BEYOND BAMBI AND BIG BUCKS: EXPLORING THE SOCIAL COMPLEXITY OF DEER MANAGEMENT IN INDIANA

by

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Dedicated to my father, Dan Stinchcomb, who passed before he could see me through this journey. I miss you every day and I wish I could share this work with you. Everything I do now carries a piece of you. I am proud to follow in your footsteps as the next Dr. Stinchcomb.

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ABSTRACT

Human interactions with white-tailed deer (*Odocoileus virginianus*) continue to change across the U.S. The growth of deer populations and urbanization of human populations have shifted values for wildlife away from traditional use toward mutual coexistence while simultaneously providing habitat for deer to thrive. Still, a mismatch exists between the reality of human-deer interactions and the management of them. Despite a changing social landscape, the human dimensions of deer management remain focused on hunting interests and the mitigation of crop damage to agricultural producers. Amid a national push to broaden wildlife 'stakeholders' to encompass all potential beneficiaries of wildlife, state wildlife agencies need to assess the needs and concerns of the broader public they serve to determine whether and how to engage non-traditional groups in wildlife management planning.

Recognizing these needs, the Indiana Department of Natural Resources (IN-DNR) partnered with Purdue University in 2018 to initiate the Integrated Deer Management Project (IDMP). As part of the IDMP, this dissertation comprises the first empirical assessment of social perceptions of white-tailed deer across Indiana. My research aimed to: (i) examine the initial context of human-deer interactions in Indiana and identify key social and cognitive factors that shape them; (ii) investigate how emotions, an understudied construct, interact with beliefs and attitudes to influence resident judgements about deer management; (iii) understand existing levels of satisfaction with deer management, potentials for social conflict over management approaches, and their social-ecological drivers; and (iv) develop indices and tools that can help IN-DNR officials better account for social perceptions and concerns in deer management planning. Due to a lack of prior knowledge about human-deer interactions in the state, I used an exploratory mixed-methods research design to address these objectives. I began by conducting 59 semi-structured interviews with residents around Indiana and two focus groups in the city of Bloomington (n=14) to understand their existing perceptions, beliefs, attitudes, and emotions related to deer and deer management. These interviews informed the development of a quantitative survey which I distributed to 6,000 residents across the state. I received 1806 completed surveys for a response rate of 33%.

My data show that social perceptions of deer and deer management remain complex, driven by dynamic feedbacks among emotions, personal experiences, livelihood and behavioral contexts, beliefs about deer management, and beliefs about other social groups. I found that mixed emotions, situational contexts, and perceived power imbalances play key roles in shaping and shifting deer-related cognitions, yet models of cognitive processing, and human-wildlife interactions more broadly, neglect these dynamics. Emotions, specifically, have been marginalized by researchers and practitioners, likely due to the perception that they represent irrational reactions rather than calculated judgements. Under different scenarios of encountering deer, however, I found that respondent emotions exert a mediating effect on their judgments about deer management, and that the type of deer encountered matters. Emotions thus work together with cognitions to process various stimuli in a human-wildlife encounter and reach a normative decision. I posit that understanding when and why emotional responses arise will help practitioners develop more effective and socially accepted approaches to wildlife management.

I next developed and analyzed indices of public satisfaction with the IN-DNR and potentials for social conflict over deer management approaches. I found that public satisfaction with deer management is nuanced and multidimensional. Cognitive variables like residents' perceived acceptability of management methods and their deer-related concerns most strongly predicted agency performance and quality measures of satisfaction, whereas demographic characteristics including self-identity, wildlife value orientation, and allowance of hunting on one's property exerted the strongest influences on trust components of satisfaction. Future studies should advance a multidimensional conception of satisfaction and associate it with key variables that I suspect underly satisfaction but were not captured in this study: perceived control, psychological distance, and norms of knowledge exchange between wildlife agencies and the public. Next, I found that potentials for social conflict over deer management varied with resident self-identities and management methods but showed more predictable variation with political ideologies. Geographically, hotspots of social conflict clustered around urban areas, indicating that cities and their residents should serve as a focus for public engagement efforts and mixed management strategies. Expanding agency conceptions of public satisfaction and social conflict represents a critical step towards broadening support for wildlife management and practicing good wildlife governance. I conclude by discussing barriers to integrating social and ecological data and the practicality of incorporating complex social dimensions into wildlife management planning.

CHAPTER 1. INTRODUCTION

Managing wildlife involves managing people and their interactions with wildlife. People impact wildlife habitat and behavior, and human-wildlife conflicts are driven largely by human-human conflicts over the values, use, and cultural meaning of wildlife (Dickman 2010, Redpath et al. 2013, Nyhus 2016). Social conflicts over wildlife also arise over different perceptions about wildlife management and whose interests it represents (Robbins 2006, Vernon and Clark 2016). Understanding existing perceptions about wildlife, public satisfaction with the managing agency, and the potential for future conflicts over wildlife management approaches will help practitioners begin to address social conflicts and better consider the people in management decisions.

Across the midwestern United States, white-tailed deer (*Odocoileus virginianus*) remain abundant, and human communities continue to urbanize, shifting the frequency and nature of human-deer interactions (Manfredo et al. 2020). For a variety of reasons, deer management in the region has been slow to adapt, remaining focused on maintaining hunting opportunities and mitigating impacts to agricultural livelihoods and public safety. Research on human-deer interactions also focuses narrowly on the interests of hunters and farmers or on the perceptions of hunting methods among non-hunting groups to inform a hunting-based management system (Diefenbach et al. 1997, Bath 1998). Yet values for mutualism and coexistence are expected to be increasing which can spur social conflicts over how wildlife should be managed (Manfredo et al. 2009, Dietsch et al. 2019). Leaving these changing values and public interests out of wildlife management decisions will reduce public trust in state agencies and hinder sustainable wildlife governance.

In Indiana, few studies have examined human-deer interactions. Corn and soybean producers have been included occasionally in ecological studies or national surveys on wildlife-induced crop damage (Wywialowski 1994, Humberg et al. 2007). Indiana has also been included in nationwide surveys about the acceptability of deer management methods among social groups (Messmer et al. 1997). Deer hunters are surveyed annually about their hunting activities, satisfaction, and more recently, their trust in the state wildlife agency. But only two studies have moved beyond the hunting and farming demographics to examine urban perceptions of deer and deer management (Stewart 2011, Knackmuhs and Farmer 2017). This limited literature suggests

that (i) public perceptions of deer vary with one's identity as pro- or anti-hunting; that (ii) urban residents hold unique concerns about the safety and ethics of deer hunting (Stewart 2011); and that (iii) residents' trust in their city's deer management decisions depends on evaluations of the decision-making process, preferences for hunting, and resident age (Knackmuhs and Farmer 2017). Taken together, these studies suggest that perceptions and behavior are not reducible to simply demographic data.

Apart from these studies, the social context of human-deer interactions in Indiana remains largely unknown. More targeted approaches are needed to understand how resident perceptions, experiences, emotions, and values related to deer vary across wider geographies and public interests. Moreover, empirical social research should move beyond descriptive surveys of deer-related perceptions to assess the situational, social, and cognitive factors that underly those perceptions and drive social conflicts over deer and deer management.

Recognizing these gaps in the current understanding of human-deer interactions in Indiana and the need to incorporate more diverse interests into deer management, the Indiana Department of Natural Resources (IN-DNR) partnered with Purdue University in 2018 to initiate the Integrated Deer Management Project (IDMP). The goal of the IDMP is to integrate biological, ecological, and social dimensions of deer management to improve the IN-DNR's deer management strategy. Specifically, the IDMP will help the IN-DNR conduct science-based management of deer populations and incorporate social science to better understand "the desires of all Indiana residents…beyond farming landowners and hunters." (IN-DNR 2018:online).

As part of the IDMP, my dissertation comprises the first empirical assessment of social perceptions of white-tailed deer across Indiana. Due to a lack of prior knowledge, I use an exploratory mixed-methods research design to better understand the values, beliefs, attitudes, normative judgements, and emotions of Indiana residents in relation to deer and deer management. I began with qualitative semi-structured interviews with 59 residents around Indiana and two focus groups in Bloomington (n=14) to understand their existing perceptions, beliefs, attitudes, and emotions toward deer populations and management in the state. I present these findings in chapter 1. Interviews informed the development of a quantitative survey which was distributed to 6,000 Indiana residents. I received 1,806 usable surveys for a response rate of 33%. I use the data from this survey to conduct three analyses, which I present in chapters 2-4. The first two chapters closely examine the interactions between residents' emotions and cognitions about deer, while the final

two chapters develop indices and practical tools for the IN-DNR to begin integrating social dimensions into deer management planning.

In chapter 2, I use qualitative interview data to explore the context of human-deer interactions among Indiana residents. Through thematic analysis, I demonstrate that resident perceptions of deer and deer management exist within a complex mental system involving feedbacks among emotions, personal experiences, livelihood and behavioral contexts, beliefs about deer management, and beliefs about other social groups. I discuss how mixed emotions, situational salience, and power dynamics challenge conventional management approaches which focus inadequately on mitigating human-deer conflicts and reduce public interests to narrow demographic categorizations. This chapter contributes a refined understanding of how multidimensional emotions and experiences influence public (dis)interest in wildlife management, and what this implies for managers who aim to balance competing social interests with ecological conditions.

Expanding on the influential role of emotions in chapter 3, I present a quantitative analysis of how emotions interact with other cognitions and the context of a human-deer interaction to influence resident judgements about deer management. In each of four hypothetical deer encounter scenarios, I model the structural relationships among general deer attitudes, mutualist wildlife beliefs, scenario-specific emotions, and scenario-specific acceptability of lethal deer control (i.e., hunting or culling). I find that emotions work together with cognitions to process stimuli in a human-wildlife encounter and come to a normative decision, but the strength of emotional influence depends on the type of deer encountered. Emotions mediate 14% of the effect of general attitudes on lethal control acceptability in the fawn encounter, and completely mediate this effect in the encounter with a diseased deer, but they show no effect when encountering a large buck nor a deer eating the nearest plants. Because emotions play a significant role in formulating people's perceptions of human-wildlife interactions, accounting for emotions in decision-making will help practitioners develop more effective and socially accepted approaches to wildlife conservation and management.

State wildlife agencies require practical methods and tools to integrate public perceptions into wildlife management planning and better realize the principles of public trust management and good governance (McNie 2006, Bennet et al. 2017, Pomeranz et al. 2021). Public satisfaction with wildlife management is a key component of good governance (Hendee and Potter 1971, Van

Ryzin 2014), but in the human dimensions of wildlife, its conceptualization remains limited to the satisfaction of traditional customers (i.e., hunters, anglers, recreators) with their outdoor experiences (Hendee 1974, Tian-Cole et al. 2002, Gruntorad et al. 2020). In chapter 4, I draw from literature in business, organizational studies, governance, and natural resource management to develop an index of public satisfaction with deer management based on service quality, agency performance, trust in the agency, and trust in information. I then use this satisfaction index in regression analyses to examine what variables explain whether residents are satisfied with and trusting of the IN-DNR and its management of deer. I find that residents' perceived acceptability of management approaches and deer-related concerns most strongly affected performance and quality measures of satisfaction, whereas demographic characteristics including self-identity, wildlife value orientation, and allowance of hunting on one's property exerted the strongest influences on trust. Future research should advance the multidimensional conception of satisfaction and associate it with key variables that I suspect underly satisfaction but were not captured in this study: perceived control, psychological distance, and norms of knowledge exchange between wildlife agencies and the public.

Social conflict over management methods presents another challenge for good wildlife governance and a critical issue for agencies to address if they wish to broaden public support for wildlife management (Lute and Gore 2014, Vernon and Clark 2016). In chapter five, I use a well-established method, the Potential for Conflict Index$_2$ (PCI_2), to quantify levels of social conflict over six deer management methods among (a) resident self-identity ('stakeholder') groups and (b) resident political ideologies. Advancing the utility of this index, I calculate PCI_2 values across Indiana and conduct a hotspot analysis to map areas of significantly high social conflict ('hotspots') and significantly low social conflict ('coldspots') over each of the six management methods. I find that social conflicts vary with resident self-identities and management methods but show more predictable variation with political ideologies. Political data may thus be more reliable and accessible than stakeholder categories for agencies to predict levels of social conflict over wildlife management. I also find that hotspots of conflict over lethal methods cluster around urban areas, indicating that the managing agency should focus on engaging with urban residents about deer management. Future analyses of the spatial relationships between social conflicts and ecological variables will advance agencies toward the social-ecological integration necessary for effective wildlife governance.

I conclude my dissertation with a synthesis of findings and what they imply for Indiana's deer management strategy moving forward. I pay particular attention to the complexity of human cognition and emotions, the challenges of integrating social and ecological data, and the practicality of including social dimensions in wildlife management planning. Despite several barriers, continuing to research human-wildlife interactions and working to incorporate the findings of such research into wildlife management strategies will help agencies practice good wildlife governance in the trust of a wider public.

1.1 References

Bath, A. J. 1998. The role of human dimensions in wildlife resource research in wildlife management. *Ursus* 10:349–355.

Bennett, N. J., R. Roth, S. C. Klain, K. Chan, P. Christie, D. A. Clark, G. Cullman, D. Curran, T. J. Durbin, G. Epstein, A. Greenberg, M. P. Nelson, J. Sandlos, R. Stedman, T. L. Teel, R. Thomas, D. Veríssimo, and C. Wyborn. 2017. Conservation social science: Understanding and integrating human dimensions to improve conservation. *Biological Conservation* 205:93–108.

Brown, G., C. McAlpine, J. Rhodes, D. Lunney, R. Goldingay, K. Fielding, S. Hetherington, M. Hopkins, C. Manning, M. Wood, A. Brace, L. Vass, and L. Swankie. 2019. Integration of social spatial data to assess conservation opportunities and priorities. *Biological Conservation* 236:452–463.

Dickman, A. J. 2010. Complexities of conflict: The importance of considering social factors for effectively resolving human–wildlife conflict. *Animal Conservation* 13(5):458–466.

Diefenbach, D. R., W. L. Palmer, and W. K. Shope. 1997. Attitudes of Pennsylvania sportsmen towards managing white-tailed deer to protect the ecological integrity of forests. *Wildlife Society Bulletin* 25(2):244–251.

Dietsch, A. M., M. J. Manfredo, L. Sullivan, J. T. Bruskotter, and T. L. Teel. 2019. A multilevel, systems view of values can inform a move towards human-wildlife coexistence. Pages 20–44 *in* B. Frank, J. A. Glikman, and S. Marchini, editors. *Human–Wildlife Interactions: Turning Conflict into Coexistence*. First edition. Cambridge University Press.

Gruntorad, M. P., J. J. Lusk, M. P. Vrtiska, and Christopher. J. Chizinski. 2020. Identifying factors influencing hunter satisfaction across hunting activities in Nebraska. *Human Dimensions of Wildlife* 25(3):215–231.

Hendee, J. C. 1974. A multiple-satisfaction approach to game management. *Wildlife Society Bulletin* 2(3):11.

Hendee, J.C., and D.R. Potter. 1971. Human behavior and wildlife management: needed research. *Transactions of the North American Wildlife and Natural Resource Conference* 36:383-396.

Humberg, L. A., T. L. Devault, B. J. Macgowan, J. C. Beasley, and O. E. Rhodes. Jr. 2007. Crop depredation by wildlife in Indiana. *Proceedings of the National Wild Turkey Symposium* 9:199–205.

Indiana Department of Natural Resources (IN-DNR). 2022. 2017-2022 Deer management goal. IN-DNR, Indianapolis, Indiana, USA. [online] URL: https://www.in.gov/dnr/fish-and-wildlife/wildlife-resources/animals/white-tailed-deer/deer-management-and-reports/

Knackmuhs, E., and J. R. Farmer. 2017. Factors influencing trust in a wildlife management agency: A case study of deer management in Bloomington, Indiana. *Journal of Park & Recreation Administration* 35(3):48–64.

Lute, M. L., and M. L. Gore. 2014. Stewardship as a path to cooperation? Exploring the role of identity in intergroup conflict among Michigan wolf stakeholders. *Human Dimensions of Wildlife* 19(3):267–279.

Manfredo, M. J., T. L. Teel, A. W. Don Carlos, L. Sullivan, A. D. Bright, A. M. Dietsch, J. Bruskotter, and D. Fulton. 2020. The changing sociocultural context of wildlife conservation. *Conservation Biology* 34(6):1549–1559.

Manfredo, M. J., T. L. Teel, and K. L. Henry. 2009. Linking society and environment: A multilevel model of shifting wildlife value orientations in the western United States. *Social Science Quarterly* 90(2):407–427.

McNie, E. C. 2007. Reconciling the supply of scientific information with user demands: an analysis of the problem and review of the literature. *Environmental Science & Policy* 10(1):17–38.

Messmer, T. A., L. Cornicelli, D. J. Decker, and D. G. Hewitt. 1997. Stakeholder acceptance of urban deer management techniques. *Wildlife Society Bulletin* 25(2):360–366.

Nyhus, P. J. 2016. Human–wildlife conflict and coexistence. *Annual Review of Environment and Resources* 41(1):143–171.

Pomeranz, E. F., D. Hare, D. J. Decker, A. B. Forstchen, C. A. Jacobson, C. A. Smith, and M. V. Schiavone. 2021. Successful wildlife conservation requires good governance. *Frontiers in Conservation Science* 2:76.

Redpath, S. M., J. Young, A. Evely, W. M. Adams, W. J. Sutherland, A. Whitehouse, A. Amar, R. A. Lambert, J. D. C. Linnell, A. Watt, and R. J. Gutiérrez. 2013. Understanding and managing conservation conflicts. *Trends in Ecology & Evolution* 28(2):100–109.

Stewart, C. M. 2011. Attitudes of urban and suburban residents in Indiana on deer management. *Wildlife Society Bulletin* 35(3):316–322.

Tian-Cole, S., J. L. Crompton, and V. L. Willson. 2002. An empirical investigation of the relationships between service quality, satisfaction, and behavioral intentions among visitors to a wildlife refuge. *Journal of Leisure Research* 34:1–24

Vernon, M. E., and S. G. Clark. 2016. Addressing a persistent policy problem: The elk hunt in Grand Teton National Park, Wyoming. *Society & Natural Resources* 29(7):836–851.

Wywialowski, A. P. 1994. Agricultural producers' perceptions of wildlife-caused losses. *Wildlife Society Bulletin* 22(3):370–382.

CHAPTER 2. COMPLEX HUMAN-DEER INTERACTIONS CHALLENGE CONVENTIONAL MANAGEMENT APPROACHES: THE NEED TO CONSIDER POWER, TRUST, AND EMOTION

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2.1 Abstract

In the United States, the management of white-tailed deer has typically focused on improving hunting opportunities and mitigating human-deer conflicts. Yet the expansion and diversification of human communities and activities implies that human-deer interactions may also be diversifying. Approaches based on complex adaptive systems theories have been posited as a way to better attend to the diversity of these interactions between humans and wildlife. Using Indiana as a case, this study draws from the Integrated Adaptive Behavior Model (IABM) to understand human-deer interactions as a complex system. We use empirical social science to understand how citizens across Indiana perceive deer populations, what outcomes they desire, and how these perceptions could be integrated into Indiana's deer management plan. In Indiana, neither wildlife managers nor researchers have assessed public perceptions of deer beyond hunting and farming stakeholders. From May to September 2019, we collected 59 semi-structured interviews and two focus groups (n=14) with deer stakeholders including woodland owners, farmers, deer hunters, and urban area residents. Through mixed inductive-deductive coding, we found that Indiana citizens hold complex emotions towards deer regardless of their stakeholder identity. Factors influencing these emotions include past experiences, current livelihood and behavioral contexts, beliefs about responsibilities and ethics in deer management, and beliefs about other social groups. Our results suggest that the IABM, despite adding in much-needed complexity and realism to the analysis of human-wildlife interactions, still lacks explanatory power over several important dynamics that emerged from our interviews. Here, we discuss how mixed emotions, situational salience, and power dynamics challenge conventional management approaches which focus narrowly on mitigating human-deer conflicts, and which reduce public interests to demographic categorizations. To better inform social-ecological governance, models of complex

human behavior should account for power within management institutions and across management scales. Our work contributes a refined understanding of how multidimensional emotions and experiences influence public (dis)interest in natural resource management, and what this implies for managers who aim to balance competing social interests with ecological conditions.

2.2 Introduction

Across the eastern and midwestern United States (U.S.), human interactions with white-tailed deer (*Odocoileus virginianus*) typify a complex and changing social-ecological system. This system exhibits multiple drivers of change, both episodic and abrupt (Holling 2001), to which human-deer interactions adjust in response (Chapin et al. 2009). Expanding human communities have created ideal 'edge' habitat for deer populations to thrive (Brown and Parker 1997). At the same time, expanding deer populations impact forest ecosystem dynamics, browse on economically important crops, and increase risks of vehicle collisions and disease spread (DeNicola et al. 2000; Rooney and Waller 2003). In response, deer management continues to rely on hunting to mitigate deer-related impacts, which incentivizes the maintenance of certain deer densities (Webster and Parker 1997, Gren et al. 2018, Serfass et al. 2018). Yet values for deer well-being, human-deer coexistence, and humaneness in deer management are proliferating in urban areas (Patterson et al. 2003, Manfredo et al. 2009, Dietsch et al. 2019), raising tensions between opposing social identities, ideologies, and normative behaviors like the lethal control and consumptive use of wildlife (Frank and Glikman, 2019). These reciprocal feedbacks among deer, humans, and environment comprise key dynamics of complex adaptive systems (CAS; Schlüter et al. 2012) and a critical lens through which we can analyze human-wildlife interactions.

