considered completely urbanized, Weckel et al. (2010) included the most urban and most rural towns of Westchester

County, New York. Interestingly, Weckel et al. (2010) found that homeowners who reported encountering a coyote were on average 50% closer to forest, 36% closer to grasslands, and 66% further from medium to high intensity development. In contrast, human-coyote interactions in the present study were farther from forests and grasslands, and closer to open space and to low, medium, and high intensity development. It is important to note that whereas Weckel et al. (2010) compared locations where human-coyote interactions had and had not occurred, the present study compared locations where interactions had occurred with random points (i.e., pseudo non-encounters). That said, the differences between the two studies suggest that the landscape characteristics of human-coyote interactions are dependent upon the degree of urbanization. Although this is not entirely surprising, it is important for wildlife managers to understand how development influences human-coyote interactions, especially as urban sprawl continues into more rural areas.

Predictive Models: variable importance and the influence of scale

Scale is known to influence ecological phenomenon to different degrees, including species distribution (Bradter et al. 2013) and occupancy (Doligez et al. 2004; Martin 1998). As such, it is important for managers to understand what role variables play in human-coyote interactions at various scales. I found that a change in scale led to differences in both how correlated a variable was with human-coyote interactions and relationships between predictor variables (i.e., collinearity). Although models were not

validated with a test data set, the 1.25 km model was the only model that fit the data ($\chi^2=14.51$, $df=8$, $sig=.069$). Open space, medium + high intensity development and open space + low intensity development were positively correlated with the probability of an interaction (Table 3.8). Open space had the largest independent effect at the 1.25 and 4 km scales, while open space + low intensity development had the largest effect at the 6 km scale (Table 3.8). Such a correlation has been found in other studies, as well. For example, Poessel et al. (2012) found human-coyote conflict occurred more often than expected in open space in Denver. These areas, which include golf courses, parks, and large lot family homes, provide a mixture of human activity and potential habitat for coyotes. Moreover, because my study area is highly urbanized, large forested tracts are rare when compared to landscapes that are less developed. The fragmented nature of my study area likely results in coyotes having to travel through areas with higher human activity more often to get to and from different preferred habitat patches. Indeed, Magle et al. (2014) found habitat patch size influenced human-coyote conflict with smaller, more fragmented patches being more associated with conflict.

Although the City of Atlanta is referred to as a “City in a Forest,” (Giarrusso and Smith 2014), I found forests were negatively correlated with interactions in our study. Forests correlation with interactions was greater at the 1.25 km scale, decreased at the 4 km scale and increased again at the 6 km scale (Figs 9-13). The negative relationship between forests and interactions was surprising, as coyotes have been found to prefer natural landscapes in urban systems, and previous human-coyote interaction studies have found a positive relationship between the two (Gerht and Riley 2010; Weckel and Nagy

2010; Wine et al. 2015). A recent Urban Tree Canopy study in Atlanta may help explain why this is the case. Within the city limits, the majority of tree canopy is on single-family residential land (Giarrusso and Smith 2014). Indeed, 61% of all single-family residential land is tree covered. In the present study, open space development, which includes single lot family homes, was most strongly correlated with interactions. While tree canopy does not equate to undeveloped forests, the high levels of tree canopy may indicate that yards provide a significant amount of vegetative cover, resulting in greater use by coyotes. Moreover, while larger forested or undeveloped tracts may potentially support more coyotes, human use of these areas is likely lesser relative to other areas. Studies have shown that spatiotemporal analyses of human-coyote interactions are not equivalent to coyote habitat use and preference; rather, they indicate landscapes where the two are more likely to interact (Quinn 1995).

The 6 km scale model fit the data the least, which was evident in the final map. The map appears extremely uniform (Fig. 8), suggesting human-coyote interactions were likely to occur in most areas of Urban Atlanta. This is likely due to a combination of several factors. First, the overall size of the study area was small relative to the 6 km buffers. Indeed, there was a significant amount of overlap among the buffers themselves, and between the buffers and study area boundary. Coupled with the fact that the study area is completely urbanized and, as a result, fairly uniform in its characteristics, differences among predictor variables are not as pronounced. This is further illustrated by the fact that two of the predictor variables, open space and low Intensity development, surpassed the collinearity threshold (>0.7) at the 6 km scale, though they

did not at either the 1.25 or 4 km scales. It should be noted that relationships reported occurred within a specific constraining boundary (i.e., Urban Atlanta); thus, if the boundary were to be expanded these relationships may change. In part this would depend upon the characteristics of the landscape outside of my study area.

Comments about Wine et al. (2015)

Wine et al. (2015) investigated the role landscape characteristics and socioeconomic variables play in human-coyote encounters. They buffered known human-coyote encounters and an equal number of random points to extract landscape and socioeconomic data. Moreover, they used three different buffer sizes (i.e., 2, 4, and 8 km) to represent the range of resident coyote home ranges in urban systems as reported by Gehrt et al. (2010). However, their choice of buffer sizes is incorrect, as it does not actually represent their targeted range. Indeed, the scope of home ranges they wanted to account for was 5-115 km²; however, their buffer range spans 12.54-200 km² [i.e., the area of the 2 km buffer is 12.54 km²; the 4 km is 50.24 km²; and the 8 km, 200.96 km²]. Thus, they have reduced the smallest and inflated the largest average home range. This discrepancy could have dramatic effects on their measurements, and researchers should be cautious when using their methodology and considering their results.

Methodology aside, many issues remain with their conclusions. Wine et al. (2015) suggested that wealthier households provide more resources to coyotes (e.g., cover and food). However, their study was based on human-coyote encounters reported between

February 1, 2012 and January 31, 2013. Encounters were reported to an online platform (<http://charmeck.org/mecklenburg/county/ParkandRec/StewardshipServices/NaturalResources/Pages/Coyote.aspx>). As such, their findings are likely inflated by individuals who are more likely to have Internet access. Pew Research suggests that individuals with higher incomes are not only more likely to have Internet access, but to use it more than individuals with lower incomes (Jansen 2010). The online reporting system in Atlanta has resulted in greater numbers of reports from areas of greater economic prosperity. In fact, areas of higher poverty or lower yearly earnings have very few reports. However, due to the online nature of the survey, the lack of reports from such areas should be interpreted with caution, as this may not be representative of fewer encounters, but rather a lack of Internet access. As such, this model probably best predicts human-coyote encounters for areas of higher income with Internet access. Wine et al. (2015) states that the availability of trash is likely greater in higher income areas; however, they do not cite any evidence to support this claim. Although greater amounts of trash may be generated, less trash is likely available at coyotes in higher income areas due to factors such as greater sanitation efforts and homeowner association rules.

Wine et al. (2015) also suggest that occupation type influences human-coyote encounters. Specifically, they suggest that individuals who work in outdoor occupations are more likely to spend time outside their homes and, thus, encounter a coyote. However, this underrepresents individuals who spend time outside for a variety of reasons, such as gardening, recreation (e.g., playing basketball and running), walking dogs and playing with children.

Wine et al. (2015) suggested that being a college graduate increased the likelihood an individual would encounter a coyote. They state, “college graduates will be more likely to encounter coyotes due to their increased environmental awareness and/or their ability to distinguish coyotes from related species” (Wine et al. 2015; p.160). Increased environmental awareness and/or ability to correctly identify a coyote should not be seen as increasing the likelihood of an encounter actually occurring; rather, that perhaps such individuals are more likely to realize that they had an encounter with a coyote and, thus, may be more likely to report it or become interested. Lastly, Wine et al. (2015) list the independent effects their predictor variables had on encounter probability. However, their reported lower and upper 95% confidence intervals indicate significant uncertainty. Wine et al. (2015) reported building density had the greatest independent effect on encounter probability, with a coefficient value of 0.25. However, the confidence interval is 0.07 – 0.43, suggesting the effect value could be as low as 0.07. Wine et al. (2015) fail to mention that at 0.07, building density would no longer have the greatest independent effect. Additionally, they report that managed clearings had a positive effect on encounter probability (coefficient = 0.14); however, the 95% confidence interval is -0.07 – 0.36, suggesting that managed clearings could actually have had a negative effect on encounter probability. In recognition of these issues, managers should use Wine et al. (2015)’s findings with a high level of caution.

Limitations and biases

My sample was acquired through a non-random online survey, thus my results should not be interpreted as a random sample. An online survey requires individuals to have Internet access and to be aware of the study. Pew Research indicates that socioeconomic characteristics influence Internet access and use (Jansen 2010). Not surprisingly, wealthier individuals are more likely to have Internet access. As such, socioeconomic biases, such as interactions occurring in higher income areas, may exist. Future research should attempt to obtain a random sample to compare to my current model. Lastly, the performance of final models was not tested in the present study due to time constraints. Future work should test current models and identify additional variables, such as habitat patch size, presence of railroad corridors, and prey availability, which could improve the models.

Conclusion

This study represents the first analysis of human-coyote interactions in a completely urbanized landscape. Additionally, it is the first study to illustrate how ecological scale affects human-coyote interaction predictive variables. My work provides a baseline understanding of how a human-coyote interaction model would perform in an urban environment across various spatial scales. Managers who intend to use predictive models in urban environments should identify the geographic boundaries within which management efforts will be focused because boundaries may affect the performance of models. Nuances in the landscape appear to be best detected at the smallest scale (i.e.,

1.25 km), becoming more homogenous with increasing scale. This is likely due, in part, to the relatively homogeneous nature of my study area. Furthermore, the 1.25 km scale aligns with the average urban coyote home range across several studies (Gehrt and Riley 2010). As such, to produce a meaningful model, researchers and managers should consider coyote ecology and study area homogeneity when determining which scales to use. Future work should test current models and identify additional ecological and/or habitat variables that could improve the models and potential correlations between tree canopy, overall vegetative cover and coyote habitat use.

CHAPTER IV
URBAN COYOTE MANAGEMENT: SUGGESTIONS, CONSIDERATIONS AND CONFLICT
INVESTIGATION PROTOCOLS

Human-coyote interactions appear to be increasing across the country and, as a result, the probability of human-coyote conflict has increased (Weckel et al. 2010; Lukasik and Alexander 2011; Poessel et al. 2012). Human experiences with wildlife have been indicated as a significant influence in both management and decision-making processes (Wieczorek-Hudenko et al. 2008). Cities are beginning to use sightings reports to better understand human-coyote interactions and inform management decisions. My study is consistent with previous research indicating that, in general, negative experiences with wildlife lead to more negative attitudes towards wildlife (Ericsson and Heberlein, 2003, Naughton-Treves et al. 2003). However, even individuals who assumed they had a negative experience with a coyote, with little evidence, had more negative views than individuals with neutral experiences in my study. In recognition of this, and the fact that research suggests that tolerance for carnivores can increase over time with management focused on reducing negative experiences (Vaske and Needham 2002), I believe that human-coyote conflict investigations should be conducted on a routine basis.

I suggest wildlife agencies and/or cities, municipalities and others should strongly consider hiring and/or training an individual for human-wildlife conflict investigations. Few urban wildlife biologists exist and, to my knowledge, no official human-coyote conflict investigation protocols exist. Here I provide suggestions and considerations for such investigations based on my personal experience as an unofficial urban coyote specialist, and on investigative protocols for livestock depredations (Washington Department of Fish and Wildlife 2013).

Who should conduct the investigations?

Currently, few cities employ urban wildlife biologists, and even fewer have an individual who focuses on urban coyote-related efforts (see Ashley DeLaup, Wildlife Ecologist, City and County of Denver Parks and Recreation, Denver, CO). Fortunately, times are changing. For example, the Texas Parks and Wildlife Department employs urban biologists in 6 major cities in the state (Texas Parks and Wildlife Department). Governmental agencies are not the only entities that are hiring urban wildlife biologists. Adams and Lindsey (2010) note that urban wildlife biologists are becoming more common in the private sector, including non-governmental organizations (NGOs). The roles of these biologists vary and can be designed to meet specific local goals. I served as an urban coyote specialist for the Reflection Riding Arboretum and Nature Center in Chattanooga, TN from 2011-2015. Responsibilities for this position included conducting

research, public education and involvement in management efforts, which included the investigation of putative coyote-pet conflict.

A more efficient and cost-effective effort could come through partnerships between state wildlife agencies, city governments and NGOs, which could help to fund urban wildlife biologist positions. However, issues would remain, such as determining to whom the biologist would report. One solution could be that the biologist is employed by one entity (e.g., a state agency), with the position funded through grants from the partnerships. Certainly, the crossing of managerial boundaries may present management and philosophical difficulties, but progressive and innovative actions might allow for such an effort to occur.

If it wasn't a coyote, what was it?

There are roughly 78 million pet dogs and 86 million pet cats in the U.S (APPA 2015). For many people, dogs and cats represent another member of the family. As such, when pets are killed or lost it can be a very traumatizing experience. When investigating coyote-pet attacks, I found that many people attribute missing or lost pets to coyotes. While coyotes are certainly one potential cause of pet attacks, it is important for wildlife professionals and pet owners to consider all possible causes before making management decisions.

Little data is available on the disappearances and/or deaths of domestic pets and their causes (see Gehrt et al. 2013 for feral cat statistics). New et al. (2004) reported cats

were 3 times more likely than dogs to disappear. Weiss et al. (2012) found that 15% of pet owners lost their dog and/or cat at some point, although the majority of these pets were eventually found again (93% of dogs and 75% of cats were reunited with their owners). Owners were less likely to put a collar or any identification on their cat than dogs. Furthermore, two-thirds of missing cats lacked identification tags, potentially explaining the difference in discovery rates between dogs and cats. The American Society for the Prevention of Cruelty to Animals estimates that 1-in-3 pets will go missing at some point with roughly 7.6 million lost pets entering animal shelters every year (ASPCA 2016). Of those that enter shelters, APSCA estimates that roughly 5% of cats and 26% of dogs are returned home, respectively. Due to the consistent flow of pets into shelters and the lack of resources needed to handle such large numbers, these 7.6 million pets are either put up for adoption, euthanized or returned to their owner. Specifically, of the estimated 7.6 million pets that enter a shelter 35% of dogs and 37% of cats are adopted out; 31% and 41% of dogs and cats are euthanized; and 26% and 5% are returned to their owner. The majority of survey respondents in our study reported that a cat (n=60; 75.9%) was the victim of a coyote attack. Forty-two (70%) of these 60 used indirect evidence to conclude that a coyote was the reason for a cat disappearing or sustaining an injury or death. Thirty-two (76%) of these 42 were cats that disappeared. New Jr. et al. (2004) suggested that people might pay less attention towards and feel less concern for cats than dogs. Indeed, they found that cat owners often assumed it to be normal behavior for a cat to disappear for a few days and return on their own. As a result, they suggested that future

research strongly consider the human dimensions of cat and dog owners to better understand the relationship between people and their pets (New Jr. et al., 2004).