Humans thus interact with deer in a multiplicity of ways, both within a single geographic area and even within a single individual. People not only value deer differently under different contexts of human-deer interaction, but also differentially weigh the acceptability of deer management methods based on their social identity, age, gender, area of residence, beliefs about hunting, and personal experiences (Dougherty et al. 2003, Dickman 2010, Hicks 2017). For instance, Michigan hunters and farmers do not share the concerns of nonhunting and nonfarming rural residents, who worry about the inhumaneness of deer hunting and risks to personal safety from large deer populations (Lishcka et al. 2008, Campa III et al. 2011). In a New York suburb,

male and female residents valued the consumptive use and well-being of deer differently, yet they shared values related to ecosystem protection (Lauber et al. 2001). Prior research has centered this variability around enumerable individual characteristics. Conversely, our research reveals that how people perceive deer is not entirely reducible to the demographic they occupy. In fact, certain aspects of deer become salient at different times or in different spaces for different people. Adding complexity to the system—in the sense of additional demographic variables—will not go as far towards understanding its dynamics as one might expect, because human-wildlife interactions adapt to individual, social, and ecological circumstances.

The complexity of these social-ecological systems remains difficult to deal with in research and practice. Without an applied framework that seeks to address the cross-scalar drivers underlying public perceptions of deer as a nuisance, an asset, or something in between, human-human conflicts over deer and management approaches tend to persist (Dickman 2010, Redpath et al. 2015). Here, we draw on a conceptual model that frames human decision-making as a CAS, the Integrated Adaptive Behavior Model (IABM, Jochum et al. 2014), to better characterize these drivers and their interactions in the human-deer system of Indiana. In Indiana and across the midwestern and eastern U.S., white-tailed deer remain the most abundant and charismatic species left on the local landscape, making them a great candidate for using the IABM lens to understand human-deer relationships and how they influence the larger social-ecological system. The IABM emphasizes that human emotions and cognitions, along with contextual factors, interact dynamically to process a wildlife encounter. We find, however, that the IABM omits dynamics of 1) power asymmetry, 2) trust, and 3) emotional multiplicity which emerged as critical variables explaining when and why people express certain attitudes towards deer or deer management. Paradoxically, this 'complex-systems' model serves to simplify the processes at work across cognitive-emotional and socio-ecological dimensions. Throughout this paper, we seek to illuminate how researchers and managers could overcome this paradox and reconceptualize human perceptions of wildlife as adaptive and not neatly divisible into demographic categories.

From conflict to complexity

Human-wildlife interactions in North America have historically been conceptualized through a conflict lens (Dickman 2010; Frank and Glikman 2019). Concomitantly, wildlife

management has emphasized the consumption and control of wild animals through recreational hunting and the lethal removal of 'overabundant,' 'problem,' or 'nuisance' wildlife (Yarbrough 2015, Peterson and Nelson 2017, Dietsch et al. 2019). Recent scholarship, however, has documented a public shift towards coexistence, including increasing non-consumptive, existence, and mutualist values for wildlife (Patterson et al. 2003, Manfredo et al. 2009). The construct of human-wildlife conflict thus not only represents a visible clash between human and wildlife populations; it also comprises hidden tensions among different social groups when the needs or values of those groups are not equally represented in decision-making (Patterson et al. 2003, Dickman 2010, Madden and McQuinn 2014). These human-human conflicts become deeply rooted in power imbalances, opposing social identities, and divergent perceptions of moral or ethical norms (Lute and Gore 2014, Peterson and Nelson 2017).

The field of Human Dimensions of Wildlife (HDW) arose in the 1970s to help managers understand such social-ecological conflicts (Decker et al. 2012). For decades, research in HDW examined human-wildlife interactions under a cognitive hierarchy framework, where abstract values influence more specific beliefs and measurable attitudes, which are used to predict behavioral outcomes (Whittaker et al. 2006). Here, we define values as "fundamental motivational goals that influence human thought and…behavior" (Dietsch et al. 2019:21) that tend to persist across time and contexts (Manfredo 2008). Research that focuses on attitudes and behaviors towards wildlife but neglects corresponding values therefore limits its generalizability beyond the original human-wildlife interaction (Dietsch et al. 2019). Other aspects of human cognition like emotions, personal experiences, and cultural meanings have only recently emerged as important constructs in HDW research, despite exerting evident influence on values, motivation, memory, information processing, and decision-making (Izard 2007, Jacobs 2012, Sponarski et al. 2015, Jacobs and Vaske 2019).

Research on emotions within the HDW field remains sparse and primarily focused on human interactions with carnivores, which elicit negative emotions like fear and intolerance (Manfredo 2008, Jacobs and Vaske 2019). This limited attention has been partly attributed to a pervading perception in management agencies that human emotions are irrational and subjective, and partly to methodological challenges of quantifying emotional responses (Manfredo 2008, Manfredo et al. 2009, Hicks 2017). Yet scholarship in environmental anthropology (Milton 2002, West 2006), conservation psychology (Castillo-Huitrón et al. 2020), and related disciplines

suggest that qualitative research using interviews, participant observation, or photo elicitation can ameliorate this by uncovering how emotions influence cognitions about wildlife and why this relationship changes across interaction contexts. As managers seek to engage more diverse publics, key questions to consider include: (i) how different emotions, meanings, and values related to wildlife can be balanced; and (ii) how conflict can be reduced and coexistence promoted, not only between humans and wildlife, but among diverse social groups? (Jacobs and Vaske 2019). These questions require more comprehensive understanding of stakeholders' emotions towards different wildlife species, how emotions interact with cognitions to influence attitudes and behaviors, and what role social, political, and environmental factors play.

Recognizing that cognitive and emotional systems operate in a coupled, dynamic interaction, social psychologists have proposed integrated models of human decision-making in response to environmental stimuli (Manfredo 2008, Jacobs 2009). One such model, the Integrated Adaptive Behavior Model (IABM, Jochum et al. 2014), integrates multiple theories of human cognition into a mental system wherein cognitive, emotional, and contextual components operate simultaneously to process a wildlife encounter, assign it meaning or relevance, and influence behavioral intentions and outcomes (Figure 2.1). Applied to human-wildlife interactions, these feedbacks help to explain why we express different emotions when we see a predator in the wild as opposed to in a zoo, or why some individuals feel very strong emotions when they see charismatic wildlife and others do not (Jacobs and Vaske 2019). In this model, salient personal experiences also feed back into an individual's belief system, shifting existing beliefs and attitudes towards wildlife or wildlife management. The IABM also recognizes that when and where a wildlife encounter occurs differentially influence attitudinal and behavioral outcomes. These *scale* components include spatial proximity to the animal, temporal proximity to the encounter, and the encounter environment. Such ecological dimensions remain crucial to consider when analyzing human-wildlife interactions (Nyhus 2016). Thus far, however, the IABM has been used very sparsely to research human-wildlife interactions *in situ* (Jones et al. 2016, Pooley et al. 2017, Booth and Ryan 2019).

This evolution of ideas about how humans interact with wildlife reflects the complex and adaptive nature of human-wildlife systems and human-environment systems more generally. Here, we advance this thinking by applying the IABM to conceptualize individuals' perceptions of deer in Indiana as comprised of multiple feedback loops among cognition, emotion, and experience,

and influenced by diverse social, environmental, and scalar factors. From a management perspective, understanding the feedbacks among wildlife-related experiences, emotions, and beliefs can elucidate the social dynamics that perpetuate conflicts over wildlife. Scholars broadly agree that better understanding the dynamics of social and ecological complexity is necessary to overcome natural resource management conflicts (Liu et al 2013). Yet increasing evidence suggests that current approaches to understanding complex ecological systems do not adequately account for human perceptions, experiences, and behaviors, and thus represent fragile or even misleading sources of insight for managers (Helmreich 2000, Lansing 2000, Peterson et al. 2010, Orr et al. 2015). Thus, we employ the IABM as a robust tool for understanding human interactions with the environment. We also assess its limits to consider what additional factors are needed for CAS frameworks to sufficiently explain how, when, and why people perceive wildlife in different ways.

Study context: Human-deer interactions in the Midwest

Across the midwestern U.S., deer populations continue to proliferate, and human communities continue to urbanize, shifting the frequency and nature of human-deer interactions. For a variety of reasons, human-deer research and management in the region have been slow to adapt, remaining focused on the measurable impacts that deer exert on agricultural livelihoods and public health and safety. Even when experiencing these impacts, however, people enjoy seeing herbivores around their community, much more so than predators (Booth and Ryan 2019). Both negative and positive experiences unequally affect nonhunting and nonfarming stakeholders (Lischka et al. 2008, Campa III et al. 2011), but hunting interests still drive deer management decisions towards the maintenance of a huntable population (Jacobson et al. 2010, Serfass et al. 2018, Sullivan 2019). Accordingly, research on human-deer interactions has either involved only hunters and farmers or examined perceptions of hunting methods among non-hunting groups to inform a hunting-based management system (Diefenbach et al. 1997, Bath 1998).

Some human-deer research exists for Illinois (Mankin et al. 1999, Urbanek and Nielsen 2012, Urbanek et al. 2015, Hicks 2017), Ohio (Dougherty et al. 2003), and Michigan (Lischka et al. 2008, Marcoux and Riley 2010, Campa III et al. 2011). Most of these studies employ surveys to quantify social perceptions of deer populations and management approaches. Only a select few

have explored how gender, ethical judgements, and emotions influence beliefs about deer and evaluations of deer management decisions (Lauber et al. 2001, Dougherty et al. 2003, Hicks 2017). Their findings suggest that women tend to have greater concern than men for the unintended consequences of deer culling, like reduced access to public parks, impacts on pets or other wildlife, and noise or safety concerns (Lauber et al. 2001, Dougherty et al. 2003). Such differences suggest that cognitive processing is conditioned by prevailing gender socialization (Gilligan 1995, Noddings 1995), with women basing their "attitudes about lethal control on underlying beliefs and values, more so than male respondents" (Dougherty et al. 2003:621). Finally, Hicks (2017) provides qualitative evidence that emotional experiences pervade human reasoning about deer across public and professional spheres, but individual reflections on those emotions change with experiential learning and institutional contexts.

Few HDW studies have focused on human-deer interactions in Indiana. Corn and soybean producers have been surveyed occasionally to supplement ecological studies on crop depredation (Humberg et al. 2007). Indiana has been included in nationwide surveys on producer perceptions of wildlife-induced crop damage (Wywialowski 1994) and the acceptability of deer management methods among social groups (Messmer et al. 1997). Only a few studies have moved beyond the farming demographic to examine urban perceptions of deer and deer management (Stewart 2011, Knackmuhs and Farmer 2017). This limited literature suggests that deer-related perceptions can vary with one's identity as pro- or anti-hunting, and urban residents typically hold various concerns about the safety and ethics of deer hunting (Stewart 2011). A recent study of residents in Bloomington, Indiana, found that trust or mistrust in the city's decisions to cull deer within Griffy Lake Nature Preserve depended on how residents evaluated the decision-making process and scientific information about the preserve's deer population, as well as resident preferences for hunting and their age (Knackmuhs and Farmer 2017) Taken together, these studies suggest that perceptions and behaviour are not reducible to simply demographic data.

Apart from these studies, however, the social context of human-deer interactions in Indiana remains largely unknown. More fine-grained qualitative approaches are needed to understand how resident perceptions, experiences, emotions, and values related to deer vary across wider geographies and public interests. Moreover, studies should aim to move beyond descriptive surveys of deer-related perceptions to assess the environmental, social, and cognitive factors that underly those perceptions and drive social conflicts over deer and deer management.

Research motivation and questions

The present study follows a transition in the Indiana Department of Natural Resources (IN-DNR) under which the agency recognized a need to conduct science-based management of deer populations, including empirical social science to better understand "the desires of all Indiana residents…beyond farming landowners and hunters." (IN-DNR, 2018: online). Until 2017, the state had collected little data on how its residents interact with deer, nor how they feel about deer populations and management. The motivation for this study is to assess the general context of deer-human interactions across Indiana and whether and how those interactions vary among typical deer stakeholder groups. We are also interested in residents' perceptions of deer management and the changes they would like to see. Specifically, this paper addresses three interrelated research questions: (i) How do Indiana residents value, perceive, and experience white-tailed deer populations? (ii) What outcomes do they desire from deer management (and why)? and (iii) What role do emotions and personal experiences play in shaping beliefs about deer and deer management?

2.3 Methods

Conceptual framework guiding data collection and analysis

Guided by the IABM, we conducted semi-structured interviews with residents across Indiana to collect data on their perceptions of, experiences with, and emotions towards white-tailed deer, and to analyze how these cognitive factors interact to influence their beliefs about deer management. Specifically, we examine how key contextual factors, such as livelihood and land management practices, components of scale, and salient political events—influence individual perceptions and emotions around deer. We then focus on the interactions of values, motivations, and experiences with emotions and how they feed back into an individual's belief system (Figure 2.1). Finally, we home in on power dynamics in deer management, an emergent but highly influential factor in shaping individuals' emotions and beliefs related to deer and wildlife more broadly.

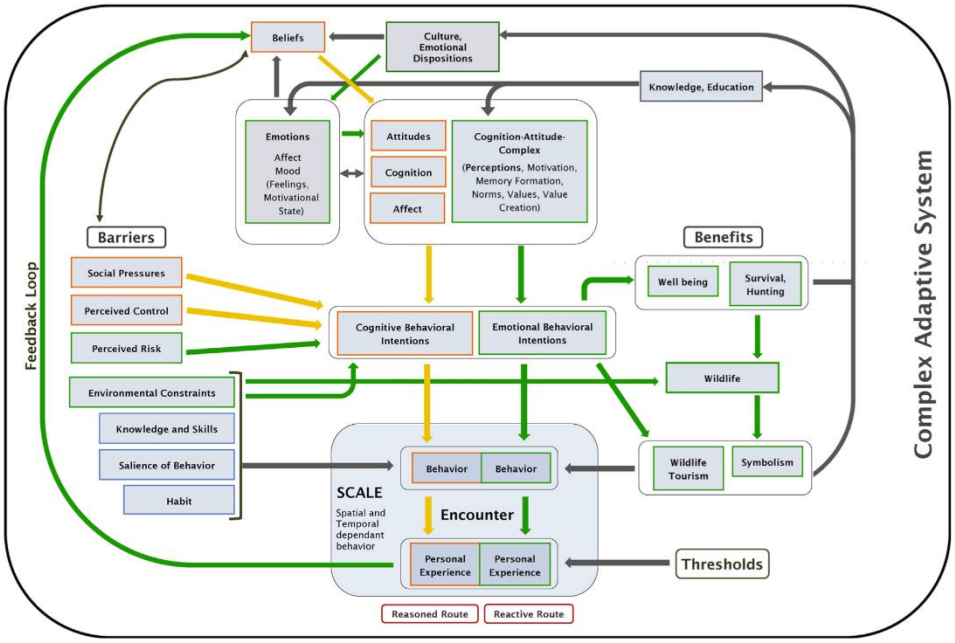

Figure 2.1. The Integrated Adaptive Behavior Model of human-wildlife encounters (IABM). From Jochum et al. (2014:80), Figure 2. "Yellow/light gray markings refer to components that derived originally from the Theory of Reasoned Action and the Theory of Planned Behavior. Green/medium gray markings refer to theories developed in emotions toward wildlife research. Blue/dashed marks additional components recognized in the Integrated Behavioral Model. Dark gray markings are based on Complexity Theory and components were connected by the authors. The importance of scales is displayed as overarching. The Reasoned and Reactive Route concept is based on Fuzzy Trace Theory. The Reasoned Route is based on cognitive principles (yellow/light gray arrows); the Reactive Route is based on emotional principles (green/medium gray arrows). Inhibitory and excitatory links between emotions and cognition are based on The Parallel Constraint Satisfaction Model."

Data collection and analysis

Our research was open-ended by design and encompassed the state of Indiana to scale to state-level management practices. For our sample population, we focused on four broad deer stakeholder groups: farmers, woodland owners, urban area residents, and deer hunters. In wildlife management, the term 'stakeholder' commonly refers to any individual or social group whose interest (or 'stake') significantly affects or is significantly affected by wildlife and/or wildlife management decisions (Decker et al. 2012). A 'stake' comprises any recreational, economic, cultural, social, or health and well-being impact or benefit derived from interacting with wildlife

(Decker et al. 1996, 2012). While hunters and farmers have been traditionally considered the primary stakeholders in deer management, we also consider woodland owners and urban area residents as stakeholders to obtain a more inclusive perspective of the impacts and benefits of deer populations in Indiana. We recognize that deer stakeholder groups are often not mutually exclusive. Yet respondents often see themselves as members of a primary group with a clear identity when it comes to deer interactions (e.g., primarily through the lens of hunter, landowner, etc.). Moreover, conventional management approaches commonly use this kind of categorization based on stakeholder identity. Thus, we employ traditional stakeholder categories because respondents readily self-identified as such for sampling purposes. At the same time, we use this grouping structure to test the validity of such categorizations in wildlife management through open-ended qualitative analyses, the coding strategy for which does not rest on stakeholder categorization.

We conducted 59 semi-structured interviews with deer stakeholders throughout Indiana from May to September 2019. Prior to data collection, our study design was approved by the Institutional Review Board of Purdue University (approved protocol #1902021653). The lead author conducted all interviews either in person or over the phone, depending on the interviewee's preference. Since relatively little is known about the context of human-deer interactions in Indiana, a semi-structured approach allowed our respondents to answer our questions openly and provide detailed accounts of their deer-related views and experiences. This qualitative approach provided in-depth understanding (Henderson 1991, Mangun et al. 2007, Schutt 2018) of how different residents perceive deer populations, deer management, and their relationships to each.

Our interview protocol included questions about personal observations of deer populations and changes, experiences with and feelings about deer, and individual behaviors taken in response to deer presence or impacts. We also inquired about interviewees' experiences with the IN-DNR and deer hunters or hunting; their beliefs about deer management responsibilities and public engagement; and their desired changes for deer management in Indiana. We collected additional information about the interviewee's educational and occupational background, length of residence in Indiana, time spent in the outdoors, and general feelings towards wildlife.

To recruit study participants, we used purposive sampling to maximize representation (Creswell and Clark 2018) and snowball sampling to recruit interviewees within social groups (Neuman 2011). Both are non-probability sampling strategies commonly used in qualitative

research. Together they allow researchers to recruit study participants who provide an in-depth understanding of people's emotions and experiences in their social settings (Neuman 2011, Corbin and Strauss 2015). First, we sent recruitment emails to the administrators of stakeholder organizations who then forwarded our request on to their member email lists. These organizations included the Indiana Forest and Woodland Owners' Association, the Indiana Bowhunters' Association, the Indiana Deer Hunters Conservation Alliance, the Indiana Deer Hunter Association, Neighborhood Associations from seven major urban areas in the state, the Indiana Farm Bureau, and Soil and Water Conservation Districts from 22 counties. We continued our sampling until we reached data saturation within each stakeholder group (Guest et al. 2006), which generally occurred at 11-13 interviews.

We also conducted two focus groups in September 2019 with residents of Bloomington, Indiana, to accommodate strong interest in participating in our study. Situated in south-central Indiana amid a heavily forested landscape, the development of Bloomington has created extensive 'edge' habitat that is ideal for deer populations to forage and thrive (Brown and Parker 1997, INDFW 2011). Deer can thus be seen daily in the Bloomington area, resulting in more frequent and widespread human-deer interactions compared to cities in northern Indiana (e.g., Indianapolis, Fort Wayne, South Bend). Each focus group had seven participants, lasted about 1.5 hours, and covered the same thematic topics as our interviews.

Focus groups also allow for extended discussion among participants that add a dimension of exchange and group understanding beyond what emerges from individual interviews (Morgan 1996, Minnis et al. 1997). For instance, one resident who expressed strong mutualist values for deer acknowledged halfway through the focus group discussion that they realize the need to control deer populations for public health and safety reasons. Although shifts in opinion may be transient or subject to interpersonal dynamics in small group dialogues such as focus groups (Barbour and Kitzinger 1999), the plasticity of opinion also highlights the potential for collective processes to achieve compromise among diverse individuals on otherwise controversial issues like wildlife management. Since we did not focus our research on these interpersonal dynamics, we analyzed focus group and interview data together using the same thematic coding approach.

We first transcribed all interview and focus group recordings. We then conducted thematic analysis (Saldana 2016) of all transcripts using NVivo 12, a qualitative analysis software. Our analysis took an abductive approach, whereby our overarching themes like beliefs, emotions,

experiences, behaviors, changes, and barriers were deductive (i.e., driven by our research questions and key components of the IABM), but we simultaneously allowed for new, unanticipated themes and sub-themes to emerge inductively from the interviews (DeCuir-Gunby et al. 2011). During our coding process, we implemented strategies for intercoder agreement, which involves two or more qualitative researchers reconciling their independent coding of the same text "through discussing whatever coding discrepancies they may have" (Garrison et al. 2006, Campbell et al. 2013:297). Specifically, the lead author developed the first preliminary codebook which was then used by four peer researchers and the lead author to independently code and analyze four interview transcripts. All five coders came together to discuss their coding, focusing on any incongruities in codes and interpretations that arose (Hruschka et al. 2004, Campbell et al. 2013). The lead author subsequently revised and condensed codes to reduce complexity. The codebook went through three rounds of this discursive revision process before intercoder agreement was reached. Upon agreement, the lead author finalized the codebook and applied it to code all interview transcripts. An additional coder assisted the lead author with coding the final interview transcripts, increasing the likelihood of objectivity and decreasing bias (Church et al. 2019). All thematic analysis of the coded interviews was conducted by the lead author and completed in June 2020.

2.4 Results

A total of 59 individuals were interviewed (15 woodland owners, 16 hunters, 11 farmers, and 17 urban residents), and an additional 14 individuals participated in our two focus groups (Table 2.1). Outside of the urban resident group, all but four of our interviewees were white males (Table 2.1). In our final sample, the places where interviewees live and/or hunt cover a wide distribution across Indiana (Figure 2.2).

Regardless of their stakeholder identity, many Indiana residents express mixed emotions towards white-tailed deer. These mixed emotions typically involved an appreciation or awe towards seeing deer, but frustration with deer-related damage to crops, trees, shrubs, ornamentals, or gardens, and anxiety over perceived risks to personal safety. Many interviewees also expressed a change in deer-related emotions over time. Their feelings typically shifted from excitement, novelty, or enjoyment at the sight of deer to frustration, resentment, or anxiety over the risks that deer pose, and the financial or aesthetic losses incurred from deer-related damage. Several others,

who have resided in Indiana for a lifetime, shifted from awe and enjoyment upon seeing a deer to stark indifference as deer sightings became a common occurrence. Here, we explain the nuances of these changes in emotions and key factors at play in the human-deer interaction system.

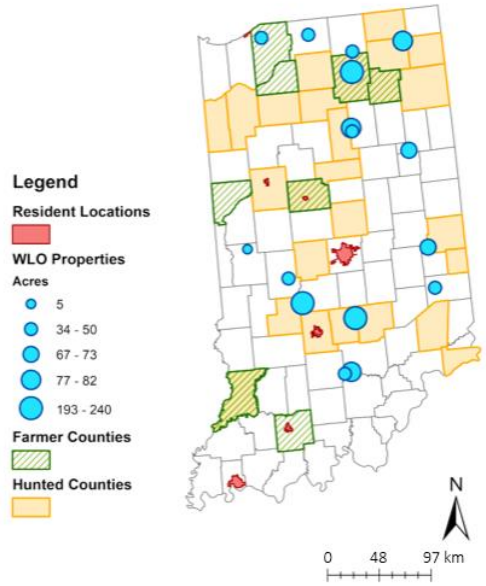

Figure 2.2. Counties and locations across Indiana represented by interview participants from four deer stakeholder categories: urban area residents (17 interviewees plus 14 individuals in a focus group in Bloomington, IN), woodland owners (WLO; 15 interviewees), farmland owners and producers (11 interviewees), and deer hunters (16 interviewees). Locations are where participants live, manage land, and/or hunt, not necessarily where the interview took place. Many hunters hunt multiple counties. County names were given by interviewees during one-on-one interviews. WLO property sizes were also stated during interviews, and property locations were identified by landowner name and/or tax address using the online GPS mapping platform, OnX. (OnXmaps, 2020). Resident locations represent the municipal boundaries of urban areas, downloaded from the IndianaMap public GIS database (Indiana Geographic Information Council, 2019).

Table 2.1. Summary of interviewees from four deer stakeholder groups across Indiana and participants from two focus groups in Bloomington, Indiana. Semi-structured interviews were conducted May-Sept., 2019 and focus groups were held on a weekend in early Sept., 2019.

Stakeholder Group	**n**	**% Male**	**% Female**
Woodland Owners	15	93	7
Farmers	11	73	27
Hunters	16	100	0
Urban Area Residents	17	53	47
Indianapolis	*4*	*75*	*25*
Greater Lafayette	*2*	*50*	*50*
Beverly Shores	*4*	*50*	*50*
Evansville	*3*	*67*	*33*
Bloomington	*4*	*25*	*75*
Subtotal (Interviewees)	**59**	**80**	**20**
Focus Group Participants	14	29	71
Group 1, Bloomington	7	43	57
Group 2, Bloomington	7	14	86
Total	**73**	**70**	**30**

Key contextual factors in the human-deer system

We found that emotions expressed towards deer depend on a suite of situational factors, including people's livelihood, involvement in land management activities, participation in environmental programs or outdoor recreation, when and where deer are encountered, prior experiences with deer or deer management, and current socio-political circumstances. The interviewee's livelihood or land management activities were seen to be the most influential factor shaping their feelings towards deer. When deer interfere with crop and timber yields or hardwood forest regeneration, they elicit frustration and blame. As one woodland owner explained, it *"take[s] a lot of work and expensive money"* to *"replace the walnuts…in our woods" and the deer "come up every night…and they browse around, biting [the walnut seedlings] off"* (WLO08).

Conversely, when deer minimally affect livelihoods or land management practices, landowner emotions remain largely positive or tolerant. For example, woodland owners *"enjoy watching the deer"* when they have *"a fairly mature woods"* (WLO13) while farmers who *"don't*

raise soybeans for a living" view deer damage to non-market crops as *"inconsequential"* (FARM05). One farmer expressed love for *"seeing the little fawns,"* and admitted that *"I carry them out and put them in the grass…and try and protect them"* despite facing scrutiny from other farmers:

> "And everybody says, 'Why in the devil didn't you take a hammer and knock them in the head while you had them?' Well, I can't do that. I can shoot them if they're eating my beans, but I can't kill them if they're not doing anything wrong."—FARM08

Such factors of 'scale'—when and where an encounter occurs and the deer's age or behavior—can change landowner emotions, even when their livelihood and land management practices are impacted in different spaces or times.

Like farmers and woodland owners, urban area residents who have experienced repeated damage to their gardens or landscaping feel *"hostile"* when they see deer, because *"the destruction of plant life is just impressive and discouraging"* and they notice that deer browse on even those plants *"which they're not supposed to eat"* (FSGP01|S7). Concerns about health and safety risks from deer pervaded urban residents' perceptions and emotions. Urban residents tended to associate ticks (*Ixodes scapularis*) with an abundant deer population and expressed serious concern about the spread of Lyme disease more often than other stakeholders. Such concerns even shifted former feelings of awe and enjoyment at the sight of deer to feelings of anxiety and fear. As one Bloomington resident expressed:

> "Well, in the beginning, I just loved it. I love seeing the deer come. And a part of me still does…And then last year, my dog and I were walking and we were charged by a female deer… And after that, I just had huge anxieties leaving my house with my dog and walking…So now personally, I have anxieties…if [it's] only me, I'm walking, I'm not afraid of the deer. But with my dog, I really fear because [what] if they [the deer] feel threatened?"—FSGP02|S8

Despite these anxious emotions, recent events led several interviewees to realize that, relatively speaking, managing deer may not be as important as other broader social and political issues affecting their communities. Soon after the Trump administration imposed economic sanctions on China, one farmer succinctly stated that "*tariff wars kind of outweighs the deer at this point in time"* (FARM02). Recalling protests at the local farmers' market that summer, a Bloomington resident expressed guilt over "*even complaining about [deer] when we have a*

farmers market problem with racism. We have affordable housing that's a huge problem. So I don't blame them [decision makers] for not focusing on [deer management]" (FSGP01|S9). Together, these situational factors—livelihood and land management activities, space and time, public health and safety, and social-political atmospheres—show that deer-related emotions are complex, context-dependent, and subject to change. A suite of factors influences one's feelings towards deer populations, and that suite differs both within and across stakeholder groups.

Feedbacks among emotion, experience, and cognition

We see above that one's personal experiences feed back into their emotions towards deer and perceptions of deer management. Values and motivations also exert a mediating influence over deer-related emotions and understandings. For example, holding mutualist values for the well-being of deer and striving to coexist with them influenced stakeholders' willingness to modify their land management behavior. Several urban residents spoke of changing what they plant in their yards to try to live with deer browsing, rather than prevent it. Among rural landowners, values for environmental stewardship and living close to nature interacted with their experience of minimal deer-related impacts to express an overall enjoyment or tolerance of deer populations. One farmer put it best, explaining that deer are *"a big part of who I am and how I feel and why I live where I live, and it's exciting to me [that] I see [deer] so frequently. It's interesting to me. I study them, I watch them, we have names for some of them. It's a big part of why I live where I live"* (FARM05).

Hunters also expressed concern about the health of deer populations, especially related to disease outbreaks, but their concern stemmed from different motivations than those of other stakeholders. Whereas many urban area residents expressed a fundamental concern for deer well-being and existence, hunters were generally motivated to maintain a huntable population. One hunter expressed concern about Chronic Wasting Disease (CWD) as something that *"could not only affect that animal but it could affect your lifestyle"* and anxiety about CWD *"killing off"* deer near their hunting property because *"on your property you want your deer as healthy as you can get"* (HUNT04). A resident of Beverly Shores made the connection that if they had ever "*seen deer that were emaciated, I would feel differently about the deer cull" (RES01).* An Indianapolis resident and deer hunter felt that it *"would be devastating"* if deer were *"infected with that*

[Chronic Wasting] disease, and we wipe out a population of animals that have been here forever" so they firmly stated, "*I think [deer should be managed] for the health of the ecosystem…you lose one part, and it can have trickling down effects on other parts including humans*" (RES11). For both hunters and urban residents, personal values and motivations thus influenced individual beliefs about the purpose of deer management.

Power dynamics in deer management

Introducing additional complexity into Indiana's human-deer system, we found that individuals' emotions and beliefs about deer management were driven not only by their experiences and values, but by their perceptions of power or powerlessness over deer management. A sense of powerlessness emerged among stakeholders who have experienced repeated deer-related damage and tried every approach they know to prevent it. Several said that the damage has "*gotten to the point where there's nothing I can do about it*" (RES05, Bloomington) and "*I'm just numb to it right now*" (FARM10). With exasperation, WLO13 said they do not even "*know what DNR could do. Come in to scold the deer, tell them not to cross?*" because the deer "*move about on their own*" and their behavior seems uncontrollable.

This lack of perceived control over the impacts of deer influences stakeholder beliefs about management responsibility. Among rural landowners, powerlessness over minimizing deer damage leads to beliefs that they "*should be able to get rid of [deer] without repercussion*" (FARM10), that the DNR has "*a reputation for not being* [*responsive]*" to landowners but being "*restrictive on depredation permits*" (WLO06), and that deer on private land are "*our [private landowners'] responsibility and concern*" (WLO11). Among urban residents, a lack of information and transparency about how authorities are currently managing deer populations also contributes to their sense of powerlessness in deer management. As one Bloomington resident said in frustration: *"that seems to be a joke. I don't see any management going on" (RES05).*

Urban residents possess a strong desire for management processes to involve local communities and governments because "*the public elects people to take care of these things on our behalf*" (RES09) and "*[the city] wouldn't listen to me, or to [omitted], but they would [listen to] the DNR*" (FSGP01|S9). If governments do not collaborate across scales, as one resident put it: "*there is a lot more risk of…not getting anything done because of controversies, local opinion*.

Whereas if this [deer management] is supported by county and state policies, they're more likely to get to a solution" (FSGP02|S3, Bloomington).

The sense of powerlessness also was reinforced by beliefs about hunting as neither effective nor desirable, often driven by experiences with trespassing or safety concerns about firing weapons in and around residential areas. Many rural landowners expressed an aversion to allowing hunters on their property, not only because of *"instances where people obviously had been there [on the property] without our knowledge"* but also because they *"like to get out in the woods too during hunting season"* and would question the safety of doing so (WLO11). Similarly, a resident of West Lafayette expressed concern that *"there's no barrier between the forest and our house. So if somebody decides to do something stupid in the forest and start shooting, you never know"* (RES13).

On the other side of this issue, Indiana deer hunters acknowledged that trespassing and poaching activities occur too often, giving hunters a poor reputation as a collective and limiting their access to private lands. Many hunter interviewees condemned such activities as irresponsible and unethical, expected other hunters to learn "*how to cooperate with the farmers' expectations*" (HUNT04), and expected management authorities to enforce "*more strict penalties*" for illegal hunting (HUNT06). Yet many hunters believed they had a personal responsibility to manage deer populations stemming from their investment in the DNR through hunting licenses and their role as the primary predator for deer in Indiana. For example, one hunter shared:

> "I think we play a vital role. I can let the population get out of control if I want to…I can shrink it by taking the does out of the herd…On the other side, I protect that herd…We go out and actually do coyote hunts outside of deer season just to keep the coyote population down in our properties. So we do a lot to manage the herd, the herd size, the age structure of our deer, everything."—HUNT02

Hunters typically shared a belief that the public does not fully understand that *"the enjoyment of hunting is not the killing"* (HUNT01) and hunting is necessary to *"help the [deer] population"* (HUNT04), which contributed to hunters' desire for the DNR to place *"more emphasis on what [hunters are] saying"* (HUNT03) and reduce its focus on engaging the wider public.

These quotes across stakeholder groups elucidate an iterative process in which prior experiences, or a lack thereof, with deer populations, hunting or hunters, and management, feed back into people's emotions which in turn affect their beliefs about deer and deer management.

Dynamics of power and powerlessness thus comprise a critical component of mental models about deer, and one that we did not fully anticipate based on the IABM.

2.5 Discussion

Insights and limitations of the Integrated Adaptive Behavior Model

Our semi-structured interviews provided a nuanced understanding of human-deer interactions across stakeholder groups in Indiana. Using the conceptual lens of the IABM allowed us to pay close attention to individuals' experiences and emotions, which proved to be particularly useful for identifying drivers of human-deer conflicts and interpreting beliefs about deer management. Our interviews made clear that personal encounters with deer have shaped an individual's deer-related emotions which fed back into their beliefs. These encounters, however, interact with components of scale to differentially influence how the interviewee felt towards deer as a nuisance to be controlled, an asset to protect, or something in between.

Previously, HDW scholars have identified personal experiences as important influencers of wildlife-related belief systems, value orientations, and behavioral decisions (Dickman et al. 2013, Smith et al. 2014, Kansky et al. 2016). Some acknowledge that wildlife experiences differ between residents of urban versus rural areas, who then express different behaviors or beliefs (Ericsson et al. 2018). Others have found that experiences with differing risk severities, mostly related to carnivores, affect both cognitions about the acceptability of management and emotions towards the animal (Vaske and Needham 2007, Sponarski et al. 2015). Although such regional and contextual differences have been examined, most have not included a more holistic concept of scale like that of the IABM nor been applied to non-carnivore interactions.

Scale in the IABM "consider[s] the spatial and temporal impacts on human-wildlife encounters as key components" of individuals' mental models (Jochum et al. 2014:81). Our findings expand on this understanding of scale to include the following social dimensions of deer encounters: what the individual is doing at the time of encounter (e.g., livelihood or habitual activities), whether the individual is alone or with family members or pets, and whether salient social-political events have recently occurred. The concept of scale thus highlights the importance of situational context when examining the relationships among human experiences, emotions, and values or beliefs, and their influence on wildlife-related behaviors or decisions. Indeed, situational

context and place-dependency remain pillars of CAS research (Levin 1998, Rogers et al. 2013, Preiser et al. 2018). Yet the IABM fails to explicitly include ecological dimensions of situational context, including the life stage, sex, and behavior of the encountered animal (Nyhus 2016), which we found to influence when and why people hold mixed emotions towards deer. As our interviewees made clear, how people feel towards wildlife in one context may not hold in another space or time, nor between encounters with large bucks versus fawns. Even the construct of scale carries inherent complexities that if reduced to certain categories (like a generalized "deer" or "stakeholder"), will miss key drivers of people's emotions and cognitions related to wildlife.

The IABM also simplifies feedbacks among personal experiences, emotions, and environmental values, which our interviews evidenced as variable and multifaceted. Although Jochum et al. (2014) stress the importance of these feedbacks and thresholds in shifting human attitudes towards wildlife, they do not explain where or how such thresholds might be reached. Our findings align with recent quantitative work on emotional dispositions, showing that when faced with different wildlife encounter scenarios, individuals express different emotions, symbolic beliefs, and degrees of acceptability for wildlife management actions (Sponarski et al. 2015). Moreover, multiple experiences with similar or divergent valences interact through emotional memory (Dillard and Meijnders 2002) to "shape future thoughts, reactions, and decisions…even attitudes and values" related to wildlife (Hicks 2014:175). Thresholds that shift one wildlife attitude to another should thus result from powerfully emotional experiences related to the circumstances of encounter, the individual's experiential history, and their underlying beliefs and value orientations towards that specific animal. In our case, individuals consistently mentioned a few memorable experiences that shaped their narrative of interacting with deer. These singular experiences within one's emotional memory represent personal touchstones, referred to recurringly in reflection and everyday conversation.

The association between human emotions and wildlife value orientations has been clearly established (Dayer et al. 2007, Larson et al. 2016, Abidin and Jacobs 2019). It was thus not surprising that deer hunters in our study, who typically orient towards wildlife domination, expressed concerns about the well-being of deer associated with their motivations to maintain a huntable population. In contrast, residents and landowners who expressed a fundamental concern for deer well-being were motivated by more intrinsic values for nature and wildlife existence, aligning with recent work on group identity and moral obligations to wildlife (Lute et al. 2016,

Bruskotter et al. 2019). What may seem like similar concerns at the surface are influenced by different values and motivations. These underlying ethical conflicts over human-wildlife interactions drive clashes among stakeholder groups, often over perceived behaviors (e.g., inhumane hunting or trespassing), desired policy outcomes (Vining and Tyler 1999, Halpenny 2010, Wang et al. 2018), and, as our research highlights, perceived power imbalances in wildlife decision-making.

A need to examine power dynamics

Previous studies have shown that along with personal experiences, emotions, and encounter contexts, power relations distinctly influence human attitudes towards wildlife (Bhatia et al. 2019). Moreover, a broad literature in political ecology has shown how viewing wildlife conflict through the lens of place, power, and politics can lead to insights into the multiplicity of perspectives and experiences individuals and communities hold. Specifically, individual perceptions of wildlife are often shaped by prior experiences with and beliefs about management agencies and government more broadly (Ingalls and Stedman 2016, Robbins 2019). In Indiana, perceived power imbalances among deer stakeholders reinforce negative perceptions about hunters by nonhunters and vice versa, which only serve to exacerbate the limitations of hunting as the primary tool for deer management. This divide presents a paradox for many states in the eastern and midwestern United States like Indiana in which 97% of land is under private ownership: deer management relies heavily on the cooperation of local property owners who may be increasingly skeptical of hunters and unwilling to provide access to their land. Under the North American Model (NAM) of wildlife conservation (Geist 1995, Geist et al. 2001), state agencies are entrusted to manage wildlife populations and their habitat for the equal benefit of all citizens, a principle known as the public trust ideal (Decker et al. 1996, Pomeranz et al. 2014). Yet the NAM's historical foundation and legal funding structure (i.e., financial reliance on fees collected from hunting permits) have advanced the concerns of white male hunters, affording little consideration to those of non-hunters, women, and other minorities (Yarbrough 2015, Peterson and Nelson 2017). Scholars increasingly criticize the NAM for being 'captured' by hunting interests (Jacobson et al. 2010, Sullivan 2019), in which wildlife managers and agencies continue to prescribe hunting as the ideal tool for wildlife management and elevate consumptive uses of wildlife over others (Feldpausch-Parker et al. 2017,

Serfass et al. 2018). Recent U.S. agency efforts to engage a wider public have been deemed superficial and political, failing to integrate diverse non-hunting interests into actual decisions, and thereby generating a sense of disrespect that perpetuates social conflicts over wildlife (Madden and McQuinn 2014, Peterson and Nelson 2017).

These power imbalances embedded in the NAM remain at play within Indiana. Deer hunters expressed an elevated sense of responsibility over deer management based on their investment into the IN-DNR via license fees and their belief in hunting as a historical conservation practice. Such expectations of respect and prioritization in management decisions are shared by large-game hunters across the U.S. (Mangun et al. 2007, Vernon and Clark 2016). Conversely, nonhunting stakeholders expected the deer management decision-making process to be more inclusive and democratic, reflecting the public trust ideal (Pomeranz et al. 2014, Decker et al. 2016). When not actively engaged by wildlife managers and researchers in decision-making and information exchange, nonhunting stakeholders become distrusting of a system they believe to be biased and which does not reflect their values nor experiences (Madden 2004, Zajac et al. 2012, Lute and Gore 2014). Hunters may also lose trust in management agencies when their knowledge of wildlife populations is neither solicited by managers nor reflected in management decisions (Mangun et al. 2007). For instance, several deer hunters we interviewed expressed mistrust in IN-DNR decisions when it did not specify how deer quotas or hunting zones were determined. Thus, our research highlights that stakeholder experiences with wildlife management and attendant knowledge production practices comprise a critical yet overlooked feedback loop within the IABM, one that either creates or reinforces dynamics of trust, power, and conflict in wildlife management.

Overall, the power-knowledge dynamics captured by our interviews contribute an important layer of complexity to deer and wildlife management. Complexity has traditionally implied 'adding more demographics of people' to wildlife management plans, rather than envisioning the multiple and often opposing emotions, beliefs, norms, and values that one person or group simultaneously holds towards wildlife and social 'others.' In Indiana, for example, we found that allowing deer hunting on private lands conflicts with rural residents' desires to spend time enjoying and working the land that they legally own. Within urban spaces, the practice of hunting conflicts with perceived norms regarding the right to live safely and securely on one's property. As they become articulated in management discourses, these struggles over land rights can discredit the legitimacy of opposing groups' knowledge and deepen the rift between stakeholders (Brogden and

Greenberg 2003, Robbins 2006). Thus, fundamental conflicts over whose rights, values, and experiences are reflected within management decision-making could undermine the compromises required to form coalitions under multi-stakeholder contexts, like that of the public trust ideal (Robbins 2006).

Management Implications

Power and powerlessness in deer management presents an emergent barrier that prevents deer stakeholders from expressing certain deer-related emotions or engaging in deer management behaviors. As discussed above, improving relationships and transparency between stakeholders and managers could increase trust in deer management, reduce perceptions of bias, and potentially address power imbalances among stakeholders.

Collaborative approaches that embrace a plurality of knowledge about social-ecological interactions can help move beyond power-laden conflicts and reach long-term conservation decisions (Collof et al. 2017). Since knowledge and learning comprise key feedbacks in the adaptive management of social-ecological systems (Folke et al. 2005), rethinking decision-making contexts to elevate diverse local knowledge and experiences would provide insight about potential, localized management scenarios while improving trust and transparency between agencies and their publics (Sjölander-Lidqvist et al. 2015; Riley et al. 2018, Zimmerman et al. 2021). Fostering knowledge plurality, however, is not easy; practitioners need to establish safe, neutral decision spaces where different understandings and values can be equitably expressed and peacefully negotiated (Brugnach and Ingram 2012).