Although I did not ask if missing pets were wearing identification, it is likely that some did not. Pet owners should be encouraged to place identification on their pets as Weiss et al. (2012) noted that many of the cats in shelters or found by others and classified as feral may in fact be someone's pet. These pets would be more likely to be reunited with their owners if they carried identification. New et al. (2004) reported that cats were most often added to households because they were "abandoned or stray" (i.e., they "just showed up"). As such, shelters should be checked immediately upon pet disappearance, with repeated visits every couple of days, to improve recovery of lost pets. In metro Atlanta, Fulton County Animal Services holds lost and stray animals for only three days (Fulton County Animal Services 2016). DeKalb County Animal Services holds lost and strays for 5 days before they are placed up for adoption or euthanized (DeKalb County Animal Services 2016). Thus, it is crucial that individuals whose pet has disappeared check animal holding centers early and often. A pet assumed to have been killed by a coyote may have actually been adopted or euthanized in an animal shelter.

Pets can succumb to a variety of different causes for mortality, including predators and disease. The different types of predators that can kill or injure a pet are numerous and vary geographically. Species that are known to or reportedly have attacked pets include red fox (*Vulpes vulpes*; Soulsbury et al. 2010) coyote, domestic and feral dogs (*Canis lupus familiaris*; Riley et al. 2010) and cats (*Felis catus*; Riley et al. 2010), Great-Horned owls (*Bubo virginianus*; Woodford 2013), red-tailed hawks (*Buteo jamaicensis*;

Wadhvani 2014), raccoons (*Procyon lotor*; Hadidian et al. 2010), bobcats (*Felis catus*; Riley et al. 2010), and humans (including vehicles). However, little is known about the impact of these species on domestic animals. A relatively new crime known as “pet flipping” is reportedly on the rise. Pet flipping results from an individual stealing a pet or claiming to be the owner of a pet found by another individual. Once acquired, the criminal will then sell the pet for profit. This has reportedly occurred in metro Atlanta. A 2013 news 11Alive article, *Pet flipping leaves animal lovers devastated*,” speaks of the practice occurring in Atlanta, stating, “If your pet disappears or you gave it to someone thinking it was to get a good home, you might want to go online. You could be surprised to find your pet is for sale” (11Alive 2013). Managers should inform pet owners of this relatively new illegal criminal activity, including ways to rule out if this has happened to them. Additionally, future studies should further investigate the role other predators play, if any, in pet attacks.

Conflict Investigation Protocol

Question the pet owner and/or other individuals involved about the alleged encounter:

Questions and considerations should include:

- 1) What kind of pet was involved?
- 2) Did someone see the attack? Explain.
- 3) Does someone believe they heard the attack? Explain.

- 4) If not, why do they believe a coyote was the cause?
- 5) Determine if the pet is alive.
- 6) If alive, or body of deceased pet is found, assess any visible wounds including punctures. Consider full necropsy and DNA analyses of bites
- 7) Identify potential predators, including feral animals, in the area. Look for coyote or other predator signs (tracks, scat, wildlife trails). Determine if coyotes have been known to use the area in the past.
- 8) Look for signs of an attack (e.g., blood, displaced dirt or drag marks, etc.).
- 9) Consider getting permission to check areas outside of home or landowner's property.
- 10) If needed, deploy cameras for further investigations; Identify areas to set up trail cameras. Camera(s) placement dependent on number available and size and characteristics of property. Identify areas of potential wildlife use ("game trails") and/or areas used by the pet.
- 11) Determine how long should camera trap be left up, consider safety of camera (avoid theft), and photo capture success rate.
- 12) Check shelters, find out how long they house animals.
- 13) Check newspapers, websites, and other sources that report on missing pets in the area
- 14) Look for attractants for coyotes or other predators, such as unsecured pet food and/or trash that may have attributed to an attack.
- 15) Use pet disappearance search protocols.

16) Consider interviewing neighbors about their experience with coyotes or other predators in the area. For example, do they believe they have seen or heard any coyote activity lately?

17) Consider other non-predators, such as bees and wasps, disease, etc.

18) Did the pet owner call anyone to report this other than you? News media? Police?

19) Maintain proper documentation and record keeping.

CHAPTER V

CONCLUSION

Managing human-coyote relations will likely be a challenge into the foreseeable future. Thus, understanding human-coyote interactions and the associated human dimensions is necessary for wildlife managers. In urbanized Atlanta, human-coyote interactions were reported across the study area, although the majority were sightings only. Interactions were most strongly associated with open space development and, surprisingly, negatively associated with forests. Ecological scale influenced relationships among predictor variables themselves, and among interactions and predictor variables. A notable portion of individuals who reported that a coyote attacked their pet did not actually witness the attack, but instead assumed a coyote was the cause of their pet's disappearance, injury, or death. Attitudes toward and perceptions of coyotes were no different among individuals who assumed or saw a coyote attack their pet. These individuals had more negative attitudes toward and greater risk perceptions of coyotes than individuals who had not experienced a coyote attack their pet. The majority of pets assumed to have been attacked by a coyote were actually missing and never accounted for. Such assumptions were also reported in news article in metro Atlanta. Notably, I found evidence that coyotes were lethally removed based on an assumption that a coyote attacked an individual's pets. The concern here is four-fold: 1) an individual

coyote or group of coyotes is removed for an action they may or may not have committed; 2) an individual or group of people might be spending significant amounts of money to resolve an issue with the wrong action (i.e., trapping coyotes who did not actually “commit the crime”); 3) an individual(s) might have unnecessary negative attitudes towards and greater risk perceptions of coyote; and 4) news media and individuals might be amplifying a risk message that is unjustified, as the negative experience has not been validated.

Investigations should be conducted to determine the true cause of a pet’s fate. Cities and other entities (e.g., NGO’s) should strongly consider hiring urban wildlife biologist who, among other duties, could investigate instances of alleged human-coyote conflict. Urban wildlife biologists and researchers should develop standardized human-coyote conflict investigation protocols, and develop a relationship with news media, emphasizing the importance of news articles on coyote-pet attacks clearly indicating whether an individual actually saw the attack or are assuming a coyote was the cause. Additionally, urban wildlife biologists should educate individuals about the various threats to their pets, besides coyotes, and ways to protect them. The development of human-coyote interaction predictive models may lead to a reduction in negative interactions, such as pet attacks, by providing a framework for targeted management and education efforts. Future research should attempt to improve and test predictive models, and investigate whether news articles on coyote-pet attacks lacking direct evidence lead to a social amplification of risk.

REFERENCES

- 11Alive Staff. 2016. Pet flipping leaves animal lovers devastated. [accessed 2016 Feb 25]. <http://legacy.11alive.com/story/news/crime/alert/2014/03/06/1953340/>
- Adams, C.E. and Lindsey, K.J. 2010. Urban Wildlife Management 2nd ed. Boca Raton (FL): Taylor and Francis Group. P. 8.
- Adams, L.W., VanDruff, L.W., and Luniak, M. 2005. Managing urban habitats and wildlife. In Techniques for Wildlife Investigations and Management, sixth edition, 713-734, ed. C.E. Braun. Bethesda, MD: The Wildlife Society.
- Adelson, A. (2016, Jan 16). Coyote trapping contract wins approval. The Indy. [accessed 2016 Jan 16]. <http://www.lagunabeachindy.com/coyote-trapping-contract-wins-approval/>.
- Allgaier, J. 2011. The difficulty of differentiating expertise and the functions of expert sources and the necessity of studying science education in the media. Cultural Studies of Science Education. 6: 479-484.
- Alliance for Audited Media. c2016. [accessed 2016 Feb 20]. <http://auditedmedia.com>
- American Society for the Prevention of Cruelty to Animals. c2016. Pet Statistics. [accessed 2016 Feb 25]. <http://www.asPCA.org/animal-homelessness/shelter-intake-and-surrender/pet-statistics>
- Antilla, L. 2010. Self-censorship and science: a geographical review of media coverage of climate tipping points. Science Communication. 34: 30-56.
- American Pet Products Association. 2015. National Pet Owners Survey. [accessed 2016 Feb 20]. http://www.americanpetproducts.org/pubs_survey.asp
- Atlanta Regional Commission. c2016. Open Data. <http://arc.garc.opendata.arcgis.com>
- Atkinson, R. and Flint, J. 2001. Accessing hidden and hard-to-reach populations: snowball research strategies. Social Research Update. Department of Sociology, University of Surrey. Issue 33 Summer 2001.

- Baker, P.J., and Harris, S. 2007. Urban mammals: what does the future hold? An analysis of the factors affecting patterns of use of residential gardens in Great Britain. *Mammal Review*. 37: 297-315.
- Barua, M. 2010. Whose issue? Representations of human-elephant conflict in Indian and international media. *Science Communication*. 32: 55-75.
- Bekoff, M., and Gese, E.M. 2003. Coyote (*Canis latrans*). Pages 467-481 in G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, eds. *Wild Mammals of North America: Biology, Management, and Conservation*. 2nd ed. Johns Hopkins University Press, Baltimore, MD.
- Bjurlin, C.C., and B.L. Cypher. 2005. Encounter frequency with the urbanized San Joaquin kit fox correlates with public beliefs and attitudes toward the species. *Endangered Species Update*. 22(3): 107-115.
- Bradter, U., Kunin, W. E., Altringham, J. D., Thom, T. J., and Benton, T. G. 2013. Identifying appropriate spatial scales of predictors in species distribution models with the random forest algorithm. *Methods in Ecology and Evolution*. 4: 167-174.
- Bruskotter, J.T., Vaske, J.J. and Schmidt, R.H. 2009. Social and cognitive correlates of Utah Residents' acceptance of the lethal control of wolves. *Human Dimensions of Wildlife: An International Journal*. 14(2): 119-132.
- Burnett, C. (2007). Wildlife ballot initiatives in California and Colorado: A punctuated equilibrium model explanation. *Human Dimensions of Wildlife*. 12(3): 201-202.
- Burnham and Anderson. 2002. *Model selection and multimodel inference: a practical information-theoretical approach* 2nd edition. Springer-Verlag, New York.
- Carifio, J. and Perla, R.J. 2007. Ten common misunderstandings, misconceptions, persistent myths and urban legends about likert scales and likert response formats and their antidotes. *Journal of Social Sciences*. 3(3): 106-116.
- Casey, A. L., P. R. Krausman, W. W. Shaw, and H. G. Shaw. 2005. Knowledge of and attitudes toward mountain lions: A public survey of residents adjacent to Saguaro National Park, Arizona. *Human Dimensions of Wildlife*. 10(1): 29-38.
- City of Atlanta. c2016. Population. [accessed 2016 Feb 1].
<http://www.atlantaga.gov/index.aspx?page=818>
- Corbett, J. B. 1995. When wildlife make the news: an analysis of rural and urban north-central U.S. newspapers. *Public Understanding of Science*. 4: 397-410.

- Decker, D.J. and O'Pezio, J. 1989. Consideration of Bear-People Conflicts in Black Bear Management for the Catskill Region of New York. Application of a Comprehensive Management Model. Pgs. 181-187 in M. Bromley, ed. Bear-People Conflicts. Proc. of a Symposium on Management Strategies. Northwest Territories Department of Renewable Resources, Yellowknife, Northwest Territories.
- Decker, D.J., Riley, S.J., and Siemer, W.F. 2012. Human dimensions of wildlife management. pp.3-14. In: Decker, D. J., Riley, S. J. and Siemer, W. F. (Eds.). Human Dimensions of Wildlife Management, 2nd ed. The Johns Hopkins University Press, Baltimore, MD.
- Dekalb County Animal Services. c2015. Lost pets. [accessed 2016 Feb 1]. <http://www.dekalbanimalservices.com/lost-pets>
- Doligez, B., Part, T., Danchin, E., Clobert, J. and Gustafsson, L. 2004. Availability and use of public information and conspecific density for settlement decisions in the collared flycatcher. *Journal of Animal Ecology*. 73: 75–87.
- Don Carlos, A.W., Dietsch, A.M., Teel, T.L., Ross-Winslow, D.J., Bonnell, M.A., & Breck, S.W. (2013). Report for Adams County, Colorado from the research project entitled “Reducing coyote conflict in Adams County: coyote behavior and human dimensions research.” Project report for the Adams County open space grants program, Adams County, Colorado. Fort Collins, CO: Colorado State University, Department of Human Dimensions of Natural Resources.
- Doyle, A.C. 2009. *The adventures of Sherlock Holmes*. Dover Publications; unabridged replication of the edition published by Harper, New York and London, 1892.
- Draheim, M. M., Patterson, K. W., Rockwood, L.L., Guagnano, G.A., and Parsons, E.C.M. 2013. Attitudes of college undergraduates towards coyotes (*Canis latrans*) in an urban landscape: management and public outreach implications. *Animals*. 3: 1-18.
- Ericsson, G. and Heberlein, T. 2003. Attitudes of hunters, locals and the general public in Sweden now that wovles are back. *Biological Conservation*. 111: 149-159.
- ESRI. c2016. How raster calculator works. [accessed 2016 Feb 20]. <http://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/how-raster-calculator-works.htm>.
- Etikan, I, Musa, S.A., and Alkassim, R.S. 2016. A comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*. 5(1): 1-4.

- Fulton County Animal Services. c2013. Lost pets. [accessed 2016 Feb 1].
<http://www.fultonanimalservices.com/lost-pets>
- Gehrt, S. 2007. Ecology of coyotes in urban landscapes. Wildlife Damage Management Conferences-Proceedings. Paper 63.
- Gehrt, S.D., C. Anchor, and L.A. White. 2009. Home range and landscape use of coyotes in a metropolitan landscape: conflict or coexistence? *Journal of Mammalogy* 90: 1045-1057.
- Gehrt, S.D., and Riley, S.P.D. 2010. Coyotes (*Canis latrans*), pp.79-95. In: Gehrt, S.D., Riley, S.P.D., and Cypher, B.L. (Eds.). *Urban carnivores: ecology, conflict, and conservation*. The Johns Hopkins University Press, Baltimore, MD.
- Gehrt, S.D., Brown, J.L., and Anchor, C. 2011. Is the urban coyote a misanthropic synanthrope? The case from Chicago. *Cities and the Environment*. 4(1): 1-23.
- Gehrt, S.D., Wilson, E.C., Brown, J.L., and Anchor, C. 2013. Population ecology of free-roaming cats and interference competition by coyotes in urban parks. *Plos One*. 8(9): 1-11.
- Georgia Power. c2016. Metro Atlanta Overview: Atlanta: The growth engine in the southeast. [accessed 2016 Feb 15].
<http://selectgeorgia.com/publications/atlanta-overview.pdf>
- Giarrusso, A.J. and Smith, S. M. 2014. Assessing urban tree canopy in the City of Atlanta; a baseline canopy study. Final Report. Retrieved from
<http://www.atlantaga.gov/modules/showdocument.aspx?documentid=14722>
- Glass, G.V., Peckham, P.D., and Sander, J.R. 1972. Consequences of failure to meet assumptions underlying the analyses of variance and covariance. *Review of Educational Research*. 42: 237-288.
- Google. c2013. About Google News. [accessed 2016 Feb 25].
http://www.google.com/intl/en_us/about_google_news.html.
- Grinder, M. I., and Krausman, P.R. 2001a. Morbidity-mortality factors and survival of an urban coyote population in Arizona. *Journal of Wildlife Diseases*. 37: 312-317.
- Grinder, M.I. and P.R. Krausman. 2001b. Home range, habitat use, and nocturnal activity of coyotes in an urban environment. *Journal of Wildlife Management* 65:887-898.