Our research suggests that wildlife managers could benefit from using value-based approaches to establish a direct and iterative collaboration with diverse stakeholders, which will help to integrate abstract goals like social-ecological balance with specific strategies to reduce human-wildlife conflict (Slagle et al. 2018). Among our interviewees, many hunters, rural landowners, and urban residents expressed some sense of responsibility to care for the environment or deer populations specifically. While these stakeholders disagreed over the ethics and safety of hunting, they generally agreed on goals of deer management: balancing the natural ecosystem, reducing deer impacts to livelihoods and land uses, and protecting the well-being of both deer and human populations. As suggested by Lute and Gore (2014), collaboratively defining a value for

stewardship could help multi-stakeholder groups compromise on wildlife management objectives and justifications. Shared values could also overcome frequent divides between hunters and animal rights advocates, who stand at opposing ends of the wildlife value continuum (Patterson et al. 2003). It remains crucial, however, to not only identify common values but to define a collective *meaning* for each value and how it applies to wildlife management approaches (Patterson et al. 2003, Slagle et al. 2018).

2.6 Conclusion

Our findings reaffirm that human-wildlife conflicts should be understood within the local, social-ecological contexts in which they occur (Zimmerman et al. 2021) and demonstrates an approach for doing so. Case studies like ours can help to elucidate the diversity of human perceptions of and interactions with wildlife that exists within a given state or locality and the range of possible management approaches. We provided in-depth contextual descriptions to help other researchers and practitioners judge how sensible it would be to transfer our findings to similar situations (Tracy 2010; Neuman 2011). Yet our specific findings should not be assumed to apply straightforwardly and unproblematically to other contexts, even when similar cultural, natural, or socioeconomic patterns exist (Zimmerman et al., 2021). For instance, our findings represent human-deer interactions in Indiana and may not be transferrable to states with more public land and mutualism orientations or weaker hunting traditions. Critically, we acknowledge that our sample lacks racial and ethnic diversity—partly due to our sampling strategy—and thus does not reflect the knowledge of non-White populations in Indiana, nor how they might transcend typical demographic categorizations. Black, Indigenous, and People of Color (BIPOC) have historically been excluded from research and decision-making in natural resource management (Yarbrough 2015; Warren 2021). Yet as the events of 2020 have brought social justice concerns to the forefront of environmental thinking (Hoover and Lim 2021), we must work harder than ever to include BIPOC perspectives in our research and practice. Future research informed by this study will attempt to capture a wider diversity of perspectives on human-deer interactions in Indiana.

Our research demonstrates that a CAS operates at the individual scale, comprised of multiple, interacting components of human cognition that influence one's perceptions of deer and deer management. Although currently understudied, emotions constitute a deeply influential

response to human-deer interactions that should not be passed off as irrational nor boxed into dichotomous emotions about "Bambi" versus "big bucks." These emotions mediate relationships between people's values for wildlife or nature and their beliefs about appropriate management (Sponarski et al. 2015), thus driving social conflicts over how wildlife should be managed and for whom (Redpath et al. 2015). Such power-laden conflicts have too frequently been excluded from human-wildlife and social-ecological models, yet our work highlights that perceived power imbalances influence not only human emotions and behaviors but also their trust in governance structures. Simply adding more categories of people or their responses to a model of human-wildlife interactions serves to reduce its multi-scalar complexity and its power to explain why human-wildlife or human-human conflicts persist while other interactions, like coexistence, remain elusive. Ultimately, considering human emotions and power dynamics in wildlife governance will help to realize a better balance between social and ecological well-being.

2.7 References

Abidin, Z. A. Z., and M. Jacobs. 2019. Relationships between valence towards wildlife and wildlife value orientations. *Journal for Nature Conservation* 49:63–68.

Barbour, R., and J. Kitzinger. 1998. *Developing Focus Group Research: Politics, Theory and Practice*. SAGE.

Bath, A. J. 1998. The role of Human Dimensions in wildlife resource research in wildlife management. *Ursus* 10:349–355.

Bhatia, S., S. M. Redpath, K. Suryawanshi, and C. Mishra. 2020. Beyond conflict: exploring the spectrum of human–wildlife interactions and their underlying mechanisms. *Oryx* 54(5):621–628.

Booth, A. L., and D. A. J. Ryan. 2019. A tale of two cities, with bears: Understanding attitudes towards urban bears in British Columbia, Canada. *Urban Ecosystems* 22(5):961–973.

Brogden, M. J., and J. B. Greenberg. 2003. The fight for the West: A political ecology of land use conflicts. *Human Organization* 62(3):289–298.

Brown, S. E., and G. R. Parker. 1997. Impact of white-tailed deer on forest communities within Brown County State Park, Indiana. *Proceedings of the Indiana Academy of Science* 106(1–2):39–52.

Brugnach, M., and H. Ingram. 2012. Ambiguity: the challenge of knowing and deciding together. *Environmental Science & Policy* 15(1):60-71.

Bruskotter, J. T., J. A. Vucetich, A. Dietsch, K. M. Slagle, J. S. Brooks, and M. P. Nelson. 2019. Conservationists' moral obligations toward wildlife: Values and identity promote conservation conflict. *Biological Conservation* 240:108296.

Campa III, H., S. J. Riley, S. R. Winterstein, T. L. Hiller, S. A. Lischka, and J. P. Burroughs. 2011. Changing landscapes for white-tailed deer management in the 21st century: Parcelization of land ownership and evolving stakeholder values in Michigan. *Wildlife Society Bulletin* 35(3):168–176.

Campbell, J., C. Quincy, J. Osserman, and O. K. Pedersen. 2013. Coding in-depth semi structured interviews: problems of unitization and intercoder reliability and agreement. *Sociological Methods and Research* 42 (3):294–320.

Castillo-Huitrón, N. M., E. J. Naranjo, D. Santos-Fita, and E. Estrada-Lugo. 2020. The importance of human emotions for wildlife conservation. *Frontiers in Psychology* 11:1277.

Chapin III, F. S., C. Folke, and G. P. Kofinas. 2009. A framework for understanding change. Pages 3-28 *in* C. Folke, G. P. Kofinas, and F. S. Chapin, editors. *Principles of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World*. 3–28. New York, NY. https://doi.org/10.1007/978-0-387-73033-2_1.

Church, S. P., M. Dunn, and L. S. Prokopy. 2019. Benefits to qualitative data quality with multiple coders: two case studies in multi-coder data analysis. *Journal of Rural Social Sciences* 34(1): 2.

Colloff, M. J., S. Lavorel, L. E. van Kerkhoff, C. A. Wyborn, I. Fazey, R. Gorddard, G. M. Mace, W. B. Foden, M. Dunlop, I. C. Prentice, J. Crowley, P. Leadley, and P. Degeorges. 2017. Transforming conservation science and practice for a postnormal world. *Conservation Biology* 31(5):1008–1017. https://doi.org/10.1111/cobi.12912

Corbin, J. and A. Strauss. 2015. *Basics of Qualitative Research*. Fourth edition. Thousand Oaks, CA: Sage Publications.

Creswell, J., and V. Clark. 2018. *Designing and conducting mixed methods research.* Third edition. Thousand Oaks, CA: Sage Publications.

Dayer, A. A., H. M. Stinchfield, and M. J. Manfredo. 2007. Stories about wildlife: Developing an instrument for identifying wildlife value orientations cross-culturally. *Human Dimensions of Wildlife* 12(5):307–315.

Decker, D. J., C. C. Krueger, R. A. Jr. Baer, B. A. Knuth, and M. E. Richmond. 1996. From clients to stakeholders: A philosophical shift for fish and wildlife management. *Human Dimensions of Wildlife* 1(1):70–82.

Decker, D. J. , S. J. Riley, and W. F. Siemer, editors. 2012. *Human Dimensions of Wildlife Management*. Baltimore, MD: The Johns Hopkins University Press.

Decker, D., C. Smith, A. Forstchen, D. Hare, E. Pomeranz, C. Doyle-Capitman, K. Schuler, and J. Organ. 2016. Governance principles for wildlife conservation in the 21st century. *Conservation Letters* 9(4):290–295.

DeCuir-Gunby, J. T., P. L. Marshall, and A. W. McCulloch. 2011. Developing and using a codebook for the analysis of interview data: an example from a professional development research project. *Field Methods* 23(2):136–155.

DeNicola, A. J., K. C. VerCauteren, P.D. Curtis, and S. E. Hygnstrom. 2000. Managing white-tailed deer in suburban environments: A technical guide. Technical Report. Cornell Cooperative Extension; The Wildlife Society; Northeast Wildlife Damage Research and Outreach Cooperative. Ithaca, NY. http://catalog.hathitrust.org/api/volumes/oclc/46874963.html.

Dickman, A. J. 2010. Complexities of conflict: The importance of considering social factors for effectively resolving human-wildlife conflict. *Animal Conservation* 13(5):458–466.

Dickman, A., S. Marchini, and M. Manfredo. 2013. The human dimension in addressing conflict with large carnivores. Pages 110–126 *in* D. W. Macdonald and K. J. Willis, editors. *Key Topics in Conservation Biology 2*. John Wiley & Sons, Oxford.

Diefenbach, D. R., W. L. Palmer, and W. K. Shope. 1997. Attitudes of Pennsylvania sportsmen towards managing white-tailed deer to protect the ecological integrity of forests. *Wildlife Society Bulletin* 25(2):244–251.

Dietsch, A. M., M. J. Manfredo, L. Sullivan, J. T. Bruskotter, and T. L. Teel. 2019. A multilevel, systems view of values can inform a move towards human-wildlife coexistence. Pages 20–44 *in* B. Frank, J. A. Glikman, and S. Marchini, editors. *Human–Wildlife Interactions: Turning Conflict into Coexistence*. First edition. Cambridge University Press.

Dillard, J. P., and A. Meijnders. 2002. Persuasion and the structure of affect. Pages 309-328 *in* J. P. Dillard and M. Pfau, editors. *The Persuasion Handbook: Developments in Theory and Practice*. SAGE, Thousand Oaks, California, USA.

Dougherty, E. M., D. C. Fulton, and D. H. Anderson. 2003. The influence of gender on the relationship between wildlife value orientations, beliefs, and the acceptability of lethal deer control in Cuyahoga Valley National Park. *Society & Natural Resources* 16(7):603–623.

Ericsson, G., C. Sandström, and S. J. Riley. 2018. Rural-urban heterogeneity in attitudes towards large carnivores in Sweden, 1976-2014. Pages 190-205 *in* T. Hovardas, editor. *Large Carnivore Conservation and Management: Human Dimensions*. Routledge, London, UK.

Feldpausch-Parker, A. M., I. D. Parker, and E. S. Vidon. 2017. Privileging consumptive use: A critique of ideology, power, and discourse in the North American Model of Wildlife Conservation. *Conservation and Society* 15(1):33–40.

Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30(1): 441–73. https://doi.org/10.1146/annurev.energy.30.050504.144511.

Frank, B., and J. A. Glikman. 2019. Human-wildlife conflicts and the need to include coexistence. Pages 1–19 *in* B. Frank, J. A. Glikman, and S. Marchini, editors. *Human–Wildlife Interactions: Turning Conflict into Coexistence*. First edition. Cambridge University Press.

Garrison, D.R., M. Cleveland-Innes, M. Koole, and J. Kappelman. 2006. Revisiting methodological issues in transcript analysis: Negotiated coding and reliability. *Internet and Higher Education* 9:1–8.

Geist, V. 1995. North American policies of wildlife conservation. Pages 77-129 *in* V. Geist, and I. M. Cowan, editors. *Wildlife Conservation Policy*. Calgary, Alberta, Canada: Detselig.

Geist, V., S. P. Mahoney, and J. F. Organ. 2001. Why hunting has defined the North American Model of Wildlife Conservation. *Transactions of the North American Wildlife and Natural Resources Conference* 66:175–185.

Gilligan, C. 1987. Moral orientation and moral development. Pages 19-33 *in* E. F. Kittay and D. T. Meyers, editors. *Women and Moral Theory*. Rowman & Littlefield, Totowa, New Jersey, USA.

Gren, I.-M., T. Häggmark-Svensson, K. Elofsson, and M. Engelmann. 2018. Economics of wildlife management—an overview. *European Journal of Wildlife Research* 64(2):22.

Guest, G., A. Bunce, and L. Johnson. 2006. How many interviews are enough?: An experiment with data saturation and variability. *Field Methods* 18(1):59–82.

Halpenny, E. A. 2010. Pro-environmental behaviours and park visitors: The effect of place attachment. *Journal of Environmental Psychology* 30(4):409–421.

Helmreich, S. 2000. Power/Networks: A rejoinder to Lansing. *Critique of Anthropology* 20(3):319–327.

Henderson, K. A. 1991. *Dimensions of choice: a qualitative approach to recreation, parks, and leisure research.* Venture Publishing, Inc.

Hicks, J. R. 2014. Mapping the connections between wildlife, learning, and emotion. *Journal of Outdoor Recreation, Education, and Leadership* 6(2):173–176.

Hicks, J. R. 2017. Mixed emotions: A qualitative exploration of northern Illinois whitetail deer-related decision making. *Journal of Outdoor Recreation and Tourism* 18:113–121.

Holling, C. S. 2001. Understanding the complexity of economic, ecological, and social systems. *Ecosystems* 4(5):390–405. https://doi.org/10.1007/s10021-001-0101-5.

Hoover, F.-A., and T. C. Lim. 2021. Examining privilege and power in us urban parks and open space during the double crises of antiblack racism and COVID-19. *Socio-Ecological Practice Research* 3(1): 55–70. https://doi.org/10.1007/s42532-020-00070-3.

Hruschka, D., D. Schwartz, D. Cobb St John, E. Picone-Decaro, R. Jenkins, and J. Carey. 2004. Reliability in coding open-ended data: Lessons learned from HIV behavioral research. *Field Methods* 16(3):307–331

Humberg, L. A., T. L. Devault, B. J. Macgowan, J. C. Beasley, and O. E. R. Jr. 2007. Crop depredation by wildlife in Indiana. *Proceedings of the National Wild Turkey Symposium 9:000*:199–205.

Indiana Division of Fish & Wildlife (INDFW). 2011. *Urban Deer Technical Guide*. Indiana Department of Natural Resources, Indianapolis, IN.

Indiana Department of Natural Resources (IN-DNR). 2022. 2017-2022 Deer management goal. IN-DNR, Indianapolis, Indiana, USA. [online] URL: https://www.in.gov/dnr/fish-and-wildlife/wildlife-resources/animals/white-tailed-deer/deer-management-and-reports/

Ingalls, M. L., and R. C. Stedman. 2016. The power problematic: exploring the uncertain terrains of political ecology and the resilience framework. *Ecology and Society* 21(1).

Izard, C. E. 2007. Basic emotions, natural kinds, emotion schemas, and a new paradigm. *Perspectives on Psychological Science* 2(3):260–280.

Jacobs, M. H. 2009. Why do we like or dislike animals? *Human Dimensions of Wildlife* 14(1):1–11.

Jacobs, M. H. 2012. Human emotions toward wildlife. *Human Dimensions of Wildlife* 17(1):1–3.

Jacobs, M., and J. J. Vaske. 2019. Understanding emotions as opportunities for and barriers to coexistence with wildlife. Pages 65–84 *in* B. Frank, J. A. Glikman, and S. Marchini, editors. *Human–Wildlife Interactions: Turning Conflict into Coexistence*. First edition. Cambridge University Press.

Jacobson, C. A., J. F. Organ, D. J. Decker, G. R. Batcheller, and L. Carpenter. 2010. A conservation institution for the 21st century: Implications for state wildlife agencies. *The Journal of Wildlife Management* 74(2):203–209.

Jochum, K. A., A. A. Kliskey, K. J. Hundertmark, and L. Alessa. 2014. Integrating complexity in the management of human-wildlife encounters. *Global Environmental Change* 26:73–86.

Jones, N., S. Shaw, H. Ross, K. Witt, and B. Pinner. 2016. The study of human values in understanding and managing social-ecological systems. *Ecology and Society* 21(1).

Kansky, R., M. Kidd, and A. T. Knight. 2016. A wildlife tolerance model and case study for understanding human wildlife conflicts. *Biological Conservation* 201:137–145.

Knackmuhs, E., and J. R. Farmer. 2017. Factors influencing trust in a wildlife management agency: A case study of deer management in Bloomington, Indiana. *Journal of Park and Recreation Administration* 35(3):48–64.

Lansing, S. 2000. Foucault and the water temples: A reply to Helmreich. *Critique of Anthropology* 20(3):309–318.

Larson, L. R., C. B. Cooper, and M. E. Hauber. 2016. Emotions as drivers of wildlife stewardship behavior: Examining citizen science nest monitors' responses to invasive house sparrows. *Human Dimensions of Wildlife* 21(1):18–33.

Lauber, T. B., M. L. Anthony, and B. A. Knuth. 2001. Gender and ethical judgements about suburban deer management. *Society and Natural Resources* 14(7):571–583.

Levin, S. A. 1998. Ecosystems and the biosphere as complex adaptive systems. *Ecosystems* 1(5):431–436.

Lischka, S. A., S. J. Riley, and B. A. Rudolph. 2008. Effects of impact perception on acceptance capacity for white-tailed deer. *The Journal of Wildlife Management* 72(2):502–509.

Liu, J., V. Hull, M. Batistella, R. DeFries, T. Dietz, F. Fu, T. W. Hertel, R. C. Izaurralde, E. F. Lambin, S. Li, L. A. Martinelli, W. J. McConnell, E. F. Moran, R. Naylor, Z. Ouyang, K. R. Polenske, A. Reenberg, G. de Miranda Rocha, C. S. Simmons, P. H. Verburg, P. M. Vitousek, F. Zhang, and C. Zhu. 2013. Framing sustainability in a telecoupled world. *Ecology and Society* 18(2):26. http://dx.doi.org/10.5751/ES-05873-180226

Lute, M. L., and M. L. Gore. 2014. Knowledge and power in wildlife management. *Journal of Wildlife Management* 78(6):1060–1068.

Lute, M. L., C. D. Navarrete, M. P. Nelson, and M. L. Gore. 2016. Moral dimensions of human-wildlife conflict. *Conservation Biology* 30(6):1200-1211.

Madden, F. 2004. Creating coexistence between humans and wildlife: Global perspectives on local efforts to address human–wildlife conflict. *Human Dimensions of Wildlife* 9(4):247–257.

Madden, F., and B. McQuinn. 2014. Conservation's blind spot: The case for conflict transformation in wildlife conservation. *Biological Conservation* 178:97–106.

Manfredo, M. J. 2008. *Who Cares About Wildlife?* New York, NY: Springer Science + Business Media LLC.

Manfredo, M. J., T. L. Teel, and K. L. Henry. 2009. Linking society and environment: A multilevel model of shifting wildlife value orientations in the western United States. *Social Science Quarterly* 90(2):407–427.

Mangun, J. C., K. W. Throgmorton, A. D. Carver, and M. A. Davenport. 2007. Assessing stakeholder perceptions: Listening to avid hunters of western Kentucky. *Human Dimensions of Wildlife* 12(3):157–168.

Mankin, P. C., R. E. Warner, and W. L. Anderson. 1999. Wildlife and the Illinois public: A benchmark study of attitudes and perceptions. *Wildlife Society Bulletin* 27(2):465–472.

Marcoux, A., and S. Riley. 2010. Driver knowledge, beliefs, and attitudes about deer–vehicle collisions in southern Michigan. *Human–Wildlife Interactions* 4(1):7.

Messmer, T. A., L. Cornicelli, D. J. Decker, and D. G. Hewitt. 1997. Stakeholder acceptance of urban deer management techniques. *Wildlife Society Bulletin* 25(2):360–366.

Milton, K. 2002. *Loving Nature: Towards an Ecology of Emotion*. Psychology Press.

Minnis, D. L., R. H. Holsman, L. Grice, and R. B. Payton. 1997. Focus groups as a human dimensions research tool: Three illustrations of their use. *Human Dimensions of Wildlife* 2(4):40–49.

Morgan, D. L. 1996. Focus groups. *Annual Review of Sociology* 22:129-152.

Neuman, W.L. 2011. Qualitative and quantitative measurement. Pages 201-244 *in* W.L. Neuman, editor. *Social Research Methods: Qualitative and Quantitative Approaches*, 7th edition. Boston, MA: Pearson/Allyn & Bacon.

Noddings, N. 1995. Care and moral education. Pages 137-148 *in* W. Kohli, editor. *Critical Conversations in Philosophy Of Education*. New York, NY: Routledge.

Nyhus, P. J. 2016. Human-wildlife conflict and coexistence. *Annual Review of Environment and Resources* 41(1):143-171.

Patterson, M. E., J. M. Montag, and D. R. Williams. 2003. The urbanization of wildlife management: Social science, conflict, and decision making. *Urban Forestry & Urban Greening* 1(3):171–183.

Peterson, M. N., and M. P. Nelson. 2017. Why the North American Model of Wildlife Conservation is problematic for modern wildlife management. *Human Dimensions of Wildlife* 22(1):43–54.

Peterson, R. B., D. Russell, P. West, and J. P. Brosius. 2010. Seeing (and doing) conservation through cultural lenses. *Environmental Management* 45(1):5–18.

Pomeranz, E. F., D. J. Decker, W. F. Siemer, A. Kirsch, J. Hurst, and J. Farquhar. 2014. Challenges for multilevel stakeholder engagement in public trust resource governance. *Human Dimensions of Wildlife* 19(5):448–457.

Pooley, S., M. Barua, W. Beinart, A. Dickman, G. Holmes, J. Lorimer, A. J. Loveridge, D. W. Macdonald, G. Marvin, S. Redpath, C. Sillero-Zubiri, A. Zimmermann, and E. J. Milner-Gulland. 2017. An interdisciplinary review of current and future approaches to improving human–predator relations. *Conservation Biology* 31(3):513–523.