- Gude, J. A., Mitchell, M. S., Ausband, D. E., Sime, C. A., and Bangs, E. E. 2009. Internal validation of predictive logistic regression models for decision-making in wildlife management. *Wildlife Biology*. 15: 352-369.
- Hadidian, J., Prange, S., Rosatte, R., Riley, S.P.D., and Gehrt, S.D. 2010. Raccoons (*Procyon lotor*), pp.35-47. In: Gehrt, S.D., Riley, S.P.D., and Cypher, B.L. (Eds.). *Urban carnivores: ecology, conflict, and conservation*. The Johns Hopkins University Press, Baltimore, MD.
- Henke, S.E. 1992. Effect of coyote removal on the faunal community ecology of a short-grass prairie. Ph.D. Thesis., Texas Tech University. Lubbock. 229pp.
- Hewitt, J.E., Thrush, S.F., and Lundquist, C. 2010. Scale-dependence in ecological systems. In: eLS. John Wiley & Sons, Ltd, Chichester. <http://www.els.net> [doi: 10.1002/9780470015902.a0021903]
- Hoare, R. 2001. A decision support system for managing human-elephant conflict situations in Africa. Africa Elephant Specialist Group, Species Survival Commission, World Conservation Union, Nairobi. 1-102.
- Homer, C. G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K. 2015. Completion of the 2011 National Land Cover Database for the conterminous United States-Representing a decade of land cover change information. *Photogrammetric Engineering and Remote Sensing*. 81(5): 345-354.
- Hosmer, D.W., Hosmer, T., Le Cessie, S., and Lemeshow, S. 1997. A comparison of goodness-of-fit tests for the logistic regression model. *Statistics in Medicine*. 16: 965-980.
- Jacobson, S. K., Langin, C., Carlton, S. and Lee Kaid, L. 2011. Content analysis of newspaper coverage of the Florida panther. *Conservation Biology*. 26(1): 171-179.
- Jansen, J. 2010. Use of the Internet in higher-income households. Report. [accessed 2016 Feb 15]. <http://pewInternet.org/Reports/2010/Better-off-households.aspx>
- Johnston, R.F. 2001. Synanthropic birds of North America, pp.49-67,. In:Marzluff, J.M., Bownman, R., Donnelly, R. (eds.). *Avian ecology and conservation in an urbanized world*. Kluwer, Boston.
- Kasperson, R. E., Renn, O., Slovic, P., Brown, S., Emel, J., Goble, R., Kasperson, J. X., and Ratick, S. 1988. The social amplification of risk: a conceptual framework: *Risk Analysis*. 8(2): 177-187.

- Kellert, S.R. 1984. Urban American perceptions of animals and the natural environment. *Urban Ecology*. 8: 209-228.
- Kellert, S. R. 1985. Public perceptions of predators, particularly the wolf and coyote. *Biological Conservation*. 31: 167-189.
- Krester, H. E. 2008. The exurban frontier: Anticipating human-wildlife interactions where we live, work, and play. Doctoral dissertation, Cornell University, Ithaca, NY.
- Kretser, H.E., Curtis, P.D., Francis, J.D., Pendall, R.J., and Knuth, B.A. 2009a. Factors affecting perceptions of human-wildlife interactions in residential areas of northern New York and implications for conservation. *Human Dimensions of Wildlife*. 14: 102-118.
- Kretser, H.E., Curtis, P.D., and Knuth, B.A. 2009b. Landscape, social, and spatial influences on perceptions of human-back bear interactions in the Adirondack Park, NY. *Human Dimensions of Wildlife* 14: 393-406.
- Levin, S.A. 1992. The problem of pattern and scale in ecology. *Ecology*. 73(6): 1943-1967
- Lischka, S. A., S. J. Riley, and B. A. Rudolph. 2008. Effects of impact perception on acceptance capacity for white-tailed deer. *Journal of Wildlife Management*. 72(2): 502-509.
- Loker, C.A., Decker, D.J., and Schwager, S.J. 1999. Social acceptability of wildlife management actions in suburban areas: 3 cases from New York. *Wildlife Society Bulletin*. 27(1): 152-159.
- Lukasik, V.M. and Alexander, S.M. 2011. Human-coyote interactions in Calgary, Alberta. *Human Dimensions of Wildlife*. 16: 114-127.
- MacCracken, J.G. 1982. Coyote foods in a southern California suburb. *Wildlife Society Bulletin*. 10: 280-281.
- Magle, S.B., Poessel, S.A., Crooks, K.R., and Breck, S.W. 2014. More dogs less bite: the relationship between human-coyote conflict and prairie dog colonies in an urban landscape. *Landscape and Urban Planning*. 127: 146-153.
- Manfredo, M. J., Fulton, D. C., & Pierce, C. L. 1997. Understanding voter behavior on wildlife ballot initiatives: Colorado's trapping amendment. *Human Dimensions of Wildlife*. 2(4): 22-39.

- Manfredo, M. J., H. C. Zinn, L. Sikorowski, and J. Jones. 1998. Public acceptance of mountain lion management: a case study of Denver, Colorado, and nearby foothill areas. *Wildlife Society Bulletin*. 26: 964-970.
- Martin, T.E. (1998) Are microhabitat preferences of coexisting species underselection and adaptive? *Ecology*. 79: 656–670.
- Martinez-Espineira, Roberto. 2006. Public attitudes toward lethal coyote control. *Human Dimensions of Wildlife*.11(2): 89-100.
- McClure, M.F., Smith, N.S., and Shaw, W.W. 1995. Diets of coyotes near the boundary of Saguaro National Monument and Tucson, Arizona. *Southwestern Naturalist*. 40: 101-104.
- McComas, K. 2006. Defining moments in risk communication: 1996-2005. *Journal of Health Communication*.11: 75-91.
- McDonald, J.H. 2014. *Handbook of Biological Statistics* (3rd ed.). Sparky House Publishing, Baltimore, MD.
- McQuail, D. 2010. *McQuail's mass communication theory*. 6th edition. Sage, London.
- Miller, N. (2015, Jan 24). Police: Dog not killed by coyotes. *The Framingham Tab*. [accessed 2016 Jan 20].
<http://framingham.wickedlocal.com/article/20150124/NEWS/150127562>
- Morey, P. S., Gese, E. M., and Gehrt, S. 2007. Spatial and temporal variation in the diet of coyotes in the Chicago metropolitan area. *American Midland Naturalist*. 158: 147-161.
- Multi-Resolution Land Characteristics Consortium. n.d. National Land Cover Database 2011 (NLCD 2011). http://www.mrlc.gov/nlcd11_data.php
- Murchison, A. 2013. Sandy Springs to hold public meeting on coyote sightings. *Sandy Springs Patch*. [accessed 2016 Jan 20].
<http://patch.com/georgia/sandysprings/sandy-springs-to-hold-public-meeting-on-coyote-sightings>.

- Murray, J.V., Low Choy, S., McAlpine, C.A., Possingham, H.P., and Goldizen, A.W. 2008. The importance of ecological scale for wildlife conservation in naturally fragmented environments: A case study of the brush-tailed rock-wallaby (*Petrogale penicillata*). *Biological Conservation*. 141: 7-22.
- National Park Service. 2016. Death Valley: frequently asked questions. [accessed 2016 April 1]. <https://www.nps.gov/deva/faqs.htm>
- Naughton-Treves, L., Grossberg, R., and Treves, A. 2003. Paying for tolerance: rural citizens' attitudes toward wolf depredation and compensation. *Conservation Biology*. 17:1500-1511.
- New Jr., J.C., Kelch, W.J., Hutchison, J.M., Salman, M.D., King, M., Scarlett, J.M., and Kass, P.H. 2004. Birth and death rate estimates of cats and dogs in U.S. households and related factors. *Journal of Applied Animal Welfare Science*. 7(4): 229-241.
- Newson, R. 2002. Parameters behind nonparametric statistics: Kendall's tau, Somer's D and median differences. *Strata Journal*. 2: 45-64.
- Niemeyer, C. 2012. *Wolfer: A Memoir*. Boise, ID: Bottlefly Press.
- Norman, G. 2010. Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Sciences Education*.
- Parker, G. 1995. *Eastern coyote: the story of its success*. Halifax, NS: Nimbus Publishing.
- Paul, P., Pennell, M.L., and Lemeshow, S. 2013. Standardizing the power of the Hosmer-Lemeshow goodness of fit test in large data sets. *Statistics in Medicine*. 32: 67-80.
- Peng, C.Y.J., and So, T.S.H. 2002. Logistic regression analysis and reporting: a primer. *Understanding Statistics*. 1(1): 31-70.
- Petroni, S. (2015, Jan 23). Framingham Police Issue Coyote Warning. Framingham Patch. [accessed 2016 Feb 25]. <http://patch.com/massachusetts/framingham/framingham-police-issue-coyote-warning-1>.
- Pidgeon, N.F., Kasperson, N., and Slovic, P. 2003. *The social amplification of risk*. London: Cambridge University Press.

- Poessel, S. A., Breck, Stewart W., Teel, T., Shwiff, S., Crooks, K., and Angeloni, L. 2012. Patterns of human-coyote conflicts in the Denver metropolitan area. *Journal of Wildlife Management*. 77(2): 297-305.
- Prange, S. Gehrt, S.D., and Wiggers, E. P. 2004. Influences of anthropogenic resources on raccoon (*Procyon lotor*) movements and spatial distribution. *Journal of Mammology*. 85: 483-490.
- Quinn, T. 1995. Using public sighting information to investigate coyote use of urban habitat. *Journal of Wildlife Management*. 59: 238-245.
- Reiter, D. K., Brunson, M.W., and Schmidt, R. H. 1999. Public attitudes toward wildlife damage management and policy. *Wildlife Society Bulletin*. 27(3): 746-758.
- Responsive Management. 1997. State biological science information needs assessment survey results, Volume I. Responsive Manage, Harrisonburg, VA. 333.
- Riley, S.P.D., Boydston, E.E., Crooks, K.R., and Lyren, L.M. 2010. Bobcats (*Lynx rufus*), pp.121-138. In: Gehrt, S.D., Riley, S.P.D., and Cypher, B.L. (Eds.). *Urban carnivores: ecology, conflict, and conservation*. The Johns Hopkins University Press, Baltimore, MD.
- Roskaft, E., T. Bjerke, B. Kaltenborn, J. D. C. Linnell, and R. Anderson. 2003. Patterns of self-reported fear towards large carnivores among the Norwegian public. *Evolution and Human Behavior*. 24(3): 184-198.
- Ruxton, G. D. and Beauchamp, G. 2008. Time for some a priori thinking about post hoc testing. *Behavioral Ecology*. 19(3): 690-693.
- SAS. c2016. [accessed 2016 Jan 20]. http://www.sas.com/en_us/home.html.
- Siemer, W. F. 2008. Effects of mass media exposure on perception risk from black bears. Unpublished manuscript.
- Siemer, W.F., Sol Hart, P., Decker, D.J., and Shanahan, J.E. 2009. Factors that influence concern about human-black bear interactions in residential settings. *Human Dimensions of Wildlife*. 14: 185-197.
- Somers, R.H. 1962. A new asymmetric measure of association for ordinal variables. *American Sociological Review*. 27: 799-811.
- Sommer, B. 2006. Types of Samples. [accessed 2016 Jan 26]. <http://psc.dss.ucdavis.edu/sommerb/sommerdemo/sampling/types.htm>

- Soulsbury, C.D., Baker, P.J., Iossa, G., and Harris, H. 2010. Red foxes (*Vulpes vulpes*), pp.63-74. In: Gehrt, S.D., Riley, S.P.D., and Cypher, B.L. (Eds.). Urban carnivores: ecology, conflict, and conservation. The Johns Hopkins University Press, Baltimore, MD.
- SPSS. c2016. SPSS Statistics. [accessed 2016 Jan 20]. <http://www-01.ibm.com/software/analytics/spss/products/statistics/>.
- Sullivan, G.M., and Artino Jr., A.R. 2013. Analyzing and interpreting data from Likert-type scales. *Journal of Graduate Medical Education*. 5(4): 541-542.
- Texas Parks and Wildlife Department. Urban Wildlife Program. [accessed 2016 Feb. 1]. http://tpwd.texas.gov/huntwild/wild/wildlife_diversity/urban_program/
- Treves, A. and Karanth, K.U. 2003. Human-carnivore conflict and perspectives on carnivore management worldwide. *Conservation Biology*. 17(6): 1491-1499.
- United Nations Population Fund. 2007. State of the World Population 2007: Unleashing the Potential of Urban Growth.
- United States Census Bureau. 2010. Computer and internet use in the United States: 2010. <http://www.census.gov/hhes/computer/publications/2010.html>
- United States Census Bureau. 2014. Annual estimates of resident population: April 1, 2010 to July 1, 2013-United States-metropolitan and micropolitan statistical area; and for Puerto Rico. American Fact Finder. <http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmm>
- United States Department of Agriculture. 1995. Urban Community Ecosystems: A National Action Plan. Washington, DC: United States Government Printing Office.
- Urban Coyote Research. 2015. Coyote conflicts: a research perspective. [accessed 2016 Feb 15]. <http://urbancoyotersearch.com/coyote-conflicts-research-perspective>
- Uscinski, J. E. 2009. When does the public's issue agenda affect the media's issue agenda (and vice-versa)? Developing a framework for media-public influence. *Social Science Quarterly*. 90: 796-815.
- Vaske J. J. and Manfredi M. J. 2012. Social psychological considerations in wildlife management. In: Decker, D.J., Riley, S.J., and Siemer, W.F., editors. *Human Dimensions of Wildlife Management*. 2nd ed. Baltimore (MD): The Johns Hopkins University Press. P. 44.