Preiser, R., R. Biggs, A. De Vos, and C. Folke. 2018. Social-ecological systems as complex adaptive systems: organizing principles for advancing research methods and approaches. *Ecology and Society* 23(4):46.

Redpath, S., S. Bhatia, and J. Young. 2015. Tilting at wildlife: reconsidering human-wildlife conflict. Oryx 49(2):222-225.

Riley, S. J., J. K. Ford, H. A. Triezenberg, and P. E. Lederle. 2018. Stakeholder trust in a state wildlife agency. *Journal of Wildlife Management* 82(7):1528-1535.

Robbins, P. 2006. The politics of barstool biology: Environmental knowledge and power in greater Northern Yellowstone. *Geoforum* 37(2):185–199.

Robbins, P. 2019. *Political Ecology: A Critical Introduction*. John Wiley & Sons.

Rogers, K., R. Luton, H. Biggs, R. Oonsie Biggs, S. Blignaut, A. Choles, C. Palmer, and P. Tangwe. 2013. Fostering complexity thinking in action research for change in social–ecological systems. *Ecology and Society* 18(2). http://dx.doi.org/10.5751/ES-05330-180231

Rooney, T. P., and D. M. Waller. 2003. Direct and indirect effects of white-tailed deer in forest ecosystems. *Forest Ecology and Management* 181(1): 165–76. https://doi.org/10.1016/S0378-1127(03)00130-0.

Saldana, J. 2016. *The Coding Manual for Qualitative Researchers*. Third edition. Thousand Oaks, CA: Sage Publications.

Schlüter, M., R. R. J. Mcallister, R. Arlinghaus, N. Bunnefeld, K. Eisenack, F. Hölker, E.J. Milner-Gulland, et al. 2012. New horizons for managing the environment: A review of coupled social-ecological systems modeling. *Natural Resource Modeling* 25(1):219–72. https://doi.org/10.1111/j.1939-7445.2011.00108.x.

Schutt, R. K. 2018. *Investigating the Social World: The Process and Practice of Research*. SAGE Publications.

Serfass, T. L., R. P. Brooks, and J. T. Bruskotter. 2018. North American Model of Wildlife Conservation: Empowerment and exclusivity hinder advances in wildlife conservation. *Canadian Wildlife Biology & Management* 7(2):101–118.

Sjölander-Lindqvist, A., M. Johansson, and C. Sandström. 2015. Individual and collective responses to large carnivore management: The roles of trust, representation, knowledge spheres, communication, and leadership. *Wildlife Biology* 21(3):175–185. doi: 10.2981/wlb.00065

Slagle, K. M., R. S. Wilson, J. T. Bruskotter, and E. Toman. 2018. The symbolic wolf: A construal level theory analysis of the perceptions of wolves in the United States. *Society & Natural Resources* 32(3):322–337.

Smith, J. B., C. K. Nielsen, and E. C. Hellgren. 2014. Illinois resident attitudes toward recolonizing large carnivores. *The Journal of Wildlife Management* 78(5):930–943.

Sponarski, C. C., J. J. Vaske, and A. J. Bath. 2015. The role of cognitions and emotions in human–coyote interactions. *Human Dimensions of Wildlife* 20(3):238–254.

Stewart, C. M. 2011. Attitudes of urban and suburban residents in Indiana on deer management. *Wildlife Society Bulletin* 35(3):316–322.

Sullivan, L. 2019. Conservation in context: Toward a systems framing of decentralized governance and public participation in wildlife management. *Review of Policy Research* 36(2):242–261.

Tracy, S. J. 2010. Qualitative quality: Eight "big-tent" criteria for excellent qualitative research. *Qualitative Inquiry* 16(10): 837-851.

Urbanek, R. E., and C. K. Nielsen. 2012. Deer, humans, and vegetation: A case study of deer management in the Chicago metropolitan area. *Proceedings of the 25th Vertebrate Pest Conference* 282–288. University of California Davis.

Urbanek, R. E., C. K. Nielsen, M. A. Davenport, and B. D. Woodson. 2015. Perceived and desired outcomes of suburban deer management methods. *Journal of Wildlife Management* 79(4):647–661.

Vaske, J. J., and M. D. Needham. 2007. Segmenting public beliefs about conflict with coyotes in an urban recreation setting. *Journal of Park and Recreation Administration* 25(4):79–98.

Vernon, M. E., and S. G. Clark. 2016. Addressing a persistent policy problem: The elk hunt in Grand Teton National Park, Wyoming. *Society & Natural Resources* 29(7):836-851.

Vining, J., and E. Tyler. 1999. Values, emotions and desired outcomes reflected in public responses to forest management plans. *Human Ecology Review* 6(1):21–34.

Wang, S., Z. Leviston, M. Hurlstone, C. Lawrence, and I. Walker. 2018. Emotions predict policy support: Why it matters how people feel about climate change. *Global Environmental Change* 50:25–40.

Warren, E. R. A. 2021. "There's not many times where people ask for your story": Toward a more complete narrative reflecting experiences of environmental professionals of color. Dissertation, Texas State University, 2021. https://digital.library.txstate.edu/handle/10877/13460.

Webster, C. R., and G. R. Parker. 1997. The effects of white-tailed deer on plant communities within Indiana state parks. *Proceedings of the Indiana Academy of Science* 106(3–4):213–232.

West, P. 2006. *Conservation is Our Government Now: The Politics of Ecology in Papua New Guinea*. Durham, NC: Duke University Press.

Whittaker, D., J. J. Vaske, and M. J. Manfredo. 2006. Specificity and the cognitive hierarchy: Value orientations and the acceptability of urban wildlife management actions. *Society & Natural Resources* 19(6):515–530. https://doi.org/10.1080/08941920600663912

Wywialowski, A. P. 1994. Agricultural producers' perceptions of wildlife-caused losses. *Wildlife Society Bulletin* 22(3):370–382.

Yarbrough, A. 2015. Species, race, and culture in the space of wildlife management. Pages 234-253 *in* K. Gillespie and R. Collard, editors. *Critical Animal Geographies: Politics, Intersections, and Hierarchies in a Multispecies World*. First edition. London: Routledge.

Zajac, R. M., J. T. Bruskotter, R. S. Wilson, and S. Prange. 2012. Learning to live with black bears: A psychological model of acceptance. *The Journal of Wildlife Management* 76(7):1331–1340.

Zimmermann, A., P. Johnson, A. E. de Barros, C. Inskip, R. Amit, E. C. Soto, C. A. Lopez-Gonzalez, et al. 2021. Every case is different: Cautionary insights about generalisations in human-wildlife conflict from a range-wide study of people and jaguars. *Biological Conservation* 260: 109185. https://doi.org/10.1016/j.biocon.2021.109185.

CHAPTER 3. QUANTIFYING THE INFLUENCE OF EMOTIONS ON MANAGEMENT ACCEPTABILITY FOR WHITE-TAILED DEER *(ODOCOILEUS VIRGINIANUS)*

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3.1 Abstract

Emotions pervade human-wildlife relationships across social identities and cultures. Yet research on how emotions influence the cognitive processing of wildlife encounters remains sparse. In this study, we quantify the role of anticipated emotions in processing hypothetical encounters with white-tailed deer (*Odocoileus virginianus*). In 2021, we surveyed Indiana residents about deer and deer management (n = 1806). Under four hypothetical deer encounters, we estimated the structural relationships among respondents' general attitudes towards deer, mutualist wildlife beliefs, scenario-specific emotions, and scenario-specific lethal control acceptability. Emotions mediated 14% of the effect of general attitudes on lethal control acceptability when encountering a fawn and completely mediated this effect when encountering a diseased deer. Our findings suggest that emotions work together with cognitions to process stimuli in a human-wildlife encounter and make a normative decision. Accounting for emotions in decision-making will help practitioners develop more effective and socially accepted approaches to wildlife conservation and management.

3.2 Introduction

Human emotions infuse our relationships with nature and wildlife, at different times evoking solitude and spirituality (Long et al. 2006, McKay et al. 2018), awe and enjoyment (McIntosh and Wright 2017, Hicks and Stewart 2020), or fear and frustration (Jacobs et al. 2014, Hill 2015). They also escalate social conflicts over such nature and wildlife, which often amplify a preservation-versus-use duality (Buijs and Lawrence 2013, Madden and McQuinn 2014). Perhaps no medium has been as influential in popularizing this conflict as Walt Disney's *Bambi*. From the death of young Bambi's mother to the fiery hunt for Bambi as an adult buck, the film

became an emotional appeal against hunting and mankind's domination over nature in favor of nurturing an idyllic and vulnerable forest (Hastings 1996). This elicited backlash from hunters outraged by the film's depiction of their practices and produced an enduring conflict pitting supporters of ethical hunting against the "excessive sentimentality" of those supporting animal rights, humaneness, and wilderness preservation (Lutts 1992, 161). While, scientifically, the pro- versus anti-hunting debate is classified as a clash of value orientations (Teel and Manfredo 2010), we see emotions exacerbate social animosities through derogatory slurs like "Bambi-killer" versus "Bambi-lover" (Cartmill 1993, Hastings 1996).

Yet much more complexity and multidimensionality underlie human emotions towards wildlife. These emotions shift with place (i.e., of encounter or attachment; Halpenny 2010, Jacobs and Vaske 2019), power relations (González-Hidalgo and Zografos 2020), spiritual or cultural meanings (Blumenthal 1990, Gogoi 2018), and the type of animal encountered (Nyhus 2016). Wildlife like deer, which may initially seem harmless, can elicit feelings of fear, anxiety, and anger depending on the person and their deer-related experiences (Stinchcomb et al. 2022).

Despite the pervasiveness of emotions in society and popular culture, their influence on behaviors and preferences for wildlife remains understudied in the North American context (Jacobs 2012, Jacobs and Vaske 2019). Scholars attribute this in part to a pervading institutional perception that human emotions are irrational, weak, and reactive (Manfredo 2008, Hicks 2017). Indeed, emotional expression has historically been marginalized from Western thought, exiled into a feminine and private space and placed in stark opposition to masculine and publicly acceptable rationality (Anderson and Smith 2001, Batavia et al. 2021). Contemporary understandings recognize the fluidity of emotions across gendered and public/private boundaries and their centrality to social-political life (Thrift 2004). As such, the role of emotions in how we 'rationalize' experiences with and within nature warrants empirical investigation across disciplines. Here, we aim to advance emotional research in the human dimensions of wildlife by quantifying how emotions influence people's cognitive processing of encounters with white-tailed deer (*Odocoileus virginianus*).

3.2.1 Cognition and emotion in the human dimensions of wildlife

Research in the human dimensions of wildlife (HDW) has widely used social-psychological theories to measure the relationships among human beliefs, attitudes, and behaviors towards wildlife. These theories typically describe a hierarchy of human cognition, where values lie at the foundation of cognitive processing and are operationalized through basic beliefs, which then influence more specific attitudes and norms, which finally shape behavioral intentions or outcomes (Fishbein and Ajzen 1975, Vaske and Donnelly 1999, Whittaker et al. 2006). As we move through this hierarchy, the cognitive constructs become less abstract, so that specific attitudes better predict behavioral outcomes than do more fundamental values. This specificity principle (Fishbein and Ajzen 1975) remains critical to cognitive hierarchy research because it recognizes the contextual dependence of human-wildlife interactions and provides criteria for how values, attitudes, and behaviors should be specified in quantitative research to uncover statistical relationships among them (Whittaker et al. 2006, Sponarski et al. 2015).

Despite its prominence in HDW research, the cognitive hierarchy typically explains only half of the variation in normative evaluations of management actions (Vaske et al. 2013, Sponarski et al. 2015). Recent research suggests that human emotions play an influential role in processing human-wildlife interactions and may account in part for the remaining variability (Sponarski et al. 2015, Gogoi 2018, Drake et al. 2020, Hicks and Stewart 2020, Straka et al. 2020). In this study, we use a modified cognitive hierarchy to quantify the role of emotions within this framework. While cognitive hierarchy models typically examine how beliefs and attitudes affect behaviors or behavioral intentions, we instead assess their effect on normative judgements about wildlife management actions, and how emotions modify that effect. Recent work employed similar models to analyze the role of emotions in hypothetical encounters with wolves (Jacobs et al. 2014) and coyotes (Sponarski et al. 2015). These studies measured emotional responses and normative judgements about management in several encounter scenarios, which could then be structurally associated with basic beliefs about and general attitudes towards the predators. Sponarski et al. (2015) found that emotions mediated the effects of coyote-related beliefs and attitudes on lethal control acceptability in all but the most severe scenario of a coyote snarling, in which underlying attitudes towards coyotes most strongly predicted respondent acceptability of lethal control.

Still, research on emotions towards wildlife remains sparse and primarily focused on carnivore species (Slagle et al. 2012, Jacobs et al. 2014, Sponarski et al. 2015, Drake et al. 2020).

Few studies quantify emotions related to non-carnivorous species like ungulates. The *Cervidae* family of ungulates—including elk and deer species—persist in high densities across much of the United States and impact human communities through damage to agricultural crops or hobby gardens, vehicle collisions, and disease risk (DeNicola et al. 2000). Depending on the context, ungulates can elicit complex emotions, ranging from negative feelings of frustration or anxiety (Hill 2015, Stinchcomb et al. 2022) to positive feelings of awe, joy, or cultural connection (Blumenthal 1990, Hicks 2017). Yet, emotions towards these taxa have not been quantified nor accounted for by wildlife management agencies (Manfredo 2008).

Since their reintroduction to Indiana in 1934, white-tailed deer (hereafter "deer") populations have proliferated widely and now exist in high densities across the state (Brown and Parker 1997). Reported human-deer interactions are typically negative, including damage to crops and landscaping, vehicle collisions, and health or safety risks (DeNicola et al. 2000). To control deer numbers and related impacts, deer managers in Indiana widely use lethal control measures including licensed hunting and occasional culls on public lands (Swihart et al. 2020). Yet values for mutualism and coexistence are expected to be increasing, especially in urbanized areas of the state, which can affect public trust in management decisions (Manfredo et al. 2009, Dietsch et al. 2019). Beyond hunters and farmers, however, the social perceptions of deer and deer management had not been assessed before 2021. The authors of an exploratory qualitative study found emotions to be highly influential in shaping perceptions of deer and deer management, regardless of stakeholder identity. Emotions expressed towards deer depended on the type of deer encountered, its behavior, and the individual's prior experiences and existing values, motivations, and beliefs related to deer and deer management (Stinchcomb et al. 2022). In this case, emotions and cognitions did not act separately when processing experiences with deer but were intertwined in a complex cognitive system.

3.2.2 Conceptual Model

In this study, we examine how anticipated emotions within hypothetical human-deer encounters influence the acceptability of lethal control among residents of Indiana. Our modified cognitive hierarchy model includes mutualistic beliefs about wildlife, general attitudes towards deer, and scenario-specific emotional dispositions and judgements about lethal control

acceptability. We define beliefs broadly as statements or ideas that an individual takes as truths, even if they are not true in fact (Vaske and Manfredo 2012). Sets of wildlife-related beliefs "orient" underlying values to wildlife and confer personal meaning to human-wildlife interactions (Manfredo and Dayer 2004, Whittaker et al. 2006). Previous scholarship demonstrates that these Wildlife Value Orientations exist on a continuum from domination to mutualism and fundamentally explain individual variation in attitudes related to wildlife and their management (Teel and Manfredo 2010, Dietsch et al. 2019).

Attitudes are defined as "a mental state reflected by cognitive (e.g., beliefs) and affective (e.g., emotions) components" (Sponarski et al. 2015:240). More generally, attitudes comprise a directional evaluation (i.e., positive or negative) of some object that can change with different situational factors (Whittaker et al. 2006, Vaske and Manfredo 2012). For example, attitudes towards deer may vary depending on where one encounters them (e.g., natural area vs. private property), what the deer is doing (e.g., resting vs. eating crops), and the age or sex class of the deer (e.g., a large buck vs. a young fawn). Attitudes towards wildlife *management* are typically measured as the acceptability of specific actions to control a wildlife population. Following Bruskotter et al. (2009), we conceptualize management acceptability as "a judgement or decision regarding the appropriateness of a particular action or policy" (121). Such normative judgements about wildlife management are influenced most significantly by cognitive factors—such as one's beliefs about the impacts associated with a species and general attitudes towards that species—and to a lesser extent by one's social identity or affiliations (Bruskotter et al. 2009).

Generally, emotions consist of physiological, cognitive, and behavioral responses to external stimuli which influence motivation, memory, information processing, and decision-making (Izard 2007, Jacobs 2012). Emotions interact dynamically with values, beliefs, and attitudes to produce an evaluation or judgment about a stimulus, and this evaluation differs among individuals. For instance, individuals who value wildlife existence may exhibit a stronger emotional response to lethal control measures than would an individual who remains distanced from wildlife or values personal property over wildlife protection.

The cognitive process of understanding or reflecting on an emotional experience is encompassed by emotional dispositions (Sponarski et al. 2015). Representing underlying mental traits, emotional dispositions reflect one's identity, are always present, and remain relatively stable over time (Jacobs and Vaske 2019). Cognitively, individuals use these dispositions as criteria to

appraise a stimulus and judge its emotional relevance (Sponarski et al. 2015). Specific emotional dispositions towards wildlife typically evoke strong memories or personal experiences (Vaske et al. 2013) and predict behavioral decisions or normative judgments like the acceptability of management (Jacobs and Vaske 2019). Emotional dispositions thus offer a means to better measure and interpret emotional responses to wildlife.

Here, we measured Indiana residents' anticipated emotional response to a deer encounter using discrete emotional dispositions, cross-culturally recognized, such as fear, joy, anger, or anxiety (Izard 2007, Sponarski et al. 2015, Jacobs and Vaske 2019). We examine the degree to which emotions mediate the cognitive relationship among beliefs, attitudes, and management acceptability, and how this mediation changes with the type of deer encountered. Based on the specificity principle, we expect mutualistic beliefs and general attitudes to influence scenario-specific emotional dispositions. These emotions and cognitions should, together but differentially, influence the acceptability of lethal control in each deer encounter scenario (Figure 3.1). Specifically, we hypothesize that:

(1) People who hold positive general attitudes towards deer will overall be less accepting of lethal control of deer regardless of the encounter scenario.
(2) People who hold more mutualist beliefs towards deer will overall be less accepting of lethal control of deer regardless of the encounter scenario.
(3) Emotional responses will mediate the relationship between mutualist beliefs and general attitudes on the acceptability of lethal deer control.
(4) The mediating effect of emotions will differ depending on the type of deer encountered or its behaviour.

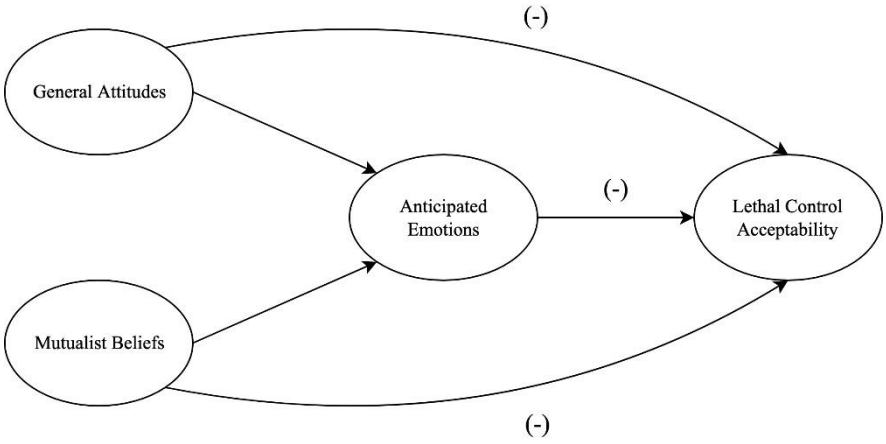


Figure 3.1. Hypothesized structural relationships among general attitudes towards deer, mutualist wildlife beliefs, scenario-specific anticipated emotions, and scenario-specific lethal control acceptability.

3.3 Materials and Methods

3.3.1 Data Collection

To quantify Indiana residents' perceptions, values, attitudes, beliefs, and emotions about deer and deer management, we implemented a state-wide survey from June through August 2021. Prior to data collection, our study design was approved by the Institutional Review Board of Purdue University. We sampled 6,000 residents randomly within a 2x4 stratified design. The higher-order stratum separated residents equally into 3,000 customers of the Indiana Department of Fish & Wildlife (DFW) and 3,000 non-customers (non-DFW). Within each of these strata, we randomly sampled 750 tax parcel addresses from four landscape types: forest, farmland, developed area, and 'integration.' We drew the 'integration' sub-sample from addresses within 6.4x6.4 km (4x4 mi) grids where ecological data have been collected by our colleagues (e.g., Delisle et al. 2022). We used ESRI ArcPro software to sample each stratum. Data were obtained from the IndianaMap geospatial database, the Indiana Department of Local Government and Finance, and the DFW. Addresses were checked for duplicates, blanks, and public or corporate ownership and re-sampled as necessary.

Survey dissemination followed Dillman's (2014) Tailored-Design Method. We sent all questionnaires via postal mail with an option to take the survey online indicated on a cover letter.

Each sampled resident was sent a pre-notification postcard, followed a week later by a survey packet, and a reminder postcard sent to non-respondents two weeks after first contact. We conducted three mailings in total, with the final two mailings sent to residents who had not yet responded via mail or online.

We received 1806 responses with 500 undeliverable, deceased, or otherwise ineligible for a response rate of 33%. We checked for non-response bias by comparing key demographic characteristics of our sample to the corresponding census data for Indiana. We used chi-squared tests to determine whether significant differences existed between our sample proportions and those expected at the state level. We consider the implications of non-response bias in our Discussion.

3.3.2 Analysis

We used structural equation modelling to examine how emotions influence the relationship among deer-related basic beliefs, attitudes, and management preferences (Figure 3.1). Anticipated emotions and management preferences were measured in each of four hypothetical encounters with deer. We developed these encounters based on recent qualitative work (Stinchcomb et al. 2022) showing that emotions expressed among Indiana residents typically depend on the age and/or sex of the deer encountered (e.g., buck vs. fawn) and how the deer behaves (e.g., foraging normally, eating crops, or appearing sick or emaciated). We thus chose to compare two classes of deer—a large buck and a fawn—and two behaviors—eating the nearest plants and looking diseased—for our encounter scenarios. In each scenario, the respondent was asked to imagine themselves walking on their property or in their neighborhood when the deer is encountered. Mutualism beliefs and general attitudes were reported elsewhere in the survey and thus did not vary with scenario context.

The structural model comprises 19 observed items, organized into four latent variables: mutualist beliefs about wildlife (7 items), general attitudes towards deer (4 items), scenario-specific anticipated emotions (7 items per scenario), and the scenario-specific acceptability of lethal deer control (1 item per scenario).

Mutualist beliefs about wildlife were: “To what extent do you disagree or agree with the following statements about wildlife in general: (i) *Animals should have rights similar to the rights*

of humans; (ii) *I view all living things as part of one big family*; (iii) *I feel a strong emotional bond with animals*; (iv) *I care about animals as much as I do about people*; (v) *We should strive for a world where humans and wildlife can live side by side without fear*; (vi) *I value the sense of companionship I receive from animals*; (vii) *Wildlife are like my family and I want to protect them*?" We measured belief items on a 5-point Likert-type scale, recoded -2 to 2 for analysis where -2 = "Strongly Disagree" and 2 = "Strongly Agree." The four general attitudes questions were: "In general, do you think of deer as: (i) *bad/good*; (ii) *dangerous/harmless*; (iii) *detrimental/beneficial*; (iv) *nuisance/asset*?" We measured each attitude on a 5-point bipolar scale, recoded from -2 to 2 for analysis. For example, the question "In general, do you think of deer as dangerous/harmless," was recoded as (-2) very dangerous; (-1) slightly dangerous; (0) neither dangerous nor harmless; (1) slightly harmless; (2) very harmless. The same scale applies to the remaining attitudes, replacing the adjective.

Anticipated emotions were based on each hypothetical scenario of encountering deer. We measured emotional responses on 5-point semantic differential scales. For example, given Scenario 2, "While walking on your property or in your neighborhood, a large buck (male deer) appears and stops on the path in front of you, then looks your way," the respondent was asked, "to what extent would you feel the following: (i) *nervous/calm*; (ii) *unexcited/excited*; (iii) *upset/pleased*; (iv) *tense/relaxed*; (v) *scared/not scared*; (vi) *sad/joyful*; (vii) *alert/not alert*?" Items were recoded from -2 (e.g., upset) to 2 (e.g., pleased) for analysis. We asked respondents to report their anticipated emotions in each of the four scenarios.

In each scenario, we also asked the respondent, "Under this scenario, how unacceptable or acceptable would it be for the following management actions: (i) *lethal control*; (ii) *nonlethal control*; (iii) *advise & monitor*; (iv) *do nothing/no management*?" For this paper, we analyze how scenarios change the acceptability of lethal control, since it is the primary method of deer management in Indiana, encompassing licensed hunting and culling or sharpshooting.

We used confirmatory factor analysis to validate the distinctions among observed indicators and the latent variables they measure. We evaluated the internal consistency (i.e., measurement reliability) of the mutualism beliefs, general attitude, and anticipated emotions latent constructs using Cronbach's alpha (Cronbach 1951). Once we established validity and reliability of the measurement models, we estimated the structural model (Figure 3.1) four times, once per scenario, using scenario-specific data for the anticipated emotion and lethal control variables. For

each scenario, we evaluated the overall model fit using a variety of criteria established by Hu and Bentler (1999), including chi-square ($\Delta\chi^2$, χ^2/df), Root Mean Square Error of Approximation (RMSEA; acceptable value .05 to .08), comparative fit index (CFI; acceptable value > 0.90), and Tucker-Lewis index (TLI; acceptable value > 0.90).

To test for the mediating role of emotions, we examined the direct, indirect, and total effects of general attitudes and mutualism beliefs on lethal control acceptability. The proportion of effect mediated by emotions was calculated as the indirect effect through emotions divided by the total effect for each construct. We evaluated how deer type and behavior influences the effects of beliefs, attitudes, and emotions on lethal control by comparing changes in these effects between scenario 2 and scenario 3 (large buck vs. fawn) and between scenario 1 and scenario 4 (eating nearest plants vs. looking diseased).

Only 14 out of 1806 responses showed missing values across the variables of interest. Since this represents a small proportion, we used the Maximum Likelihood Estimator (MLE) with missing values method for all model estimations. We report standardized coefficients to compare model fit and estimates across scenarios. All estimations and analyses were conducted using the *sem* package in STATA IC v 16.1 (StataCorp 2021).

3.4 Results

Survey respondents were 76% male and 23% female, overwhelmingly White/Caucasian (92%), with an average age of 60 and an average of 51 years of residency in Indiana (Table 3.1). Respondents self-identified primarily as either rural residents (43%) or urban residents (25%), with only 12% identifying as primarily deer hunters and 12% as primarily farmers or ranchers (Table 1).

Across our final sample, respondents generally felt positively towards white-tailed deer, reporting them as mostly harmless, good, beneficial, and an asset, but residents showed mixed agreement and disagreement on mutualism beliefs with mean values ranging from -0.51 [animal rights] to 0.69 [companionship] (Table 3.2). Residents exhibited mostly positive anticipated emotions when encountering an adult deer eating plants (scenario 1) and a fawn (scenario 3), increased alertness when encountering a large buck (scenario 2), and mostly negative emotions when encountering a diseased deer (scenario 4). Lethal control was generally rated as unacceptable

across the first three scenarios, with the least acceptable rating occurring when encountering a fawn (mean = -1.34). The average lethal control rating switched to acceptable when encountering a diseased deer (mean = 0.92; Table 3.2).

Confirmatory factor analysis empirically verified the convergent validity of observed indicators for our latent constructs and the discriminant validity among those constructs (i.e., general attitudes, mutualist beliefs, and anticipated emotions). All measurement indicators loaded onto their associated latent variable with factor loadings ≥ 0.61 except for the fifth mutualism belief (WVO11) which showed a factor loading of 0.59. We kept the fifth mutualism belief in the model due to acceptable convergent validity and item reliability. Anticipated emotions Unexcited/Excited and Alert/Not Alert showed factor loadings between 0.13 and 0.55 for most deer encounter scenarios (Table 3.2). We removed these two anticipated emotion items because they showed higher alpha-if-item-removed statistics than the overall Cronbach's alpha for three out of four emotions scales (Table 3.2).

Overall, reliabilities of items measuring general attitudes towards deer and mutualist beliefs were high (Cronbach's alpha = 0.87, 0.85 respectively). Reliabilities for the five remaining anticipated emotions in each of the four encounter scenarios were also high (Table 3.2). Post-estimation tests confirmed the convergent and discriminant validity of each structural model. Across the four scenarios, the structural models fit the data adequately with RMSEA values $\leq$ 0.08, CLI values > 0.89, and TLI values ≥ 0.87.

Table 3.1. Observed proportions on characteristics of survey respondents (n = 1806) and overall proportions from the Indiana population

	n	Sample proportion	Statewide proportion[a]
Primary Self-Identity	1771		
Farmer/Rancher		.12	.01[b]
Woodland Owner		.08	.04[c]
Deer Hunter		.12	.01[d]
Urban Area Resident		.25	.62[e]
Rural Resident		.43	.38[e]
Gender	1749		
Man		.76	.49
Woman		.23	.51
Ethnicity	1717		
White/Caucasian		.92	.62
Black/African American		.01	.12
Hispanic/LatinX		.00	.19
Asian/Asian American		.01	.06
Native American/Alaska Native		.00	.01
Pacific Islander		.00	.00
Household Income	1562		
< $50,000		.25	.43
$50,000 - $99,999		.38	.32
$100,000 - $199,999		.30	.20
> $200,000		.07	.05
Highest Education	1731		
High school or less		.32	.44
Associates degree or some college		.31	.29
College or graduate degree		.37	.27
Age	1806		
18 to 24		.01	.10
25 to 44		.15	.26
45 to 64		.39	.25
65 and older		.41	.17

[a]*Data from 2019 U.S. Census and American Community Survey, unless otherwise noted. Total Population of Indiana = 6.732 million*

[b]*2017 USDA Census of Agriculture, Indiana*

[c]*2018 USDA National Woodland Owner Survey*

[d]*2019 Indiana White-Tailed Deer Report*

[e]*Purdue University Extension Report, "Population Trends in Indiana." Proportions of the population living in urban counties and mixed rural or rural counties.*

Table 3.2. Summary, Factor Loadings, and Reliability of Structural Equation Model Variables

Variable	Description	Mean	Std Dev	Standardized Factor Loading	Item-Total Correlation	Alpha if item deleted	Cronbach's alpha
General Attitudes							0.87
In general, do you think of deer as:							
ATT_BG	Bad/Good	1.02	1.02	0.70	0.66	0.85	
ATT_DH	Dangerous/Harmless	0.67	1.14	0.71	0.67	0.85	
ATT_DB	Detrimental/Beneficial	0.58	1.12	0.88	0.79	0.80	
ATT_NA	Nuisance/Asset	0.54	1.22	0.85	0.76	0.81	
Mutualism Beliefs							0.85
WVO2	Animals should have rights similar to the rights of humans	-0.51	1.27	0.62	0.56	0.83	
WVO4	I view all living things as part of one big family	0.35	1.26	0.75	0.66	0.82	
WVO6	I feel a strong emotional bond with animals	0.27	1.15	0.61	0.58	0.83	
WVO8	I care about animals as much as I do about people	-0.13	1.29	0.62	0.58	0.83	
WVO11	We should strive for a world where humans and wildlife can live side by side without fear	0.36	1.25	0.59	0.53	0.84	
WVO12	I value the sense of companionship I receive from animals	0.69	1.09	0.65	0.62	0.83	
WVO13	Wildlife are like my family and I want to protect them	-0.04	1.21	0.84	0.73	0.81	

Table 3.2 continued

Emotional Dispositions							
Scenario 1	An adult deer appears and stops on the path in front of you, then begins eating the nearest plants						0.83
	In this scenario to what extent would you feel...						
s1_EM1	Nervous/Calm	0.99	1.12	0.70	0.62	0.79	
s1_EM2	Unexcited/Excited	0.82	1.06	0.34	0.35	0.83	
s1_EM3	Upset/Pleased	0.95	1.07	0.74	0.71	0.78	
s1_EM4	Tense/Relaxed	0.89	1.11	0.90	0.78	0.77	
s1_EM5	Scared/Not scared	1.10	1.10	0.87	0.73	0.78	
s1_EM6	Sad/Joyful	1.00	0.99	0.73	0.72	0.78	
s1_EM7	Alert/Not Alert	-0.12	1.37	0.25	0.22	0.87	
Scenario 2	A large buck (male deer) appears and stops on the path in front of you, then looks your way						0.86
	In this scenario to what extent would you feel...						
s2_EM1	Nervous/Calm	0.42	1.33	0.77	0.74	0.83	
s2_EM2	Unexcited/Excited	1.04	0.98	0.44	0.42	0.87	
s2_EM3	Upset/Pleased	0.88	1.10	0.78	0.76	0.83	
s2_EM4	Tense/Relaxed	0.43	1.24	0.86	0.81	0.82	
s2_EM5	Scared/Not scared	0.72	1.21	0.92	0.81	0.82	
s2_EM6	Sad/Joyful	0.94	0.99	0.72	0.70	0.84	
s2_EM7	Alert/Not Alert	-0.51	1.42	0.36	0.32	0.90	

Table 3.2 continued

Scenario 3	A fawn (baby deer) appears and stops on the path in front of you, then looks your way						0.85
	In this scenario to what extent would you feel...						
s3_EM1	Nervous/Calm	1.27	1.05	0.78	0.72	0.82	
s3_EM2	Unexcited/Excited	1.21	0.98	0.55	0.54	0.84	
s3_EM3	Upset/Pleased	1.29	0.97	0.82	0.79	0.81	
s3_EM4	Tense/Relaxed	1.17	1.06	0.90	0.81	0.80	
s3_EM5	Scared/Not scared	1.32	1.00	0.90	0.78	0.81	
s3_EM6	Sad/Joyful	1.27	0.96	0.76	0.75	0.82	
s3_EM7	Alert/Not Alert	-0.07	1.47	0.23	0.21	0.91	
Scenario 4	An adult deer appears and stops on the path in front of you, looking diseased						0.81
	In this scenario to what extent would you feel...						
s4_EM1	Nervous/Calm	-0.26	1.29	0.83	0.62	0.76	
s4_EM2	Unexcited/Excited	-0.03	1.10	0.13	0.21	0.83	
s4_EM3	Upset/Pleased	-0.87	1.01	0.52	0.62	0.77	
s4_EM4	Tense/Relaxed	-0.31	1.12	0.94	0.73	0.74	
s4_EM5	Scared/Not scared	0.13	1.22	0.76	0.59	0.77	
s4_EM6	Sad/Joyful	-1.05	1.05	0.40	0.54	0.78	
s4_EM7	Alert/Not Alert	-0.84	1.15	0.46	0.49	0.79	

Table 3.2 continued

Management Option			
s1_mg1	Scenario 1: How acceptable is lethal control?	-0.70	1.47
s2_mg1	Scenario 2: How acceptable is lethal control?	-0.62	1.51
s3_mg1	Scenario 3: How acceptable is lethal control?	-1.34	1.20
s4_mg1	Scenario 4: How acceptable is lethal control?	0.92	1.41

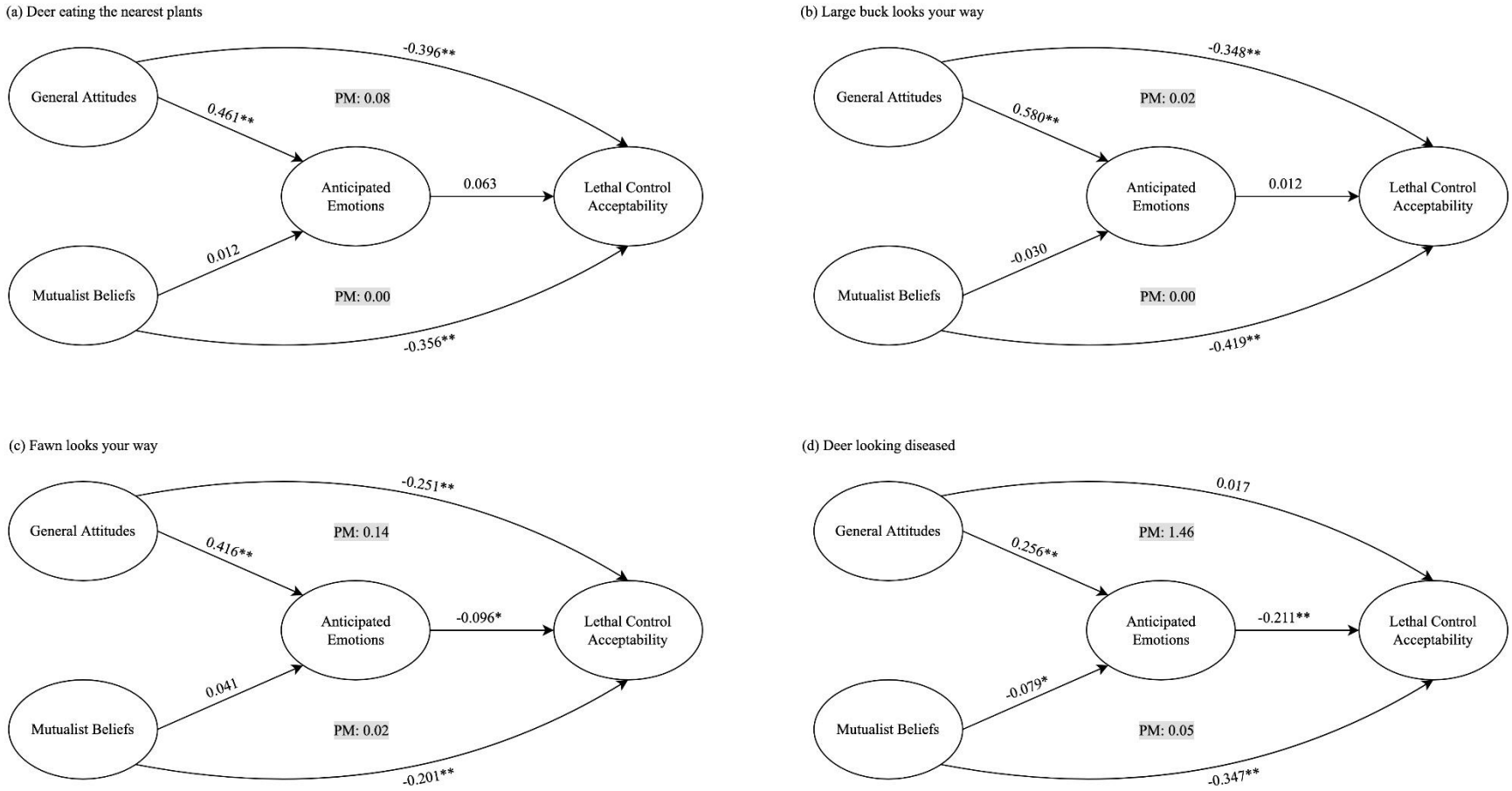


Figure 3.2. Structural equation model results for each deer encounter scenario. Proportion of effect mediated by emotions (PM) is calculated as the indirect effect of general attitudes or mutualist beliefs over their total effect on lethal control acceptability, in absolute value. Indirect effect = path from attitudes to emotions * emotions to lethal control, e.g., in (a): indirect effect = 0.461*0.063 = 0.029. Total effect = indirect + direct effect, e.g., -0.396+0.029 = -0.367. |PM| = 0.029/|-0.367| = 0.079. Stars depict effect significance. *: $p < 0.05$; **: $p < 0.001$.

Emotions interact with deer class or behavior to influence lethal control acceptability

Our first two hypotheses, that people with more positive attitudes (H1) and more mutualist beliefs (H2) would be overall less accepting of lethal control, generally held across all four scenarios. In the fourth scenario, encountering a deer looking diseased, respondents with more positive attitudes towards deer showed a slight overall acceptance of lethal control ($\lambda = 0.017$), but this direct effect was insignificant. Mutualist beliefs consistently showed a strong, significant effect on decreasing respondents' acceptability of lethal control ($-0.419 < \lambda < -0.201$; Figure 3.2).

We expected anticipated emotions to mediate the relationships between general attitudes and lethal control acceptability and between mutualist beliefs and lethal control acceptability to some degree in all scenarios (H3). Our data produced differential support for this hypothesis across the scenarios. In the first scenario, encountering a deer eating the nearest plants, anticipated emotions mediated 8% of the overall effect of general attitudes on lethal control acceptability. Emotions showed only 2% mediation of this effect when encountering a large buck. Emotional mediation nearly doubled from scenario 1 to 14% when encountering a fawn and reached nearly 150% when encountering a diseased deer (Figure 3.2). Anticipated emotions showed very little mediating influence over the effect of mutualist beliefs on lethal control acceptability, with a maximum of 5% of this effect mediated when encountering a diseased deer and only 2% mediated when encountering a fawn (Figure 3.2).

As hypothesized, the class of deer encountered affected the relationship among general attitudes, anticipated emotions, and lethal control acceptability (H4). Comparing the hypothetical encounters of a large buck versus a fawn, our data show that the direct effect of anticipated emotions on lethal control acceptability becomes statistically significant when encountering a fawn as opposed to a buck. Moreover, the indirect effect of general attitudes on lethal control acceptability (through anticipated emotions) increases in magnitude when encountering a fawn, while the total effect of general attitudes decreases. About 14% of the effect of attitudes is thus subsumed (or mediated) by anticipated emotions in the fawn scenario, compared to 2% in the large buck scenario (Figure 3.2). Together, these results indicate that the influence of anticipated emotions on resident preferences for deer management changes depending on the type of deer encountered and becomes much more prominent when encountering a young fawn, as we initially hypothesized (H4).

The behavior displayed by a deer also differentially affected the relationships in our structural model (H4). When encountering a deer eating the nearest plants, anticipated emotions had an insignificant effect on the acceptability of lethal control. Instead, positive general attitudes and mutualist beliefs both directly and significantly decreased lethal control acceptability (Figure 3.2). Conversely, when encountering a diseased deer, the entire effect of general attitudes on lethal control acceptability became mediated through anticipated emotions, with the direct effect becoming insignificant. Here, our data showed the largest and most significant direct effect of anticipated emotions on lethal control among all four scenarios (Figure 3.2). The direct effect of mutualist beliefs on lethal control remained strong and highly significant, with more mutualist beliefs decreasing respondents' acceptance of lethal control for a diseased deer.

3.5 Discussion

As hypothesized, anticipated emotions showed the strongest influence over the relationship between general attitudes and lethal control acceptability in two hypothetical deer encounters: encountering a fawn and encountering a diseased deer. Encountering a fawn doubled the mediation role of emotions compared to encountering a large buck, suggesting that positive feelings of joy, pleasure, and calm play a stronger role in residents' processing of an encounter with a young ungulate than do negative feelings of anxiety or alertness when faced with a potentially threatening adult ungulate. Since mutualistic beliefs consistently decreased lethal control acceptability across both scenarios, our data suggest that this "Bambi" effect is driven more by emotional responses than by underlying beliefs; thus, the popularized clash over *Bambi* and what it represents may be one of emotional elicitation as opposed to wildlife values. Future studies should examine whether emotional responses differ with wildlife age classes across taxa, including predator species.