- Vaske, J. J., and Needham, M. D. (2007). Segmenting public beliefs about conflict with coyotes in an urban recreation setting. *Journal of Park and Recreation Administration*. 25(4): 79-98.
- WABE 90.1 NPR. (n.d.). Media Kit. [accessed 2016 Feb 20].
http://archive.pba.org/dictator/media/2610/90.1_wabe_media_kit.pdf
- Wadhvani, A. 2014. Red-tailed hawk attacks, kills family's dog. USA Today.
<http://www.usatoday.com/story/news/nation/2014/11/30/hawk-kills-dog/19703919/>
- Washington Department of Fish and Wildlife. 2013. Livestock injury and mortality investigations: a reference guide for WDFW field personnel.
http://wdfw.wa.gov/conservation/gray_wolf/livestock/livestock_mortality_investigation_manual_mar2013.pdf
- Way, J.G., Ortega, I.M., and Strauss, J.W. 2002. Eastern coyote home range, territoriality, and sociality in an urbanized Cape Cod. *Northeast Wildlife*, 57: 1-18.
- Way, J.G., I.M. Ortega, and E.G. Strauss. 2004. Movement and activity patterns of eastern coyotes in a coastal, suburban environment. *Northeastern Naturalist*. 11:237-254.
- Way, J. 2007. *Suburban Howls: Tracking the eastern coyote in urban Massachusetts*. Dog Ear Publishing, LLC. P. 119
- Weckel, M., Mack, D., Nagy, C., Christie, R., Wincorn, A. 2010. Using citizen science to map human-coyote interaction in suburban New York, USA. *Journal of Wildlife Management*. 74(5): 1163-1171.
- Weiss, E., Slater, M., and Lord, L. 2012. Frequency of lost dogs and cats in the United States and the methods used to locate them. *Animals*. 2: 301-315.
- White, L. A. and Gehrt, S. D. 2009. Coyote attacks on humans in the United States and Canada. *Human Dimensions of Wildlife*. 14: 419-432.
- Wieczorek Hudenko, H., W. F. Siemer, and D. J. Decker. 2008. *Humans and coyotes in suburbia: Can experience lead to sustainable coexistence?* Human Dimensions Research Unit Series Publication 08-9. Ithaca, NY: Cornell University.
- Williamson, S. J. 1998. Origins, history, and current use of ballot initiatives in wildlife management. *Human Dimensions of Wildlife*. 3(2): 51-59.
- Williams, C.K., W. G. Ericsson, and T. A. Heberlein. 2002. A quantitative summary of attitudes toward wolves and their reintroduction (1972-2000). *Wildlife Society Bulletin*. 30(2): 575-584.

- Wine, S., Gagne, S.A., Meentemeyer, R. K. 2015. Understanding human-coyote encounters in urban ecosystems using citizen science data: what do socioeconomics tell us? *Environmental Management*. 55(1): 159-170.
- Withey, J.C. and Marzluff, J.M. 2009. Multi-scale use of lands providing anthropogenic resources by American crows in an urbanizing landscape. *Landscape Ecology*. 24: 281-293.
- Woodford, R. 2013. Great Horned Owl attacks pets: unusual incidents in Copper River Valley. *Alaska Fish and Wildlife News*.
http://www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.view_article&articles_id=603
- Woodroffe, R., S. Thirgood, and A. Rabinowitz. 2005. The future of coexistence: resolving human-wildlife conflict in a changing world. Pages 388-405 in R. Woodroffe, S. Thirgood, and A. Rabinowitz, editors. *People and wildlife: conflict or coexistence?* Cambridge University Press, Cambridge, United Kingdom.
- World Conservation Union. 2000. Protected areas: benefits beyond boundaries.
www.iucn.org/themes/wcpa/pubs/pdfs/WCPAInAction.pdf
- Zimmermann, B., P. Wabakken, and M. Dotterer. 2001. Human-carnivore interactions in Norway: How does the re-appearance of large carnivores affect people's attitudes and levels of fear? *Forest, Snow, and Landscape Research*. 76(1/2): 137-153.
- Zinn, H. C., Manfredo, M. J., and Vaske, J. J. (2000). Social psychological basis for stakeholder acceptance capacity. *Human Dimensions of Wildlife*. 5: 20-33.
- Zucker, H. G. 1978. The variable nature of news media influence. *Communication Yearbook*. 2: 225-245.

APPENDIX A2

INITIAL SURVEY UTC IRB APPROVAL

MEMORANDUM

TO: Jeremy Hooper
IRB #14-134
Dr. Chris Mowry

FROM: Lindsay Pardue, Director of Research Integrity
Dr. Bart Weathington, IRB Committee Chair

DATE: October 10, 2014

SUBJECT: IRB #14-134: Survey of Human-Coyote Interactions in metro Atlanta

The IRB Committee Chair has reviewed and approved your application and assigned you the IRB number listed above. You must include the following approval statement on research materials seen by participants and used in research reports:

The Institutional Review Board of the University of Tennessee at Chattanooga (FWA00004149) has approved this research project #14-134.

Please remember that you must complete a Certification for Changes, Annual Review, or Project Termination/Completion Form when the project is completed or provide an annual report if the project takes over one year to complete. The IRB Committee will make every effort to remind you prior to your anniversary date; however, it is your responsibility to ensure that this additional step is satisfied.

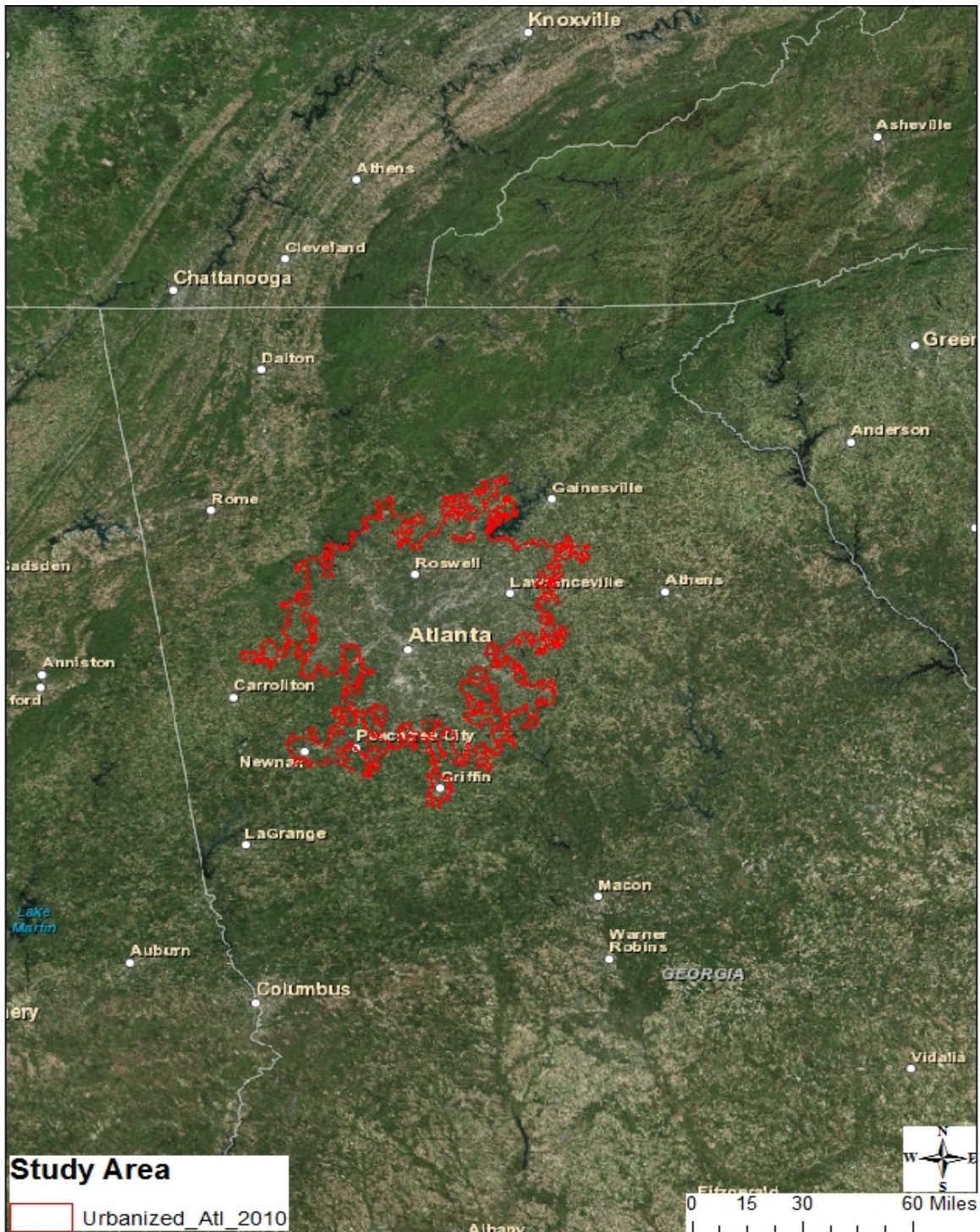
Please remember to contact the IRB Committee immediately and submit a new project proposal for review if significant changes occur in your research design or in any instruments used in conducting the study. You should also contact the IRB Committee immediately if you encounter any adverse effects during your project that pose a risk to your subjects.

For any additional information, please consult our web page <http://www.utc.edu/irb> or email instrb@utc.edu

Best wishes for a successful research project.

APPENDIX A3

URBANIZED ATLANTA 2010 STUDY AREA BOUNDARIES



APPENDIX B2

INITIAL SURVEY BERRY COLLEGE IRB APPROVAL

Faculty Research and Sponsored Programs

P.O. Box 495006
Mount Berry, GA 30149-5006
Phone: 706.290.2163 or 706.238.5849
Fax: 706.238.5910
www.berry.edu

BERRY COLLEGE

Experience it Firsthand

September 16, 2014

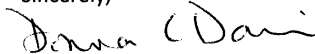
Dr. Christopher Mowry
Department of Biology
Box 430
Berry College
CAMPUS MAIL

The Berry College Institutional Review Board for Human Subjects Research (IRB) has approved of your study, *Survey of Human-Coyote Interactions in Metro Atlanta* (Protocol No. 2014-15-004). This approval is valid for one year from September 12, 2014.

No modifications can be made to your protocol or be instituted without prior approval by the IRB. In addition, you should report any unanticipated problems involving your participants to the IRB as soon as possible. Please keep in mind that all study-related documents should be kept for at least three years after the completion of your study.

Please feel free to contact me with any questions or concerns.

Sincerely,

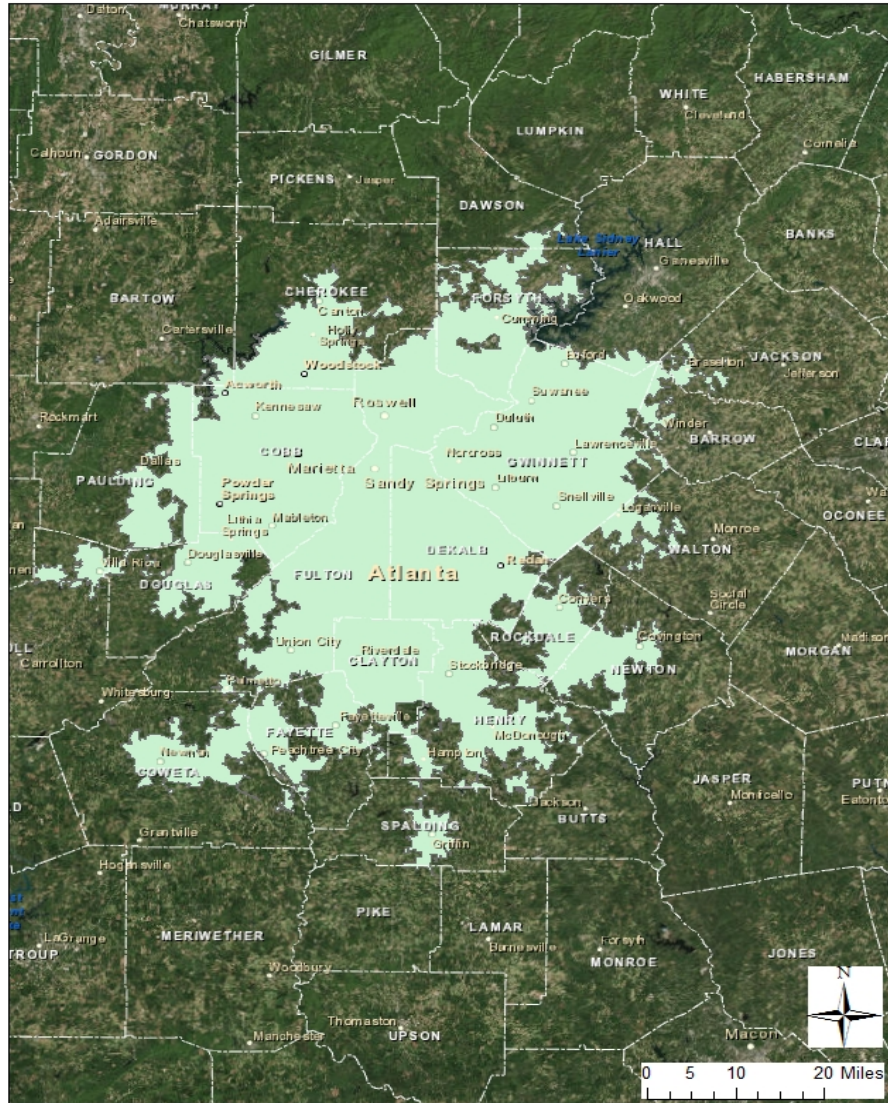


Donna C. Davin, Director
Research and Sponsored Programs
Berry College
P.O. Box 495006
Mount Berry, GA 30149
706-290-2163
facultyresearch@berry.edu

APPENDIX B3

CITIES AND COUNTIES THAT FALL WITHIN OR OVERLAP THE URBAN ATLANTA 2010 STUDY

AREA



APPENDIX C2

APPROVAL FOR CHANGE TO UTC IRB TO INCLUDE FOLLOW-UP SURVEY

Institutional Review Board
Dept. 4915
615 McCallie Avenue
Chattanooga, TN 37403-2598
Phone: (423) 425-5867
Fax: (423) 425-4052
instrb@utc.edu
<http://www.utc.edu/irb>

MEMORANDUM

TO: Jeremy Hooper **IRB # 14-134**

FROM: Lindsay Pardue, Director of Research Integrity
Dr. Bart Weathington, IRB Committee Chair

DATE: July 7, 2015

SUBJECT: **IRB #:14-134:** Survey of Human-Coyote Interactions in metro Atlanta

The Institutional Review Board has reviewed and approved the following changes for the IRB project listed below:

- To further improve our understanding of human-coyote interactions in metro Atlanta we have deemed it necessary to conduct a follow up survey of a select number of individuals that completed our original survey that was approved by the IRB on 10/10/2014. These individuals consist of respondents whom claim to have had a pet attacked by a coyote. The follow up survey will allow us to gain further input on coyote attacks on pets in metro Atlanta. Of the respondents that reported a pet attack, we will survey only those who gave their contact information and consent for follow up conversations with us.
- 1) Did you see your pet being attacked? Provide description.
- 2) Do you believe you heard your pet being attacked? Provide description.
- 3) If you did not see or hear the attack why do you believe a coyote(s) attacked your pet?
- 4) Did you search for your pet?
- 5) If it were to have been found that a coyote did not attack your pet do you believe it would change your view at all about coyotes?
-

You must include the following approval statement on research materials seen by participants and used in research reports:

The Institutional Review Board of the University of Tennessee at Chattanooga (FWA00004149) has approved this research project # 14-134.