Emotional responses skyrocketed when respondents imagined encountering a diseased deer, mediating the entire effect of general attitudes on lethal control acceptability, and even mediating about 5% of the effect of mutualistic beliefs. Drawing from qualitative research on Indiana residents' perceptions of deer, this implies that simply imagining the sufferings of deer can shift normative judgments about deer management towards an overwhelming acceptance of lethal control measures like culling (Stinchcomb et al. 2022). Alternatively, this spike in emotions could result from a fear of disease transmission to other deer or to humans. In hypothetical

encounters with wolves and coyotes, the fear of being attacked drove a stronger effect of emotions on lethal control acceptability (Vaske et al. 2013, Sponarski et al. 2015). Ungulates and predators thus elicit similar emotional dispositions under certain scenarios. Ungulates, however, can also elicit concerns about animal welfare—shifting the subject of emotional projection from oneself to the animal—whereas this emotional response remains undocumented in studies of human-predator encounters.

In contrast, emotions showed no effect on normative judgments about how to manage an adult deer eating the nearest plants. This lack of effect could be due to how we presented this scenario. We wanted to capture a generalized interaction that could apply to everyone in our state-wide sample. Thus, for an urban/suburban resident "eating the nearest plants" might mean the grass on the side of the neighbourhood road or their own ornamentals; while for a farmer walking their property, those plants could be their soybean crops. Our data might have elicited a larger effect if we had specified "eating the nearest crops, seedlings, or ornamentals," as deer damage to these plants tend to elicit frustration compared to a seemingly harmless deer grazing on the roadside. As presented "eating the nearest plants" acted as a control scenario in which emotions had no effect, leaving hierarchical cognitions (i.e., beliefs and attitudes) to predict lethal control acceptability. This scenario does help to show, however, that other types of human-deer interactions elicit emotional responses, specifically those involving more extreme and rare encounters.

Several recent studies analyzed the roles of emotions and cognitions simultaneously and argued for the importance of studying them together, rather than separately (Hill 2015). We move beyond this argument to suggest that emotions should be considered a component of the cognitive system (LeDoux and Brown 2017). Conceptualizing the mind as complex and adaptive allows us to account for dynamic feedbacks among cognitions, emotions, personal experiences, and external forces including social, political, and ecological stimuli (Holling 2001, Jochum et al. 2014). These feedbacks oppose the linearity of a cognitive hierarchy model and help to explain when, where, and how different emotions shift attitudes towards wildlife, even when underlying values remain similar (Jacobs and Vaske 2019, Stinchcomb et al. 2022). Differential roles of cognition and emotion, then, are attributed to the bundle of stimuli being processed (LeDoux and Brown 2017). As shown in our study, while an adult deer eating plants may produce minimal emotional stimuli, a fawn or a diseased deer stimulate complex emotions that shape people's normative judgements

about acceptable management. Moreover, cognitively reflecting on emotional memories, or emotional imagery of wildlife (Straka et al. 2020), can shift one cognition about wildlife and their management to another.

Our work, along with several other studies on human emotions towards wildlife and the environment, clearly demonstrate that emotions are not confined to private, feminized spaces but, rather, felt across various constituent groups to comparable intensities (Nightingale 2011, Buijs and Lawrence 2013, McIntosh and Wright 2017). Scholarship in political ecology reveals how people's understandings of the social-ecological world are embodied, subjective, and mediated by feeling (Thien 2005) and interact every day with conflicting subjectivities and power relations (González-Hidalgo and Zografos 2020). Such emotional conflicts over bodies, spaces, and ways of being underly most social struggles over the use, access to, and control of wildlife and other natural resources (Sultana 2011). Engaging with affective political ecology (Singh 2018) and emotional geography (Anderson and Smith 2001) can help us more holistically understand how human emotions shape human-environmental interactions, and, more specifically, the efficacy of wildlife conservation and management. As such, our work contributes to the ongoing scholarly shift away from a duality of emotion versus reason and highlights the importance of bringing alternative perspectives about human emotion into conventional wildlife management approaches.

Through participatory processes, researchers have found emotions and empathy—when their expression is safely supported—to be critical for understanding one's interrelations with others and co-producing conservation strategies (Tremblay and Harris 2018). Empathy for wildlife, specifically, elevates individuals' sense of moral obligation to nature and increases support for conservation (Ghasemi and Kyle 2021). When faced with perceived threats, injustices, or unmet needs, emotions also motivate people to organize and engage in political or environmental activism (Buijs and Lawrence 2013). Indeed, the word "emotion" stems etymologically from Latin *emovere* "to move out, agitate" and 16th century French *émotion* "a (social) moving, stirring, agitation" (Online Etymology Dictionary 2021). To emote is thus to organize feeling, thinking, and doing together (Anderson and Smith 2001). The blending of emotion and reason, considered a condition for compassionate conservation, allows discursive processes like collaborative decision-making to elucidate mutual dependencies, vulnerabilities, and interrelations (Batavia et al. 2021). As Batavia et al. (2021:4-5) describe, when we understand

compassion to mean passively suffering *with*, it reveals how we can "beget concern for all living beings…by recognizing that they, too, are embedded within and susceptible to the world."

As our findings confirm, emotions are part of the cognitive process, influencing one's reflections on an experience and their attitudes towards conservation and management possibilities. In the hypothetical encounter with a diseased deer, imagining the suffering of a non-human being produced a shared emotional response for that suffering to end and, by implication, not spread to others. Opening institutional practice to the idea of thinking and feeling simultaneously will 'enliven' collective capacities to co-manage resources (Nightingale 2011, Vasile 2019) and imagine ways of 'becoming with' others, both human and nonhuman (Haraway 2008, Singh 2018).

Returning to deer in Indiana, enlivening management with emotions, rather than repressing them, will elucidate the drivers of social conflict over deer and means of expanding public engagement in deer management. Social conflicts are often embedded in long histories of contention and power imbalances, over which each new dispute intensifies group emotions (Madden and McQuinn 2014) and motivates further escalation of conflict (Buijs and Lawrence 2013). Moreover, such inter-group conflicts foster mistrust in management when group needs remain unaddressed or not reflected in management decisions (Tremblay and Harris 2018). Although discussing emotional experiences can be uncomfortable (Madden and McQuinn 2014), doing so can uncover shared relations and moralities to wildlife (Lute and Gore 2014). A recent qualitative study with Indiana residents showed that hunters, rural landowners, and urban residents all expressed a sense of responsibility to steward deer populations, and while they disagreed over the morality of hunting, they generally agreed on goals for deer management (Stinchcomb et al., 2022). As Lute and Gore (2014) suggest, collaboratively defining shared morals like stewardship can facilitate multi-stakeholder compromise on wildlife management objectives and help narrow divides between groups with opposing value orientations, like hunters and animal rights advocates (Patterson et al. 2003). Moreover, rousing emotions of place and compassion stimulates people to assess their cognitive beliefs about an issue and focus clearly on the environmental goals of a decision (Wilson 2008, Buijs and Lawrence 2013). It remains crucial, however, to not only identify shared emotions, morals, or values but to collectively define the meanings of each and how they apply to wildlife management approaches (Patterson et al. 2003, Slagle et al. 2018).

As such, our research suggests that wildlife management and conservation will benefit from using participatory, value-based, and goal-oriented approaches to establish an iterative collaboration with diverse constituents (Slagle et al. 2018). Doing so will require a deeper integration of social science into each stage of the planning and decision-making processes (Niemiec et al. 2021). Acknowledging and allowing for the expression of emotions, experiences, and power relations among constituents plays a crucial role in defining management problems and objectives by ensuring that all relevant voices are represented, and their commonalities and differences can be safely negotiated (Brugnach and Ingram 2012). Yet in North America, integrating social science and participatory planning into wildlife management still faces substantial barriers including institutional culture, dominant ontological assumptions, and limited social science capacity (Niemiec et al. 2021).

Before concluding, we recommend caution when interpreting our results to broader populations, particularly in urban contexts. Compared to census data for Indiana, our sample contained significantly greater proportions of white/Caucasian, male, well-educated, high-income, and rural-dwelling respondents (Table 3.1). We attribute these differences to our sampling strategy, which intentionally targeted rural forestland and agricultural properties as well as existing customers of the Indiana DFW. We encourage future research to focus on non-traditional wildlife constituents in urban areas and compare their perceptions, needs, and concerns with those from more traditional constituents in rural areas.

3.6 Conclusion

Our study provides quantitative evidence that emotions are a critical part of human cognitions about wildlife. Even when people hold strong beliefs about wildlife or hunting, emotions related to deer can shift attitudes towards management approaches. In the case of white-tailed deer, empathizing with Bambi does not necessitate opposition to hunting. Rather, the "Bambi effect" can be felt by anyone encountering a fawn or, more powerfully, a suffering deer. Here, empathy is a product of the interaction among cognitions, emotions, and situational contexts. Just as emotions mediate the relationship between cognitions and normative judgements, emotions themselves are mediated by our relationships with each other and with the spaces we inhabit. The experience of situated emotions therefore differs for different genders, cultures, and their

intersections (Batavia et al. 2021), which contests notions of homogeneity within, for example, rural or urban communities (Panelli et al. 2004). Similarly, emotions expressed towards one species of wildlife differ not only by the type of animal encountered and its behaviour, but also by when, where, and by whom it is encountered. It remains crucial to acknowledge the situational dependency of human-wildlife interactions and assess local landscapes (both social and ecological) prior to developing management interventions (Zimmermann et al. 2021), as interactions can change with variation in people, their cognitions and emotions, wildlife, landcover, and socio-political leanings. Continuing to involve emotions in research on human-wildlife interactions, and conversing with political-emotional geographies, will help to elucidate when, where, and how emotions influence public preferences for wildlife populations and management or conservation outcomes.

3.7 References

Anderson, K., and S.J. Smith. 2001. Editorial: Emotional geographies. *Transactions of the Institute of British Geographers* 26:7–10.

Batavia, C., M.P. Nelson, J.T. Bruskotter, M.S. Jones, E. Yanco, D. Ramp, M. Bekoff, and A.D. Wallach. 2021. Emotion as a source of moral understanding in conservation. *Conservation Biology* 35:1380-1387.

Blumenthal, S., 1990. Spotted cattle and deer: Spirit guides and symbols of endurance and healing in "ceremony." *American Indian Quarterly* 14:367.

Brown, S.E., and G.R. Parker. 1997. Impact of white-tailed deer on forest communities within Brown County State Park, Indiana. *Proceedings of the Indiana Academy of Science* 106:39–52.

Brugnach, M., and H. Ingram. 2012. Ambiguity: The challenge of knowing and deciding together. *Environmental Science and Policy* 15:60–71.

Buijs, A., and A. Lawrence. 2013. Emotional conflicts in rational forestry: Towards a research agenda for understanding emotions in environmental conflicts. *Forest Policy and Economics* 33:104–111.

Cartmill, M. 1993. *A View to a Death in the Morning: Hunting and Nature Through History*. Cambridge, MA: Harvard University Press.

Cronbach, L.J. 1951. Coefficient alpha and the internal structure of tests. *Psychometrika* 16:297–324

Decker, D.J., S.J. Riley, and W.F. Siemer, eds. 2012. *Human Dimensions of Wildlife Management*. Baltimore, MD: The Johns Hopkins University Press.

Delisle, Z.J., R.K. Swihart, B.M. Quinby, R.D. Sample, K.J. Kinser-McBee, E.K. Tauber, and E.A. Flaherty. 2022. Density from pellet groups: Comparing methods for estimating dung persistence time. *Wildlife Society Bulletin*: in press.

DeNicola, A.J., K.C. VerCauteren, P.D. Curtis, and S.E. Hygnstrom. 2000. Managing white-tailed deer in suburban environments: A technical guide. Cornell Cooperative Extension, Ithaca, NY. https://hdl.handle.net/1813/65

Dietsch, A.M., M.J. Manfredo, L. Sullivan, J.T. Bruskotter, T.L. Teel. 2019. A multilevel, systems view of values can inform a move towards human-wildlife coexistence. In *Human–Wildlife Interactions: Turning Conflict into Coexistence*, ed. B. Frank, J.A. Glikman, and S. Marchini, 20–44. Cambridge University Press.

Dillman, D.A., J.D. Smyth, and L.M. Christian. 2014. *Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method.* 4th Edition. Wiley.

Drake, M.D., M. Nils Peterson, E.H. Griffith, C. Olfenbuttel, C.S. DePerno, and C.E. Moorman. 2020. How urban identity, affect, and knowledge predict perceptions about coyotes and their management. *Anthrozoös* 33:5–19.

Fishbein, M., and I. Ajzen. 1975. *Belief, Attitude, Intention, and Behaviour: An Introduction to Theory and Research*. Reading, MA: Addison-Wesley.

Ghasemi, B., and G.T. Kyle. 2021. Toward moral pathways to motivate wildlife conservation. *Biological Conservation* 259, 109170.

Gogoi, M. 2018. Emotional coping among communities affected by wildlife–caused damage in north-east India: Opportunities for building tolerance and improving conservation outcomes. *Oryx* 52, 214–219.

González-Hidalgo, M., and C. Zografos. 2020. Emotions, power, and environmental conflict: Expanding the 'emotional turn' in political ecology. *Progress in Human Geography* 44:235–255.

Haraway, D.J. 2008. *When Species Meet*. Minnesota, MN: University of Minnesota Press.

Hastings, A.W. 1996. Bambi and the hunting ethos. *Journal of Popular Film and Television* 24:53–59.

Hicks, J.R. 2017. Mixed emotions: A qualitative exploration of northern Illinois whitetail deer-related decision making. *Journal of Outdoor Recreation and Tourism* 18:113–121.

Hicks, J.R., and W.P. Stewart. 2020. Learning from wildlife-inspired awe. *The Journal of Environmental Education* 51: 44–54.

Hill, C.M. 2015. Perspectives of "conflict" at the wildlife–agriculture boundary: 10 years on. *Human Dimensions of Wildlife* 20:296–301.

Holling, C.S. 2001. Understanding the complexity of economic, ecological, and social systems. *Ecosystems* 4:390–405.

Hu, L., and P.M. Bentler. 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling* 6:1–55.

Izard, C.E. 2007. Basic emotions, natural kinds, emotion schemas, and a new paradigm. *Perspectives on Psychological Science* 2(3):260–280.

Jacobs, M., and J.J. Vaske. 2019. Understanding emotions as opportunities for and barriers to coexistence with wildlife. In *Human–Wildlife Interactions: Turning Conflict into Coexistence*, ed. B. Frank, J.A. Glikman, and S. Marchini, 65-84. Cambridge University Press.

Jacobs, M.H. 2012. Human emotions toward wildlife. *Human Dimensions of Wildlife* 17:1–3.

Jacobs, M.H., J.J. Vaske, S. Dubois, and P. Fehres. 2014. More than fear: Role of emotions in acceptability of lethal control of wolves. *European Journal of Wildlife Research* 60:589–598.

Jochum, K.A., A.A. Kliskey, K.J. Hundertmark, and L. Alessa. 2014. Integrating complexity in the management of human-wildlife encounters. *Global Environmental Change* 26:73–86.

LeDoux, J.E., and R. Brown. 2017. A higher-order theory of emotional consciousness. *PNAS* 114:E2016–E2025.

Long, C., T.A. More, and J.R. Averill. 2006. The subjective experience of solitude. *Proceedings of the 2006 Northeastern Recreation Research Symposium*, GTR-NRS-P-14:67-76.

Lute, M.L., and M.L. Gore. 2014. Knowledge and power in wildlife management. *Journal of Wildlife Management* 78:1060–1068.

Lutts, R.H. 1992. The trouble with Bambi: Walt Disney's Bambi and the American vision of nature. *Forest and Conservation History* 36:160–171.

Madden, F., and B. McQuinn. 2014. Conservation's blind spot: The case for conflict transformation in wildlife conservation. *Biological Conservation* 178:97–106.

Manfredo, M.J. 2008. *Who Cares About Wildlife?* New York, NY: Springer Science + Business Media LLC.

Manfredo, M.J., and A.A. Dayer. 2004. Concepts for exploring the social aspects of human–wildlife conflict in a global context. *Human Dimensions of Wildlife* 9:1–20.

McIntosh, D., and P.A. Wright. 2017. Emotional processing as an important part of the wildlife viewing experience. *Journal of Outdoor Recreation and Tourism* 18:1–9.

Niemiec, R.M., R. Gruby, M. Quartuch, C.T. Cavaliere, T.L. Teel, K. Crooks, J. Salerno, J.N. Solomon, K.W. Jones, M. Gavin, et al. 2021. Integrating social science into conservation planning. *Biological Conservation* 262(2021):109298.

Nightingale, A.J. 2011. Beyond design principles: Subjectivity, emotion, and the (ir)rational commons. *Society & Natural Resources* 24:119–132.

Nyhus, P.J. 2016. Human–wildlife conflict and coexistence. *Annual Review of Environment and Resources* 41:143–171.

Panelli, R., J. Little, and A. Kraak. 2004. A community issue? Rural women's feelings of safety and fear in New Zealand. *Gender, Place and Culture* 11:445–467.

Patterson, M.E., J.M. Montag, and D.R. Williams. 2003. The urbanization of wildlife management: Social science, conflict, and decision making. *Urban Forestry and Urban Greening* 1:171–183.

Singh, N. 2018. Introduction: Affective ecologies and conservation. *Conservation and Society* 16(1):1-7.

Slagle, K.M., J.T. Bruskotter, and R.S. Wilson. 2012. The role of affect in public support and opposition to wolf management. *Human Dimensions of Wildlife* 17:44–57.

Slagle, K.M., R.S. Wilson, J.T. Bruskotter, and E. Toman. 2018. The symbolic wolf: A construal level theory analysis of the perceptions of wolves in the United States. *Society & Natural Resources* 32:322-337.

Sponarski, C.C., J.J. Vaske, and A.J. Bath. 2015. The role of cognitions and emotions in human–coyote interactions. *Human Dimensions of Wildlife* 20:238–254.

Straka, T.M., K.K. Miller, M.H. Jacobs. 2020. Understanding the acceptability of wolf management actions: Roles of cognition and emotion. *Human Dimensions of Wildlife* 25:33–46.

Stinchcomb, T. R., Z. Ma and Z. Nyssa. 2022. Complex human-deer interactions challenge conventional management approaches: the need to consider power, trust, and emotion. *Ecology and Society* 27 (1):13. [online] URL: https://www.ecologyandsociety.org/vol27/iss1/art13/

Sultana, F. 2011. Suffering for water, suffering from water: Emotional geographies of resource access, control, and conflict. Geoforum 42:163–172.

Swihart, R.K., J.N. Caudell, J.M. Brooke, and Z. Ma. 2020. A flexible model-based approach to delineate wildlife management units. *Wildlife Society Bulletin* 44:77-85.

Teel, T.L., and M.J. Manfredo. 2010. Understanding the diversity of public interests in wildlife conservation. *Conservation Biology* 24:128–139.

Thien, D. 2005. After or beyond feeling? A consideration of affect and emotion in geography. *Area* 37:450–454.

Thrift, N. 2004. Intensities of feeling: Towards a spatial politics of affect. *Geografiska Annaler* 86 B(1):57–78.

Tremblay, C., and L. Harris. 2018. Critical video engagements: Empathy, subjectivity and changing narratives of water resources through participatory video. *Geoforum* 90:174–182.

Vasile, M. 2019. The enlivenment of institutions: Emotional work and the emergence of contemporary land commons in the Carpathian Mountains. *Journal of Environmental Planning and Management* 62:124–150.

Vaske, J., and M.P. Donnelly. 1999. Demographic influences on environmental value orientations and normative beliefs about national forest management. *Society & Natural Resources* 14:761–776.

Vaske, J.J., and M.J. Manfredo. 2012. Social psychological considerations in wildlife management. In: *Human dimensions of wildlife management*, *Human dimensions of wildlife management,* eds. D.J. Decker, S.J. Riley, and W.F. Siemer, 43–57. Baltimore, MD: John Hopkins University Press.

Vaske, J.J., J.M. Roemer, and J.G. Taylor. 2013. Situational and emotional influences on the acceptability of wolf management actions in the Greater Yellowstone Ecosystem. *Wildlife Society Bulletin* 37:122–128.

Whittaker, D., J.J. Vaske, and M.J. Manfredo. 2006. Specificity and the cognitive hierarchy: Value orientations and the acceptability of urban wildlife management actions. *Society & Natural Resources* 19: 515–530.

Wilson, R.S. 2008. Balancing emotion and cognition: A case for decision aiding in conservation efforts. *Conservation Biology* 22:1452–1460.

Zimmermann, A., P. Johnson, A.E. de Barros, C. Inskip, R. Amit, E.C. Soto, C.A. Lopez-Gonzalez, C. Sillero-Zubiri, R. de Paula, S. Marchini, et al. 2021. Every case is different: Cautionary insights about generalisations in human-wildlife conflict from a range-wide study of people and jaguars. *Biological Conservation* 260(2021):109185.

CHAPTER 4. ASSESSING DETERMINANTS OF PUBLIC SATISFACTION WITH WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) MANAGEMENT

4.1 Abstract

Wildlife agencies in the U.S. face mounting pressure to incorporate broader public interests into wildlife management so they can realize the principles of the public trust doctrine and good governance. Public satisfaction is a key component of good governance, but satisfaction with wildlife management has overwhelmingly focused on a traditional customer model (i.e., hunters, fishers, recreators) and wildlife-related experiences, rather than agencies and their overall performance. I draw from literature in political science, organization and marketing research, and conservation social science to develop a concept of satisfaction with wildlife management that includes agency performance, service quality and trust in the agency and its information. I use data collected from a 2021 survey of Indiana residents about white-tailed deer (*Odocoileus virginianus*) to construct a satisfaction index and analyze the social and cognitive determinants of satisfaction with deer management. Quantile regression models revealed that significant predictors of overall satisfaction were management acceptability, deer-related concerns, general deer attitudes, beliefs about hunting, and respondent self-identity, wildlife value orientation, and allowance of hunting on their property. A component-level analysis of my index suggests that perceived acceptability of management approaches and deer-related concerns most strongly affected performance and quality measures, whereas demographic characteristics exerted the strongest influences on trust. Future research should advance the multidimensional conception of satisfaction used herein and associate it with key variables I did not fully capture including perceived control, psychological distance, and norms of knowledge exchange between wildlife agencies and the public. Expanding agency conceptions of the public and its satisfaction represents a critical step towards public trust thinking and the practice of good wildlife governance.