Please remember that you must complete a Certification for Changes, Annual Review, or Project Termination/Completion Form when the project is completed or provide an annual report if the project

Institutional Review Board

Dept. 4915
615 McCallie Avenue
Chattanooga, TN 37403-2598
Phone: (423) 425-5867
Fax: (423) 425-4052
instrb@utc.edu
<http://www.utc.edu/irb>

takes over one year to complete. The IRB Committee will make every effort to remind you prior to your anniversary date; however, it is your responsibility to ensure that this additional step is satisfied.

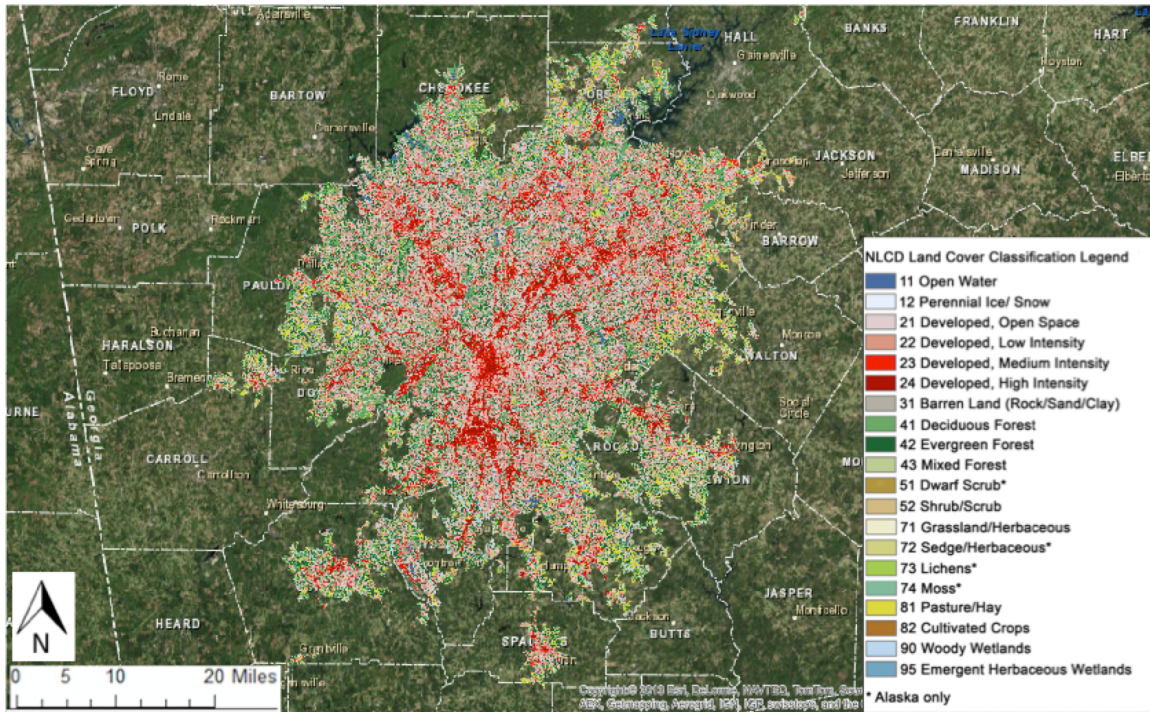
Please remember to contact the IRB Committee immediately and submit a new project proposal for review if significant changes occur in your research design or in any instruments used in conducting the study. You should also contact the IRB Committee immediately if you encounter any adverse effects during your project that pose a risk to your subjects.

For any additional information, please consult our web page <http://www.utc.edu/irb> or email instrb@utc.edu

Best wishes for a successful research project.

APPENDIX C3

NATIONAL LAND COVER DATASET 2011 – LAND COVER FOR URBANIZED ATLANTA 2010



APPENDIX D2

APPROVAL FOR CHANGE TO BERRY COLLEGE IRB TO INCLUDE FOLLOW-UP SURVEY



Berry College
Institutional Review Board for Human Subjects Research
Application for Modification of an Active Protocol

To: Berry College IRB

From: (Christopher B. Mowry)
(Biology)
(706-236-1712)

Title of Research Project: Survey of Human-Coyote Interactions in Metro Atlanta

Protocol Number: 2014-15-004

Previous Review Type: Exempt Expedited Full Board

Proposed Modification:

To further improve our understanding of human-coyote interactions in metro Atlanta we have deemed it necessary to conduct a follow up survey of a select number of individuals that completed our original survey that was approved by the IRB on 9/12/2014. These individuals consist of respondents whom claim to have had a pet attacked by a coyote. The follow up survey will allow us to gain further input on coyote attacks on pets in metro Atlanta. Of the respondents that reported a pet attack, we will survey only those who gave their contact information and consent for follow up conversations with us.

- 1) Did you see your pet being attacked? Provide description.
- 2) Do you believe you heard your pet being attacked? Provide description.
- 3) If you did not see or hear the attack why do you believe a coyote(s) attacked your pet?
- 4) Did you search for your pet?
- 5) If it were to have been found that a coyote did not attack your pet do you believe it would change your view at all about coyotes?

Reason for Modification:

Need to ask follow up questions for further data gathering.

Signature of PI: _____ **Date:** _____

Signature of Faculty Sponsor (if applicable): _____ **Date:** _____

Approved Not Approved _____ **Date:** _____
IRB Chair

APPENDIX D3

MAPS ILLUSTRATING BUFFERED POINTS OVERLAYING NLCD 2011 LAND COVER LAYER

PRIOR TO EXTRACTION AND BUFFERS WITH 2011 NLCD LAND COVER DATA EXTRACTED

APPENDIX E2
INITIAL SURVEY

2014 Human-Coyote Interactions Survey

This survey is being conducted by biologists from Berry College (Rome, GA) and Emory University to understand more about potential human-coyote interactions within the Metro Atlanta area. We are interested in learning about people's perceptions of, attitudes towards, and experiences with coyotes living in urban and/or suburban landscapes. Several questions ask for specific locations and/or street addresses. Your willingness to provide such information will allow us to more accurately map coyote movement and activity patterns.

We hope that you will take a few minutes to complete the survey. Your participation is voluntary and your responses will be kept confidential. Your consent to participate in the survey is implied when you fill out and submit the form. If you have any questions or comments about the survey please feel free to contact Dr. Chris Mowry (Professor of Biology, Berry College), the study director, by email at cmowry@berry.edu or by phone at 706-236-1712. Thank you very much for participating.

BERRY COLLEGE

1. Are you aware that coyotes live in Georgia?

- yes
 no
 I've never thought about it

2. How confident are you in your ability to identify an animal you might see as a coyote?
 (i.e., are you able to distinguish it from a dog, fox, etc.?)

- very confident
 somewhat confident
 not at all confident

Questions 3 - 7 ask your opinions about coyotes living near humans.

3. I enjoy seeing coyotes in the area near my home.

1 2 3 4 5

strongly disagree strongly agree

4. Coyotes pose a threat to the safety of children in the area near my home.

1 2 3 4 5

strongly disagree strongly agree

5. Coyotes pose a threat to pets in the area near my home.

1 2 3 4 5

strongly disagree strongly agree

6. Coyotes help to control the number of wild animals (rabbits, rats, squirrels, etc.) in the area near my home.

1 2 3 4 5

strongly disagree strongly agree

7. People need to learn how to coexist with coyotes.

1 2 3 4 5

strongly disagree strongly agree

Questions 8 - 18 ask about possible interactions you may have had with coyotes over the past 3 years.

8. Over the past 3 years, how would you characterize the level of coyote activity in the area near your home?

- It has increased
- It has remained the same
- It has decreased
- I'm not sure
- I am not aware of any coyotes near my home

9. In the past 3 years, have you seen or heard coyotes near your home?

- no
- yes, once
- yes, occasionally
- yes, frequently
- I'm not sure

10. In the past 3 years, have you ever seen a coyote eating food found at or near your residence (e.g., eating garbage, pet food, bird seed, garden, road kill)?

- no
- yes, once
- yes, occasionally
- yes, frequently
- I'm not sure

11. In the past 3 years, have you had a pet that has been injured or killed by a coyote?

- no
- yes, once
- yes, more than once
- I'm not sure

12. In the past 3 years, have you or a family member been bitten or attacked by a coyote?

- no
- yes, once
- yes, more than once
- I'm not sure

13. In the past 3 years, have you had any other experiences with a coyote that are not mentioned above?

(If yes, please describe)

14. If you have experienced any of the interactions with coyotes listed in questions 8 – 13, please select the one interaction that you remember most clearly. Otherwise, go to question 15.

(choose one)

- seen or heard a coyote near my home
- a coyote eating food at or near my residence
- a pet injured or killed by a coyote
- me or a family member bitten or attacked by a coyote
- other

15. When did this interaction that you most clearly remember occur?

(Be as specific as you can with the date and time of day.)

Month	Day	2014		Hr	:	Min	AM
-------	-----	------	--	----	---	-----	----

16. Where did this interaction occur?

(Please give the street address, nearest intersection, or name of park/open space/trail if you are willing to provide it. Otherwise, just give the zip code.)

17. Did you report this interaction to anyone?

- yes
 no
 I don't remember

18. If yes, to whom did you report the interaction?

19. In the past 3 years, do you recall seeing or hearing information about coyotes in the Atlanta Metro Area from any of the following sources?

(check all that apply)

- TV
 radio
 local newspapers
 brochures or flyers
 governmental websites (e.g., Georgia Dept. of Natural Resources)
 other websites
 educational programs or public meetings
 signs in the area near your home
 talking with friends or family
 social media sites
 Other:

20. If you did receive information about coyotes from any of these sources, did it change your behavior in any way?

(please describe)

Questions 21 - 24 ask about your potential behavior in response to coyotes in your area.

21. How likely are you to store pet foods and/or garbage indoors or in a garage in order to avoid potential negative interactions with coyotes?

1 2 3 4 5

highly unlikely highly likely

22. How likely are you to supervise pets when they are outdoors in order to avoid potential negative interactions with coyotes?

1 2 3 4 5

highly unlikely highly likely

23. How likely are you to try and frighten away a coyote that is near your home?

1 2 3 4 5

highly unlikely highly likely

24. How likely are you to alert local authorities if you see a coyote near your home?

1 2 3 4 5

highly unlikely highly likely

25. What action do you think local authorities (e.g., wildlife agencies, city or county governments) should take regarding coyotes?

(check all that apply)

- take no action
- attempt to frighten or "haze" away coyotes
- capture and relocate coyotes
- lethally remove all coyotes
- lethally remove only "problem" coyotes
- educate people on how to coexist with coyotes

26. Are you male or female?

- male
- female

27. What is your age?

- 18 - 24
- 25 - 34
- 35 - 44
- 45 - 54
- 55 - 64
- 65 - 74
- 75 or older

28. Do you have any of the following animals at your residence?

(check all that apply)

- cats
- dogs
- chickens
- other animals that live or spend time outside

29. If you have pets at your residence how do they spend their time?

(check all that apply)

- they are kept indoors
- they are kept outside
- when outside they are on a leash
- when outside they are in a fenced in area
- when outside they are free roaming
- they are outside during the day but brought in at night

30. Do you have any of the following at your residence?

(check all that apply)

- birdfeeders
- vegetable garden
- fruit trees/bushes
- compost pile
- outdoor grill

31. How long have you lived at your current address?

32. Please give your street address if you are willing to provide it. Otherwise, please provide your zip code.

33. We might be interested in gathering further input from residents in your area about coyote issues in the future. Would you be willing to be contacted for this purpose?

- yes
 no

34. If yes, please provide contact information.

Mailing address/email address/phone number (whichever method of contact you would prefer)

Thank you very much for your time!

If you would like to learn more about us, you can visit our website at <http://facultyweb.berry.edu/cmowry/Home.html>.

APPENDIX E3

2011 NATIONAL LAND COVER DATASET VARIABLE DEFINITIONS

Developed	
21	Developed, Open Space - areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
22	Developed, Low Intensity - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
23	Developed, Medium Intensity - areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
24	Developed High Intensity -highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.
Forest	
41	Deciduous Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
42	Evergreen Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
43	Mixed Forest - areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.
52	Shrub/Scrub - areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
90	Woody Wetlands - areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Herbaceous	
71	Grassland/Herbaceous - areas dominated by graminoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
81	Pasture/Hay ♦ areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.

APPENDIX F2
FOLLOW-UP SURVEY

- 1) Please indicate your name or email address, so that we can combine your responses to this survey with the original survey.

- 2) Did you see your pet being attacked by a coyote(s)? If so, please describe your experience, including where it occurred, when (i.e., estimate of day and time) and what you were doing.

- 2) Do you believe you heard your pet being attacked by a coyote? If so, please provide a description of the experience, including where it occurred, when and what you were doing.

- 3) If you did not see or hear the attack why do you believe a coyote(s) attacked your pet?

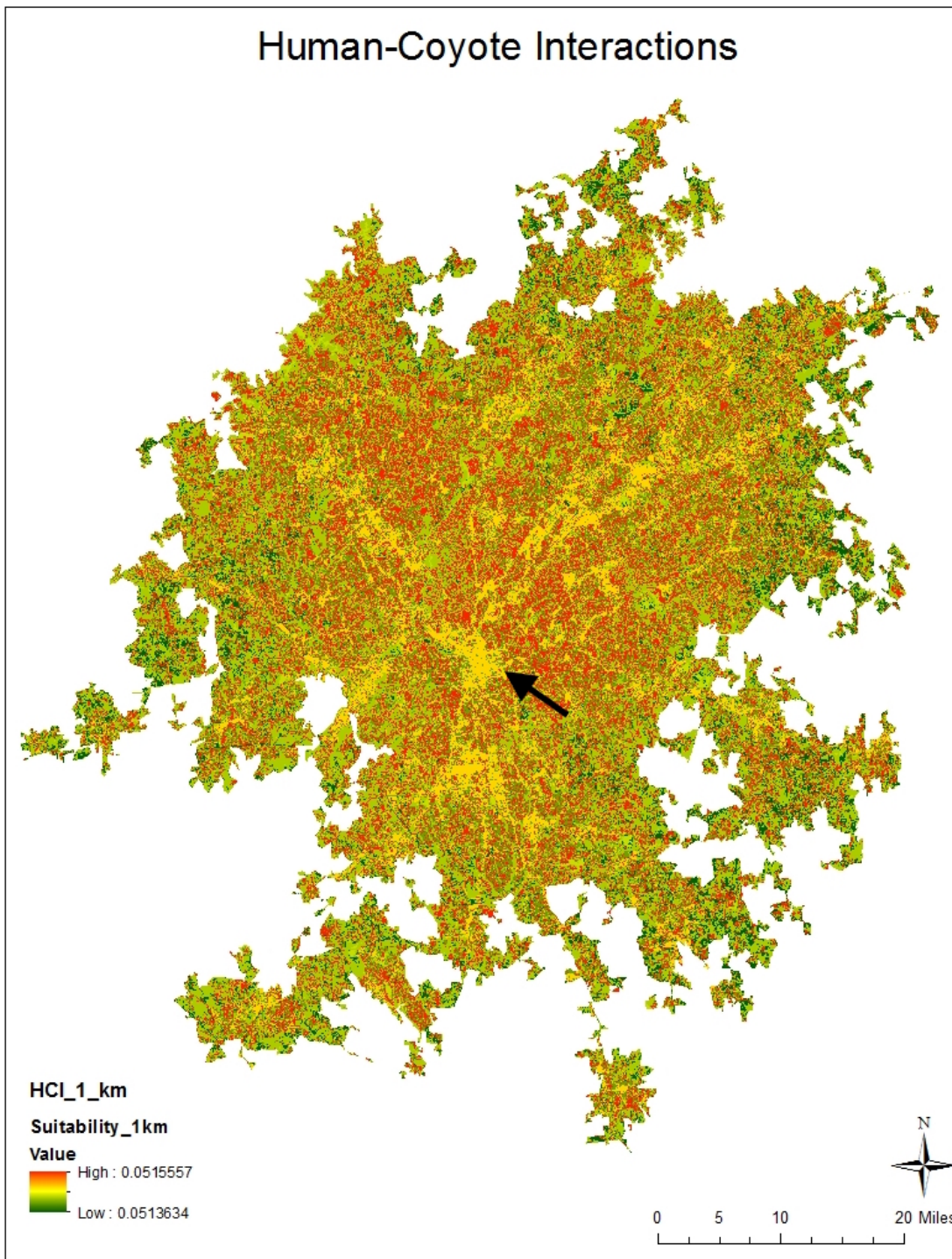
- 4) Did you search for your pet? Please describe your efforts.

- 5) If it were to have been found that a coyote did not attack your pet do you believe it would change your view at all about coyotes?

APPENDIX F3

HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 1.25 KM SCALE

Human-Coyote Interactions



APPENDIX G2

EXPLORATORY SEARCH FOR NEWS ARTICLES ILLUSTRATING THE USE OF INDIRECT
EVIDENCE IN DETERMINING A COYOTE ATTACKED A PET

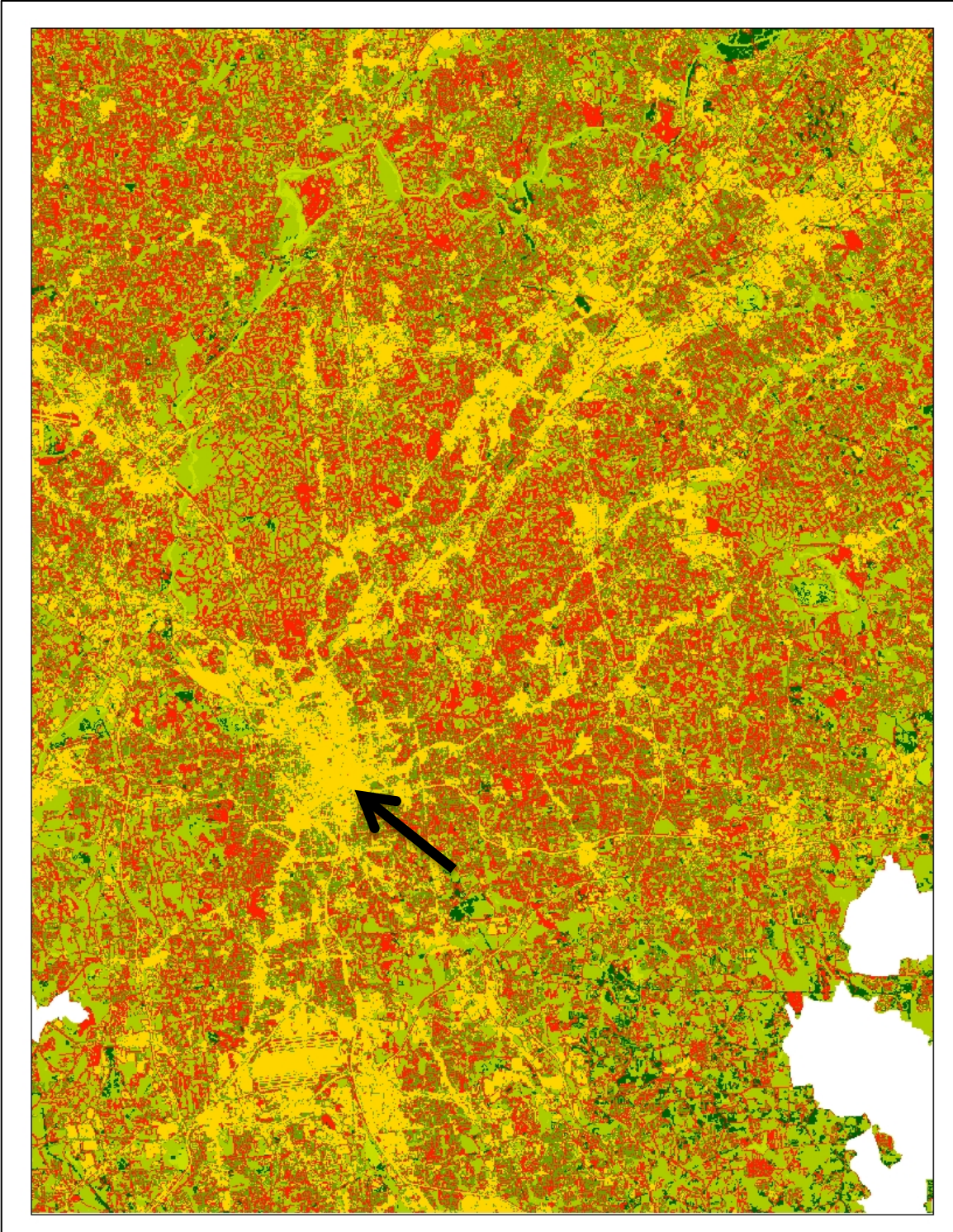
Title	Source
Tampa woman fears coyote killed her dog	http://wfla.com/2015/10/14/tampa-woman-fears-coyote-killed-her-dog/
Family dog attacked, killed by coyote in backyard of San Marino home	http://ktla.com/2015/05/25/family-dog-attacked-killed-by-coyote-in-backyard-of-san-marino-home/
Sheep killed in latest apparent coyote attack in New Jersey	http://www.nbcnewyork.com/news/local/Sheep-Killed-Apparent-Coyote-Attack-in-New-Jersey-302448321.html
Brevard county community protecting pets from coyotes	http://www.fox35orlando.com/local-news/21241868-story
Coyotes causing problems for residents near Cocoa	http://www.wftv.com/news/local/coyotes-causing-problems-residents-near-cocoa/27253189
Southridge neighbors say coyote killed their cats	http://www.nbcrightnow.com/story/30050234/southridge-neighbors-says-coyote-killed-their-cats
Dozens of coyote sightings in Mt. Pleasant; pet cats reported missing	http://counton2.com/2015/09/24/dozens-of-coyote-sightings-in-mt-pleasant-pet-cats-reported-missing/
Missing, killed pets prompt concern from Waco residents about coyotes	http://www.wacotrib.com/news/environment/missing-killed-pets-prompt-concern-from-waco-residents-about-coyotes/article_7fb2a4df-017b-5e63-88b0-15af2496f7b5.html
Varmint or victim?: Mountain view residents tackle growing coyote problem	http://www.losaltosonline.com/news/sections/inside-mountain-view/50876-varmint-or-victim-mountain-view-residents-tackle-growing-coyote-problem
Cat maulings by coyote prompt warning for pet owners	http://paloaltoonline.com/news/2015/08/18/cat-maulings-by-coyotes-prompt-warning-for-pet-owners
Coyote attacking small pets in Melbourne	http://www.mynews13.com/content/news/cfnews13/news/article.html/content/news/articles/cfn/2015/8/13/coyote_attacking_sma.html
Coyote attack in Greenville likely killed pet cat	http://wsps.com/2015/07/30/coyote-attack-in-greenville-likely-killed-pet-cat/
Missing Longmeadow pets may have become meals for predators	http://www.masslive.com/news/index.ssf/2014/11/missing_cats_in_longmeadow_sto.html
El Cerrito residents see number of cats disappearing	https://www.yahoo.com/news/video/el-cerrito-residents-see-number-082645339.html?ref=gs

Coyotes post risk to pets in suburban areas	http://www.cullmantimes.com/news/coyotes-pose-risk-to-pets-in-suburban-areas/article_cb3cb5a6-276a-11e5-bf17-2f2c58263167.html
Coyotes keep Punta Gorda residents on their toes	http://www.nbc-2.com/story/30119287/coyotes-keep-punta-gorda-residents-on-their-toes#.VxUgp2NUNFI

APPENDIX G3

HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 1.25 KM SCALE MAGNIFIED

WITH ARROW INDICATING DOWNTOWN ATLANTA



APPENDIX H2

SAMPLE SIZES OF REPORTED PET ATTACKS FROM VARIOUS STUDIES

	Poessel et al. 2012	Lukasik and Alexander 2011	Hooper and Straker, unpublished data	Don Carlos et al. 2013	Wieczorek-Hudenko et al. 2008
N=	4,006 ^{AG}	1,685 ^{BG}	6,603 ^{DG}	280 ^{CF}	2,598 ^{EF}
# of reported pet attacks	471 (11%)	38 (2%)	179 (2.7%)	11 (4%)	21 (<1%)

A: Sample represents reports obtained between 2003-2010.

B: Sample represents reports obtained between 2005-2008.

C: Samples represents reports of attacks that occurred between 2009-2013

D: Sample represents reports obtained between 2010-2015.

E: Samples represents reports, obtained in 2007, of a coyote "threatening" a pet

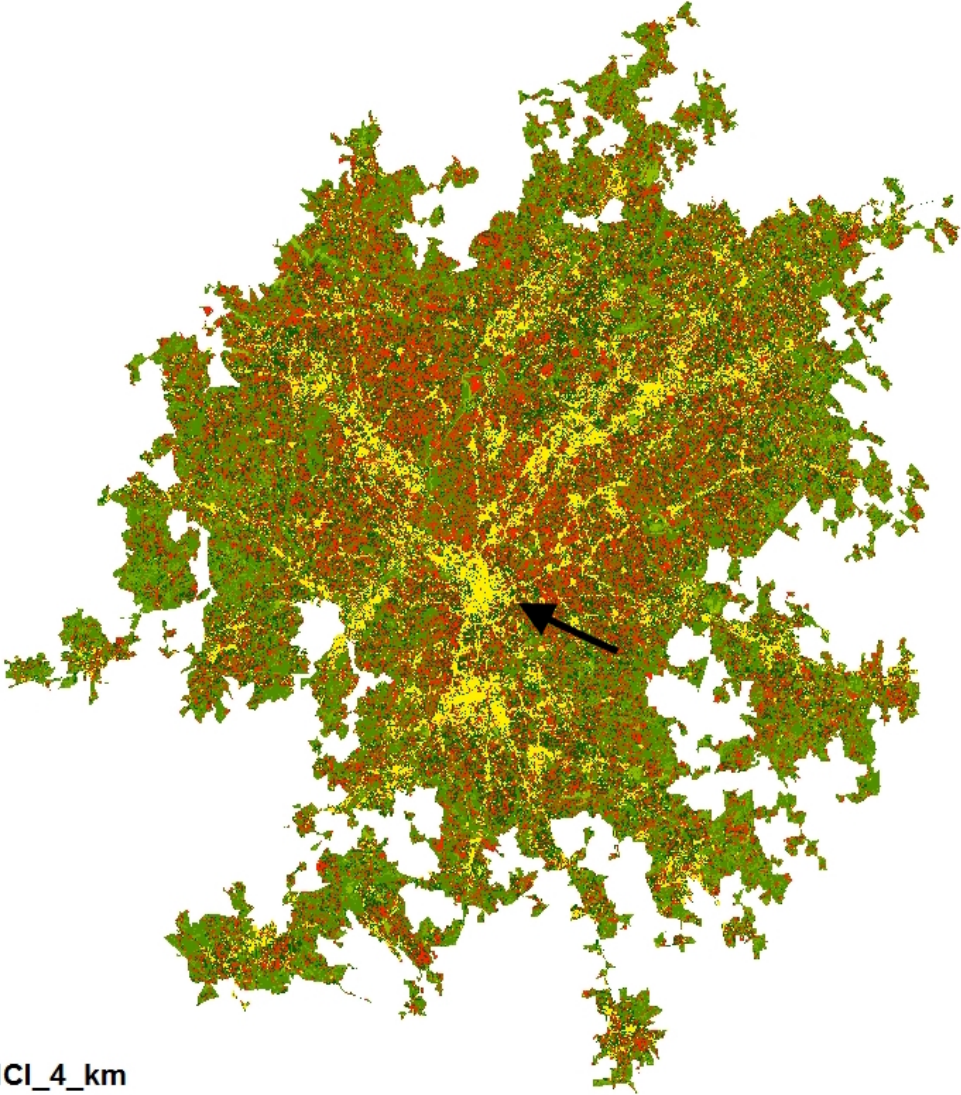
F: Represents a random sample

G: Represents a nonrandom sample

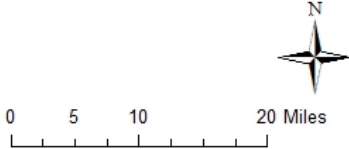
APPENDIX H3

HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 4 KM SCALE

Human-Coyote Interactions



HCI_4_km
km_4_suitability
Value
High : 0.027129
Low : 0.0271158



APPENDIX I2

SURVEY DISTRIBUTION MECHANISMS USED AND POTENTIAL POPULATION REACH

Distribution	Type	Estimated #	Facebook	Newspaper Circulation	Website
<i>NPU's</i>	Email	420,114 ^C	-	-	-
<i>Atlanta ABC affiliate Ch.2</i>	Website and Facebook	-	539,836 ^D	-	NA
<i>Atlanta Journal Constitution</i>	Newspaper and website	-	-	665,062 ^B	5,083,000 ^{AB}
<i>WABE NPR Atlanta</i>	Radio and website	-	-	-	>400,000 ^E

A: Unique visitors

B: Alliance for Audited Media 2014

C: City of Atlanta.gov

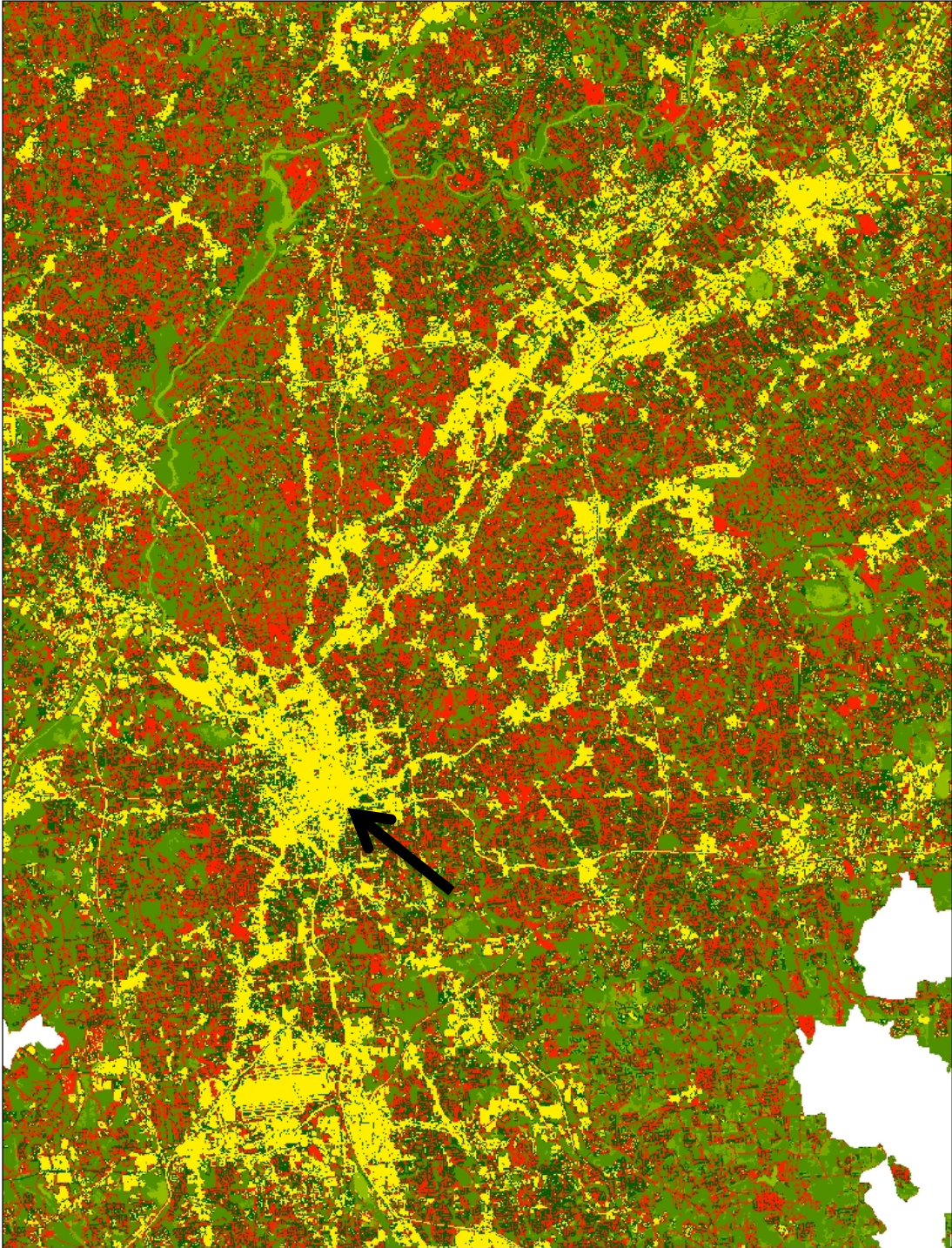
D: Represents the number of page followers at the time the survey was posted on their Facebook page

E: WABE 90.1 NPR Media Kit

APPENDIX I3

HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 4 KM SCALE MAGNIFIED

WITH ARROW INDICATING DOWNTOWN ATLANTA



APPENDIX J2

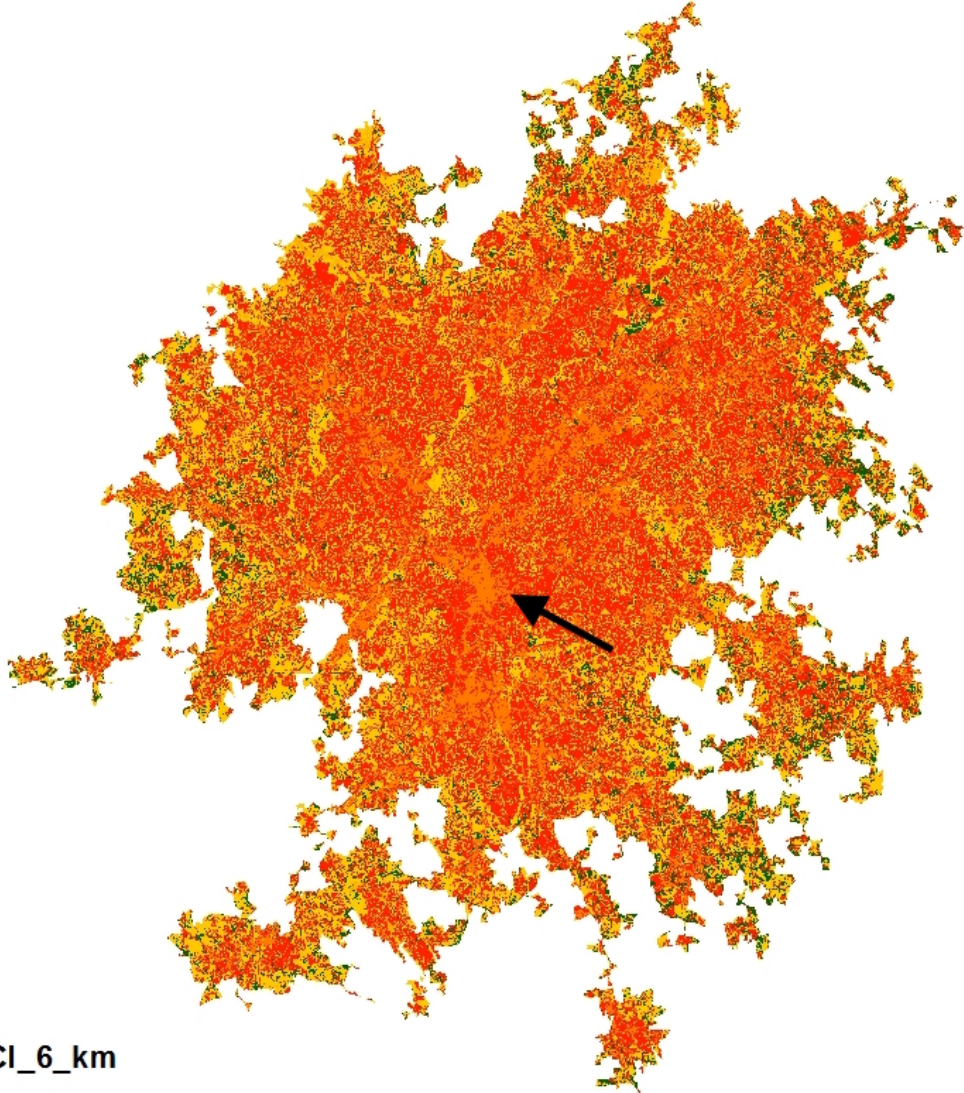
NEWS ARTICLES CLASSIFIED AS PRESENTING INDIRECT EVIDENCE

- 1) Coyotes make tracks in Metro
- 2) Coyotes: a very real danger in metro Atlanta. We can change that before it is too late
- 3) Coyotes blamed for death of family pet
- 4) Residents suspect coyotes of killing cats
- 5) Local agencies can't fix Buckhead coyote problem
- 6) Marietta resident: Coyote ate my cat
- 7) Coyote mauls Roswell family's dog
- 8) Dog mauling renews concerns about coyotes
- 9) Missing a pet peacock? Coyotes come to Atlanta
- 10) Coyote population explodes in metro Atlanta
- 11) Atlanta pest control company Team Pest USA warns Atlantans about recent coyote attacks
- 12) Coyotes continue to prowl Atlanta suburbs
- 13) Wild coyote attacks neighborhood pets
- 14) County by county news for Friday
- 15) Coyote trapped in area where missing pets are common
- 16) Coyotes spotted near elementary school
- 17) Coyotes attacks, eat family's pet goat
- 18) Woman says coyote attacked her cat at Lawrenceville apartment complex
- 19) Virginia Highland residents say coyotes to blame for disappearing pets
- 20) Coyotes on the prowl in Virginia Highland
- 21) Cobb residents complain of coyote attacks
- 22) East Cobb residents report increase in coyotes
- 23) Trapper catches coyote in Roswell neighborhood
- 24) As coyotes slink into Macon, locals wary of their wile
- 25) Cat stuck in tree for 5 days after coyote scare
- 26) Milton woman believes pack of coyotes killed at least 1 dog

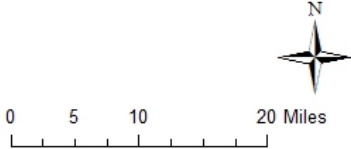
APPENDIX J3

HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 6 KM SCALE

Human-Coyote Interactions



HCI_6_km
6km_Suitability
Value
High : 0.0704217
Low : 0.0704092



APPENDIX K2

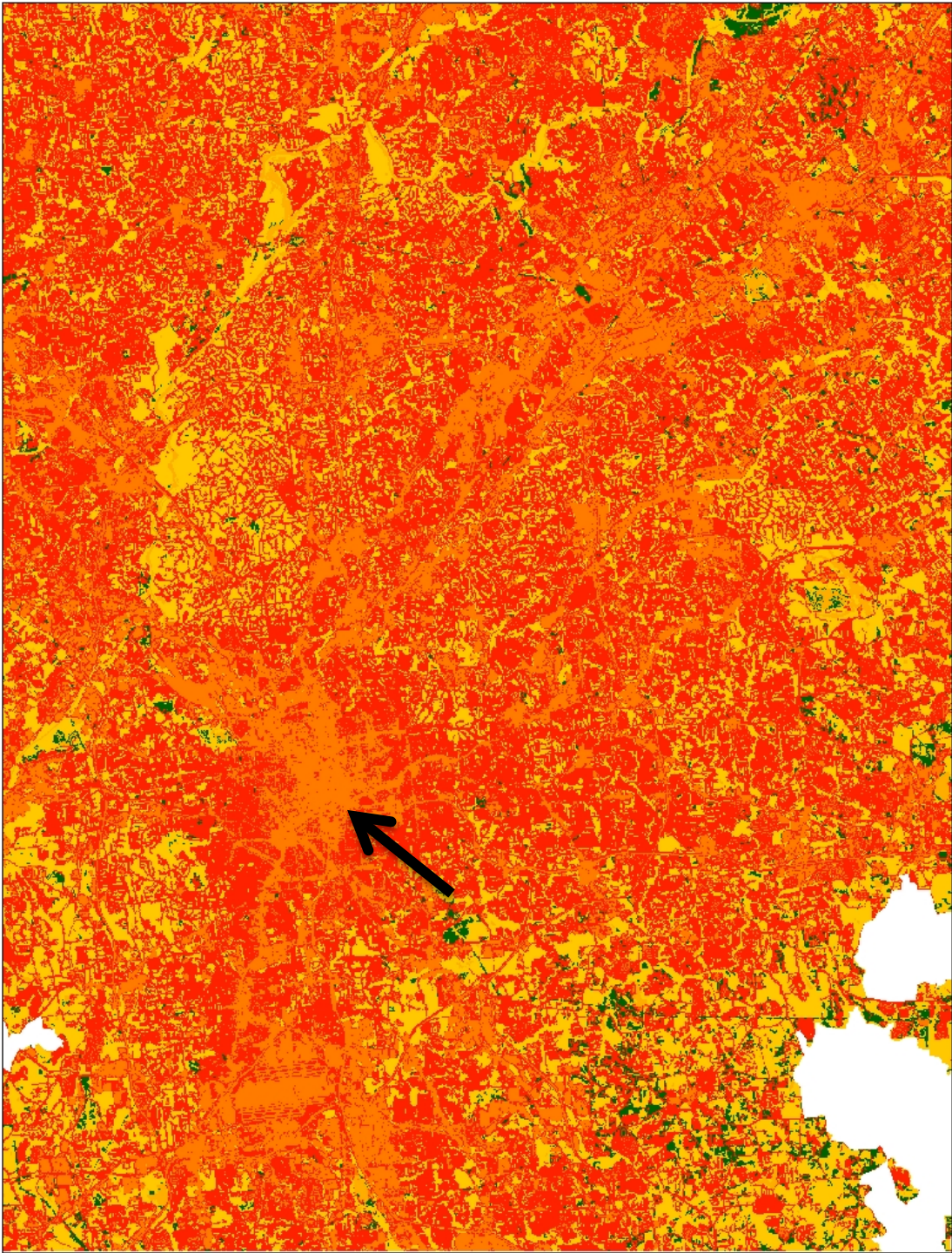
SOURCES FOR NEWS ARTICLE CLASSIFIED AS PRESENTING INDIRECT EVIDENCE

1. <http://www.11alive.com/news/article/78049/0/Coyotes-Make-Tracks-in-Metro>
2. <http://www.thedustininmansociety.org/private/bob.html>
3. <http://www.wsbtv.com/news/news/coyotes-blamed-for-death-of-family-pet/nJXCX/>
4. <http://www.wsbtv.com/news/news/residents-suspect-coyotes-of-killing-cats/nJRXn/>
5. <http://www.cbsatlanta.com/story/14770829/local-agencies-cant-fix-buckhead-coyote-problem-1-03-2011>
6. <http://www.cbsatlanta.com/story/14771345/marietta-resident-coyote-ate-my-cat-2-01-2011>
7. <http://www.ajc.com/news/news/local/coyote-mauls-roswell-familys-dog/nQS55/>
8. <http://www.cbsatlanta.com/story/17508719/dog-mauling-renews-concerns-about-suburban-coyotes>
9. <http://www.nytimes.com/2012/04/19/us/coyotes-come-to-atlanta-showing-predatory-side.html>
10. <http://roswell.11alive.com/news/news/112281-coyote-population-explodes-metro-atlanta>
11. <http://www.24-7pressrelease.com/press-release/atlanta-pest-control-company-team-pest-usa-warns-atlantans-about-recent-coyote-attacks-277762.php>
12. <http://www.accessnorthga.com/detail.php?n=247608>
13. <http://www.cbsatlanta.com/story/19005772/wild-coyote-attacks-neighborhood-pets>
14. <http://www.ajc.com/news/news/local/county-by-county-news-for-friday-74/nRMH8/>
15. <http://www.11alive.com/news/article/264948/40/Coyote-trapped-in-area-where-missing-pets-are-common>
16. <http://www.11alive.com/news/article/284422/40/Coyotes-sighted-near-elementary-school>
17. <http://www.ajc.com/news/news/state-regional/coyotes-attack-eat-goat/nW2NT/>
18. <http://www.wsbtv.com/news/news/local/woman-says-coyote-attacked-her-cat-lawrenceville-a/nYPWP/>
19. <http://www.wsbtv.com/news/news/local/virginia-highlands-residents-say-coyotes-blame-dis/nYYsS/>
20. <http://clatl.com/freshloaf/archives/2013/06/30/first-slice-63013-coyotes-on-the-prowl-in-virginia-highland>
21. <http://www.accessatlanta.com/videos/news/cobb-residents-complain-of-coyote-attacks/vCJcZT/>
22. <http://www.wsbtv.com/news/news/local/east-cobb-residents-report-increase-coyotes/nbxY8/>
23. <http://www.wsbtv.com/news/news/local/trapper-catches-coyote-roswell->

- [neighborhood/nfNGs/](#)
24. <http://www.macon.com/2015/01/23/3547380/as-coyotes-slink-into-macon-locals.html>
 25. <http://www.wsbtv.com/news/news/local/cat-stuck-tree-5-days-after-coyote-scare/nd4cp/>
 26. <http://www.wsbtv.com/news/local/milton-woman-believes-pack-coyotes-killed-her-2-do/53640713>

APPENDIX K3

HUMAN-COYOTE INTERACTION PROBABILITY MAP AT THE 6 KM SCALE MAGNIFIED
WITH ARROW INDICATING DOWNTOWN ATLANTA



APPENDIX L2

SELECT QUOTES FROM NEWS ARTICLE THAT PRESENT INDIRECT EVIDENCE

1. Before the coyotes showed up, Wages said the community had a problem with wild cats—not anymore. But the coyotes business is hunting- and neighbors here have learned to keep their pets close. After our cat disappeared, right down there at the end of our driveway a coyote was seen about six in the morning lying in the road. We think it was waiting for our other cat.
2. A neighbor reported hearing a squeal from our house and the bark of the coyotes that freely roam our county one Friday night while we were out to dinner. We never saw Bob again. Coyotes are literally everywhere. Reports are that coyotes are seen in Midtown Atlanta. Friends who work late on Marietta Square tell me they have seen coyotes there. Missing pet flyers begging for assistance in finding lost cats, and increasingly, small dogs, are a regular sight all over the metro. I agree with Dr. Malsby, Something has to be done.
3. Roaming coyotes in Cobb County are being blamed for the death of one family's pet near the Kennesaw Battlefield park, He was limping badly and his shoulder was ripped apart. David Allens saws along with his cat, five other missing pets in his neighborhood have also been killed by coyotes and he worries that the coyotes will go from attacking pets to people."
4. Katie Mull and her neighbors believe a pack of coyotes are prowling their Fairfax subdivision off Rucker Road in Alpharetta. We'd notice small pets have been disappearing and we'll either find the small pet or we find clumps of fur. In the last month, residents reported four missing cats. In most cases, the family pet never returns home. Neighbors believe coyotes are to blame.
5. Linda Dye said her cat Ethel Merman went missing in November. She put up fliers. Every time someone sees my fliers or runs into me they say, You know we have coyotes; that's probably what happened to her, Dye said. Neighbors hired a private trapping company. It makes Dye feel good knowing something is being done to prevent her other cats from falling prey to a coyote.
6. We've had sightings of coyotes coming down the streets, going into the neighbors' back yards, she's missing off the front porch, our cats been missing for four days. If I happen to see him, I will shoot at him [the coyote] or something, I have a .12 gauge pump gun.
7. Joe Feinberg said he and his wife were watching tv Saturday night when they heard a commotion in the back yard of their Shadowbrook Drive home. I know there were coyotes in the area and rushed to go outside. There he found his dog Abby seriously injured. The 40-pound, 4 year old Australian shepherd mix sustained three deep gashes—under her rib cage, on her right hip and on her

- rear. My guess is the coyotes were hunting and she was at the wrong place at the wrong time. He theorizes Abby was attacked by a group of coyotes. If that's the case, Georgia [officials] need to be much more worried than they are about the animals, Feinberg said. He said he opposed trapping coyotes before, but the weekend attack changed his mind. Feinberg said he now fears not only for his pet but for his daughter.
8. Same reported attack as in #7
 9. Same reported attack as in #7. Feinberg and residents have reported coyotes have taken their pet swans and peacocks.
 10. Same reported attack as in #7. Also, claims to have had geese decimated.
 11. Pest control company warns about pet attacks. Mentions same attack from #7. This attack makes it clear that coyotes in the Roswell area and elsewhere in the metro Atlanta area are becoming bolder with their aggression. Aggressive attacks on pets are becoming more commonplace and it is becoming more dangerous for children to unattended outside at night.
 12. Same reported attack as in #7
 13. A coyote attacked and killed a family's pet, and now neighbors are on edge after the wild animal made another surprise appearance-this time at the neighborhood pool. On Monday, a Chihuahua named Sassy was attacked by the wild coyote- her owner called 911 when she found the injured dog. I walked out on my front porch to find my Chihuahua walking up and she looked a little skittish and I thought, what's going on? Said Amy Baughcum, the dog's owner. And I looked and her feet had blood on them, and we looked on her side and she had a big open wound. Baughcum's neighbor also spotted the coyote after it cornered a neighborhood cat – she worries about her neighbor's animals too. Officials warn people to be aware of their surroundings and be coyote conscious; keep your pets indoors, but if you can't do that, make sure they're in a kennel or an enclosed area. They also warn people not to approach the coyote – officials worry the animal might be injured.
 14. The coyotes suspected of preying on smaller animals. Hapeville's leaders ask residents to keep a watchful eye on pets and bring them in each night.
 15. An animal trapper may have at least partially solved the case of the missing cats for one Vinings neighborhood. Wednesday morning, Tim Smith of Catch It Wild trapped a young coyote near a neighborhood that in an area frequented by wildlife and missing cat posters. The Rich family believes they lost their cat to

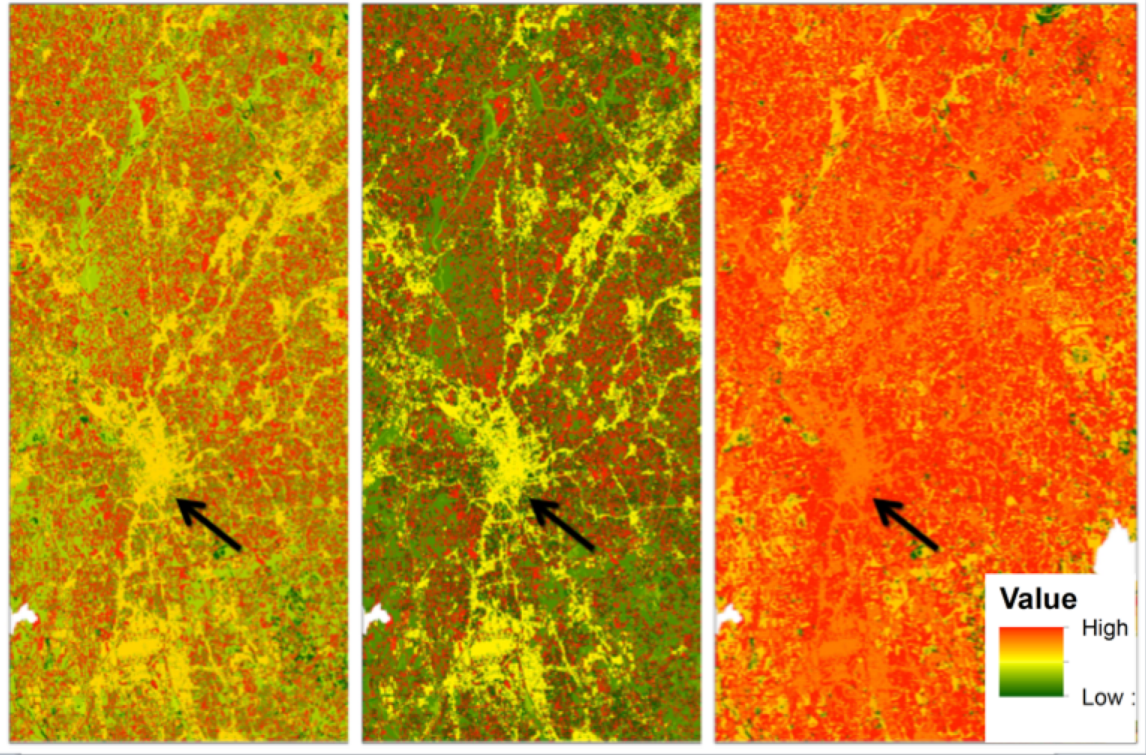
coyotes. Rich lives in the Paces Manor subdivision where, last week, one cat owner found his pet's collar, fur, and nothing more. He went out on a Friday night and never came back. The only thing we suspect is a coyote. The trapper has reportedly caught an estimated 20 coyotes in this area.

16. Several people living in the Northcrest neighborhood said they have heard the howls at night, seen the footprints during the day, and even had pets disappear.
17. Gordon Clement knows the killers are out there, waiting. They've taken one life; given the chance, they'll take another. On Thursday, the Alpharetta resident's wife discovered the bleeding, broken body of Charro, one of two goats living in a quarter-acre enclosure behind their home. The attackers had jumped a 5-foot fence. By the time Lynda Clement found its body, white fur splashed with red, Charro was dead. Coyotes prefer smaller prey. The Clements' goat weighed 90 pounds, which indicates more than one animal made the kill.
18. A Gwinnett County woman said she is scared to go outside at night after coming face-to-face with a coyote she believes attacked her cat. Wanda Campbell said her cat, Mister, has been in bad shape after an encounter with a coyote steps from her Lawrenceville apartment. Campbell said she heard screeching Sunday morning, and when she finally found Mister, his paw was mangled. There's a coyote running around here who's not afraid of people. There's children here that play. I hope they'll do something before something happens to somebody or somebody else's pet.
19. Some residents in northeast Atlanta believe a pack of coyotes is attacking and killing pets. At least eight dogs and cats have been reported missing. Carol Muelle told Davis one of her two miniature dachshunds disappeared from the back yard when a neighbor let them out for just a few minutes. Her neighbor found a puddle of blood in their backyard. It would be nice to see animal services to come own through here but apparently they don't do.
20. Same event from number 19. Some Virginia-Highland residents think a pack of coyotes living in a vacant lot might be partly responsible for the recent disappearance of nearly 10 pets.
21. Coyotes are attacking small pets in an east Cobb County neighborhood. Residents in Sibley Forest told Channel 2 Action News that nearly all of the outdoor cats have disappeared. We lost two cats ourselves, one of them right in the front lawn, said homeowner Tony Rogowski. We'll see the 'Pets Lost' up on the board on the way out of the subdivision, most of us usually know what happened to that pet. I just hope we start looking at solutions before we have a crisis, said Rogowski.

22. Residents in Roswell neighborhood are breathing a little easier Friday after trappers caught a coyote they say had been attacking pets. Russ King told Channel 2's Mike Petchenik small animals were turning up dead on his piece of property in Roswell so he hired a coyote trapper. One week later, they caught the culprit. A lot of people have pets in the neighborhood that they allow to go free, King said. There is still a trap on the property to catch the female coyote. The trapper hopes to do that before she has babies.
23. Not long ago, a feral cat that Petty had looked after for years disappeared. Coyotes? What else could have happened to her? Pet asked. Southeast of there, Shelby Cramer, who lives off Rivoli Drive, has seen five coyotes in her yard since last summer. She is convinced the bushy-tailed canids ate her cat.
24. There have been sightings, but one neighbor says a week ago someone's pet became a victim. About 30 feet up, a cat has been nestled in a tree for five days. The cat, neighbors are convinced is a victim of the coyote problem they're experiencing. Neighbors believe a coyote chased the cat up the tree and they're worried coyotes would turn on children and runners in the area. There are so many people here with small dogs, you know, small kids. These coyotes are pretty bad. We've seen three together at one time. I think they're growing. They want authorities to do something about the potential threat coyotes bring to the homes.
25. A Milton dog owner is warning other pet owners to be vigilant after she believes a pack of coyotes killed one of her dogs and a possibly a second. Anne Cease told Channel 2's Mike Petchenik she let three of her Papillons out behind her Phillips Circle Home late last month, but only one of them came back. I went out searching for them, calling them. They never don't respond, so I knew something had happened, Cease said. Cease told Petchenik she searched nearly two dozen acres of land near her home on Phillips Circles, but couldn't find the dogs. Then, a few hours, later, she said her husband found the body of one dog, Aslin, in the woods. It was obvious that probably a group of coyotes had gotten him because of the condition of his body, she said.

APPENDIX L3

COMPARISON OF 1.25, 4, AND 6 KM SCALE PROBABILITY MAPS MAGNIFIED WITH
ARROW INDICATING DOWNTOWN ATLANTA



VITA

Jeremy Hooper was born in Gadsden, AL, to the parents of Barry and Kim Hooper. He is the first of two children, having a younger sister. He attended Barksdale Elementary and continued to Clarksville High School in Clarksville, Tennessee. After graduation, he attended the University of Tennessee at Chattanooga where he became interested in human-wildlife conflict. Jeremy completed a Bachelors of Science degree in 2010 in Environmental Science with a concentration in Biology before entering the University of Tennessee at Chattanooga's Master's of Environmental Sciences program. Jeremy graduated with a Master's of Science degree in Environmental Science in August 2016. Jeremy is continuing his education in human-wildlife conflict by pursuing a Ph.D. degree at Clemson University.