4.2 Introduction

Developing a more refined concept of public satisfaction with wildlife management could help agencies incorporate more diverse public interests into management planning and overcome

inter-cultural differences with their constituents (AFWA and WMI 2019). A close examination of public satisfaction enables agencies to determine why their constituents may be unsatisfied with certain management programs and identify with whom they should begin to improve their relationships. In the United States, under the Public Trust Doctrine, natural resource agencies hold wildlife in trust for all its potential public beneficiaries (Jacobson et al. 2010), so improving relationships with individuals and groups and increasing public satisfaction with wildlife management is critical for achieving this public trust principle (Coleman et al. 2019).

In the North America, wildlife managers have overwhelmingly focused measurements of satisfaction on the 'customer,' examining factors that determine whether their traditional customers (i.e., hunters, anglers, or recreators) are satisfied with their experiences (Hendee 1974, Chanter and Owen 1976, Tian-Cole et al. 2002, Gruntorad et al. 2020). Recent studies have also examined customer satisfaction with specific management approaches used by these agencies (Schroeder et al. 2017, Pruitt et al. 2021), and some acknowledge that customer satisfaction is multidimensional (Hammitt et al. 1990, Vaske et al. 1996, Manfredo et al. 2004). But the natural resource literature does not clearly define public satisfaction; satisfaction is often used interchangeably with the appeal, acceptability, or perceived effectiveness of certain management programs. Moreover, a customer-based approach does not adequately capture satisfaction with wildlife management because it does not incorporate broader public interests. Agencies must therefore work to identify diverse groups beyond the traditional customer and clearly define satisfaction with wildlife management to truly serve the public trust (Jacobson et al. 2010).

Scholarship in business and governance provides insight into how natural resource agencies can define a multidimensional measure of public satisfaction. Customer satisfaction depends critically on service quality and performance, and dissatisfaction occurs when individuals' expectations exceed the quality or performance of a service they experience (Oliver 1980, Matzler et al 2003, Fulton and Hundertmark 2004, Tonge and Moore 2007). Studies in parks and protected area management have used multiple customer preferences such as crowding, environmental conditions, and sensory experiences to measure the gap between visitors' expected quality of services (e.g., public land activities, access, and maintenance) and visitors' evaluation of their experience (Hollenhorst and Gardner 1994, Ryan and Cessford 2003, Tonge and Moore 2007). But another determinant of public satisfaction that agencies do not fully consider is how customer service relates to good governance. Good governance can be evaluated as both the quality of

services provided by an agency and the integrity of democratic processes, as perceived by the public (Kelly and Swindell 2002, Van Ryzin 2007, Ariely 2013). Overall satisfaction with governance typically depends on the degree to which citizens perceive their governing bodies to be transparent and trustworthy (Park and Blenkinsopp 2011). Therefore, to develop a more holistic measure of satisfaction, wildlife management agencies need to consider how the public perceives their decision-making processes and governance capacities.

Building trust between agencies and the public represents a key practice of good governance, particularly in natural resource contexts (Stern and Coleman 2015). Like satisfaction, trust is based upon one's expectations of the target's intentions or behavior (Rousseau et al. 1998, Stern and Coleman 2015), and trust erodes when those expectations are unmet. When organizations betray public or workplace trust in their operations—through fraud, corruption, exploitation, or negligence—their employees retaliate through reduced effort or public protest (Gillespie and Dietz 2009). Similarly, distrust in the competencies or values of government agencies often motivates civic engagement as a means of dissent (Smith et al. 2013, Inglehart and Norris 2016). Recent events in Wisconsin, USA, provide a prime example of how trust in wildlife management agencies can quickly erode. During the wolf (*Canis lupus*) hunting season in February 2021, hunters killed 97 more wolves than the Wisconsin Department of Natural Resources had anticipated. This perceived oversight led to multiple lawsuits from animal rights groups and six Native American (Chippewa) tribes, which resulted in a judicial injunction placed on the November wolf hunting season (Kaeding 2021, Richmond 2021). In this case, a lack of transparency about how the agency came to their initial quota and a lack of communication with non-hunting stakeholders fostered public dissatisfaction with the agency's wolf management approaches and distrust in the agency's competence and credibility (Stern and Coleman 2015, Manfredo et al. 2017). This transparency-trust relationship occurs in other wildlife management contexts (Sjölander-Lindqvist et al. 2015, Riley et al. 2018, Schmidt et al. 2018) and demonstrates a clear connection between informational and organizational trust (Denize and Young 2007). As such, evaluating public satisfaction in wildlife governance requires that agencies measure informational trust and transparency along with trust in their technical competencies and credibility.

Although scholars identify three major dimensions of trust in wildlife agencies—technical competency, shared value similarity, and procedural fairness (Needham and Vaske 2008, Smith et

al. 2013)—recent studies suggest that procedural fairness is the most important predictor of trust between natural resource agencies and their constituents (Riley et al. 2018, Ford et al. 2020). Procedural fairness involves equitably including diverse public voices in decision-making processes, being transparent about how and why decisions are made, and treating all public interests equally (Young et al. 2016, Riley et al. 2018). Agency credibility and perceived fairness is compromised when sectors of the public perceive management decisions to favor the interests of specific groups over others (Lute and Gore 2014, Stinchcomb et al. 2022). But wildlife administrators often struggle to address imbalances across constituents, likely because they lack awareness about the factors that constitute public trust in their agency. Such awareness is typically acquired by specialists in the human dimensions of wildlife management, but these individuals make up a tiny fraction of wildlife agency staff (Morales et al. 2021). Developing greater trust between agencies and their constituents is an important part of agencies becoming more relevant to new customers. Recent guidance from the Association of Fish and Wildlife Agencies alluded to the factors that influence public trust in natural resource management, but it did not explicitly define trust nor its multiple dimensions (AFWA and WMI 2019). Therefore, agencies need to first understand the importance of procedural trust and its relation to satisfaction, then measure the determinants of trust among their constituents, and finally improve trust through visible efforts to make decision-making processes more inclusive, unbiased, and transparent.

Trust between agencies and their constituents remains highly nuanced and context bound and depends on the characteristics of the agency or organization of interest and the local peoples, groups, or communities it serves (Saunders 2012). For example, Scandinavian communities place higher trust in government agencies than most European countries due to their collectivist cultures and extensive government provision of social benefits (Fitzgerald and Wolak 2014). In the North American Arctic, communities were less likely to trust organizations associated with extractive industries or law enforcement and more likely to trust those associated with local fish and wildlife management (Schmidt et al. 2018). Trust also varies with region, gender, and education level (Schmidt et al. 2018), and public satisfaction varies with individual characteristics, motivations, interpersonal history with the organization, and intergroup conflicts over service inequalities (Kelly 2005). The satisfaction of landowners in Texas and South Africa with conservation easement and private land stewardship programs determined their continued participation (Stroman and Kreuter 2014, Selinske et al. 2015). But their satisfaction varied with motivations

and place-based values, and it eroded when conservation programs did not meet their expectations for services like technical support and personal contact with program staff (Selinske et al. 2015). Analyzing individual, group, and community differences in expected and perceived agency performance is key to gauging public satisfaction with natural resource management. Further, these analyses can help agencies understand what, where, and why agency efforts and outcomes are inequitably distributed (Kelly 2005).

Overall, prior research has revealed four major components that influence public satisfaction with natural resource governance: (i) performance of governing agencies; (ii) the quality of services they provide; (iii) trust between agencies and the public, contingent on transparency, procedural fairness, and communication; and (iv) individual characteristics and local contexts. Moving beyond a simple rating, satisfaction can be conceptualized as the gap between expectations and outcomes, where outcomes for the public include performance, service quality, trust, and information dissemination. Separately, however, neither trust and transparency nor performance and service quality alone will enable us to completely understand public satisfaction or how wildlife agencies can better fulfil their role as public trust administrators. Despite their conceptual linkages, studies in wildlife management have rarely brought perceptions of management performance, agency trust, and informational trust together to provide a holistic view of public satisfaction with wildlife agencies. Here, I combine these constructs into one index to tease apart the various determinants of satisfaction with the management of white-tailed deer (*Odocoileus virginianus*, hereafter "deer"*)* in Indiana, USA. By evaluating satisfaction, trust, and their determinants, I take an important first step toward addressing social concerns about and conflicts over deer and deer management. My index, constructed with survey data, provides an accessible tool for agencies to identify which segments of the public are dissatisfied with wildlife management and what drives that dissatisfaction. Applying such an index will help agencies incorporate broader public interests into wildlife management, thus moving closer to the public trust ideal.

4.2.1 Research context and objectives

Since their reintroduction to Indiana in 1934, white-tailed deer populations have proliferated widely and now exist across the state (Brown and Parker 1997). Through movement

and foraging behavior, they impact forest ecosystems (Brown and Parker 1997), agricultural activities (Brown et al. 1978, Curtis and Lynch 2001), and public health and safety from risks of vehicle collisions and disease transmission (Marcoux and Riley 2010, INDFW 2011, Urbanek et al. 2015). Yet people also derive benefits from deer including hunting opportunities, awe, enjoyment, and cultural connection (King 2002, Hicks 2017, McIntosh and Wright 2017). As values for wildlife continue to shift across the U.S., agencies face increasing impetus to include broader constituencies and social science research into wildlife management (Manfredo et al. 2009, AFWA and WMI 2019)

Deer and wildlife management in Indiana falls under the authority of the Indiana Department of Natural Resources (IN-DNR) Division of Fish & Wildlife (DFW). I referred in the survey only to the IN-DNR, so I refer to this governing agency throughout my paper. As part of their annual deer management survey, the IN-DNR asks licensed hunters and anglers to rate their satisfaction with deer management on a scale 1 to 100 and, more recently, includes questions about customer trust in the IN-DNR's competencies and credibility. But the survey does not include procedural trust nor other dimensions of satisfaction and does not reach Indiana residents who are not license holders. Thus, the IN-DNR sought a more inclusive and multidimensional measure of public satisfaction with deer management.

My study has three main objectives. First, I develop a satisfaction index from survey questions on the IN-DNR's performance, the quality of deer management, agency trust, and informational trust. Second, I determine which major psychological and demographic characteristics most influence respondents' satisfaction scores and how these predictors vary with index components. Finally, I evaluate the utility of my index for wildlife and natural resource management.

4.3 Methods

4.3.1 Data Collection

To quantify Indiana residents' perceptions of deer management and the IN-DNR, I implemented a statewide survey from June to August 2021. Prior to data collection, my study design was approved by the Institutional Review Board of Purdue University. I sampled 6,000 residents randomly within a 2x4 stratified design. The higher-order stratum separated residents

equally into 3,000 customers of the Indiana DFW and 3,000 non-customers (non-DFW). Within each of these strata, I randomly sampled 750 tax parcel addresses from four landscape types: forest, farmland, developed area, and 'integration.' I drew the 'integration' sub-sample from addresses within 6.4x6.4 km (4x4 mi) grids used in ongoing studies by colleagues to collect ecological data. I used ESRI ArcPro software to sample each stratum. Data were obtained from the IndianaMap geospatial database, the Indiana Department of Local Government and Finance, and the DFW. Addresses were checked for duplicates, blanks, and public or corporate ownership and re-sampled as necessary.

Survey dissemination followed Dillman's (2014) Tailored-Design Method. I sent all questionnaires via postal mail with an option to take the survey online indicated on a cover letter. Each sampled resident was sent a pre-notification postcard, followed a week later by a survey packet, and a reminder postcard sent to non-respondents two weeks after first contact. I conducted three mailings in total, with the final two mailings sent to residents who had not yet responded via mail or online.

I checked for non-response bias by comparing key demographic characteristics of my sample to the corresponding census data for Indiana. I used chi-squared tests to determine whether significant differences existed between my sample proportions and those expected at the state level. I consider the implications of non-response bias in my Discussion.

4.3.2 Data Analysis

Based on the literature, I presumed satisfaction with deer management to be comprised of the following four components: an individual's (1) perception of the IN-DNR's performance in deer management, (2) perception of the efficacy of existing management approaches, (3) trust in the IN-DNR's technical capacity, procedural fairness, and value similarity, and (4) trust in information coming from the IN-DNR. I expected multiple other factors to predict satisfaction including general attitudes toward deer, concerns about deer populations, beliefs about hunting, respondent self-identity, and other demographic characteristics.

To create an index of satisfaction, I combined the following items from my survey to measure the four components listed above: overall rating of the IN-DNR's deer management, effectiveness ratings for existing deer management approaches, level of trust in the IN-DNR, and

level of trust in information sources from the IN-DNR (Table 4.1). I assessed the inter-item reliability for each component using Cronbach's alpha (Cronbach 1951). Exploratory factor analyses were conducted to determine whether survey responses used to measure each component for creating the satisfaction index loaded onto the expected number of factors. For example, a factor analysis showed that my data did not sort into the three hypothesized elements of agency trust: technical competency, procedural fairness, and value similarity. Instead, all items on this question loaded onto a single factor with factor loadings of 0.83-0.89 (Table 4.1). For these cases, I averaged responses across the survey questions to create one factor score for that component. Although agency and informational trust could be similar measures, a combined principal-components factor analysis of these items revealed that they loaded onto separate factors, so they were not pooled together. For management efficacy, items loaded onto a single factor, but with variable factor loadings from 0.64 to 0.83 (Table 4.1). Each item was thus multiplied by its factor loading which served as a weight, then summed together to create the composite variable. I generated a final satisfaction score for each respondent by summing across the respondent's standardized management efficacy score, average scores for agency trust and informational trust, and their overall rating of the IN-DNR, producing final values between -10 and 22.

Next, I used the satisfaction index as the dependent variable in regression analyses to determine what variables best predict satisfaction. Independent variables in the full model included a respondent's average acceptability of lethal management methods (e.g., licensed hunting, culling, Community Hunting Access Programs (CHAPs)) and of nonlethal management methods (e.g., contraception, translocation, information provision), average level of deer-related direct concerns (e.g., forest damage, crop damage, vehicle collisions) and indirect concerns (e.g., disease transmission, hunting opportunities, population sizes, urban area management), average general attitude toward deer (positive/negative), average agreement with beliefs about deer hunting, and respondent characteristics including self-identity, hunter status, wildlife value orientation, whether they allow hunting on their land, organizational membership, political ideology, gender, and having graduated college. Initial testing of an un-weighted Ordinary Least Squares (OLS) model revealed significant issues with heteroscedasticity and kurtosis across most independent variables. Under a weighted OLS model my data still contained substantial outliers. I thus used quantile regression via the *quantreg* command in STATA 16 with bootstrapped standard errors. Quantile regression is robust to heteroscedastic errors, outliers, and spiked survey responses (Cade and

Noon 2003, Sauzet et al. 2019). Instead of estimating the mean of the dependent variable and minimizing the sum of squared residuals, quantile regression can estimate the median and minimizes the sum of the absolute residuals (Koenker and Bassett 1978). Rates of change (i.e., slopes) can be estimated at any quantile of the response variable, conditional on the predictor variables (Cade and Noon, 2003). To observe whether the relationship of covariates changes at the extremes of the satisfaction index distribution versus the median, I estimated regression parameters for the 10^{th}, 50^{th} (median), and 90^{th} quantiles of satisfaction.

To examine the patterns of variation within my final satisfaction index, I conducted quantile regression analyses using each of the index components as dependent variables. This allowed us to compare the influence of independent variables across each component of the index. Each regression equation was the same as that for the overall satisfaction index, but with management efficacy, agency trust, informational trust, and IN-DNR score each substituted in place of the satisfaction index.

Finally, due to differing factor loadings for items comprising management efficacy, I conducted an item-level analyses of this variable using the same predictors as above. Since survey items were Likert-type scales, I conducted multinomial logistic regressions on each item via the *mlogit* command in STATA after finding that multiple predictor variables violated the proportional odds assumption for ordinal models (Long and Freese 2006).

Table 4.1. Description, summary statistics, and factor loadings for variables comprising the satisfaction index and independent variables of interest

Variable	Description of variable and value levels (%of responses at each level)	Mean	S.D.	Factor loading
Overall Satisfaction	Continuous – an index comprised of the variables below. Final values range from -10.33 to 21.33.	9.16	5.47	n/a
Satisfaction Components				
Management Efficacy	Continuous - composite variable of the items for *"how ineffective or effective do you consider existing actions to manage deer in Indiana?"*	2.35	2.91	n/a
Licensed Hunting	-2 = Very ineffective (2%), -1 (3%); 0 = neither (15%); 1 (31%); 2 = Very effective (45%)	1.18	0.96	0.64
Culling deer in specific areas	-2 = Very ineffective (5%), -1 (6%); 0 = neither (30%); 1 (29%); 2 = Very effective (27%)	0.69	1.09	0.76
Urban Deer Reduction Zones (DRZs)	-2 = Very ineffective (5%), -1 (7%); 0 = neither (35%); 1 (25%); 2 = Very effective (23%)	0.58	1.08	0.83
Community Hunting Access Programs (CHAPs)	-2 = Very ineffective (7%), -1 (9%); 0 = neither (41%); 1 (20%); 2 = Very effective (18%)	0.35	1.10	0.80
Provide Advice or Information	-2 = Very ineffective (5%), -1 (9%); 0 = neither (35%); 1 (24%); 2 = Very effective (22%)	0.51	1.12	0.64
IN-DNR rating	Continuous - *On a scale of 1 to 10, how well is the IN-DNR managing deer in Indiana?*	6.67	2.11	
Agency Trust	Continuous - composite variable of the items for *"How much do you distrust or trust the Indiana DNR to do the following?"*	0.51	0.94	
Employ people with the scientific expertise necessary to manage deer in Indiana	-2 = Distrust (4%), -1 (6%); 0 = neither (28%); 1 (31%); 2 = Trust (26%)	0.74	1.05	0.83
Employ people who know what needs to be done to manage deer in Indiana	-2 = Distrust (4%), -1 (8%); 0 = neither (26%); 1 (33%); 2 = Trust (24%)	0.69	1.06	0.87
Listen to the public	-2 = Distrust (8%), -1 (11%); 0 = neither (33%); 1 (29%); 2 = Trust (15%)	0.35	1.12	0.87
Treat members of the public equally	-2 = Distrust (7%), -1 (10%); 0 = neither (31%); 1 (28%); 2 = Trust (19%)	0.46	1.14	0.84

Table 4.1 continued

Communicate unbiased information to the public	-2 = Distrust (5%), -1 (9%); 0 = neither (31%); 1 (30%); 2 = Trust (21%)	0.54	1.10	0.89
Share similar values as me for deer management	-2 = Distrust (6%), -1 (9%); 0 = neither (36%); 1 (28%); 2 = Trust (17%)	0.45	1.07	0.86
Consider the opinions and needs of people like me when making deer management decisions	-2 = Distrust (7%), -1 (12%); 0 = neither (34%); 1 (27%); 2 = Trust (17%)	0.38	1.12	0.87
Informational Trust	Continuous - composite variable of the items for *"How trustworthy do you consider the following sources of deer management information in Indiana?"*	0.89	0.88	
IN-DNR website or newsletters	-2 = Very untrustworthy (2%), -1 (4%); 0 = neither (28%); 1 (33%); 2 = Very trustworthy (27%)	0.84	0.96	0.89
District Conservation Officers	-2 = Very untrustworthy (2%), -1 (4%); 0 = neither (23%); 1 (34%); 2 = Very trustworthy (30%)	0.92	0.97	0.90
District Wildlife Biologists	-2 = Very untrustworthy (2%), -1 (3%); 0 = neither (25%); 1 (33%); 2 = Very trustworthy (30%)	0.92	0.96	0.93
District Foresters	-2 = Very untrustworthy (2%), -1 (4%); 0 = neither (27%); 1 (32%); 2 = Very trustworthy (28%)	0.86	0.98	0.91
Independent Variables	**Description of variable and value levels (%of responses at each level)**	**Mean**	**S.D.**	**Factor loading**
Management Acceptability	*In your area, how unacceptable or acceptable do you consider the following potential actions to manage deer?*			
Lethal	Continuous - composite variable of lethal methods	0.24	3.41	n/a
Increasing licensed hunting	-2 = very unacceptable (14%); -1 (10%); 0 = neither (23%); 1 (23%); 2 = very acceptable (26%)	0.38	1.37	0.89
Culling deer populations	-2 = very unacceptable (19%); -1 (15%); 0 = neither (28%); 1 (19%); 2 = very acceptable (15%)	-0.05	1.34	0.85
Creating a Community Hunting Access Program	-2 = very unacceptable (18%); -1 (15%); 0 = neither (33%); 1 (17%); 2 = very acceptable (13%)	-0.09	1.28	0.82

Table 4.1 continued

Nonlethal	Continuous - composite variable of nonlethal methods	-1.01	2.83	n/a
Using contraception to control deer	-2 = very unacceptable (43%); -1 (15%); 0 = neither (22%); 1 (9%); 2 = very acceptable (8%)	-0.80	1.31	0.79
Trapping & relocating deer	-2 = very unacceptable (38%); -1 (18%); 0 = neither (22%); 1 (11%); 2 = very acceptable (8%)	-0.69	1.32	0.86
Providing advice or information about deer	-2 = very unacceptable (8%); -1 (9%); 0 = neither (33%); 1 (24%); 2 = very acceptable (23%)	0.47	1.18	0.51
Deer Concerns	How concerned are you about the following issues related to deer?			
Direct	Continuous - composite variable of direct concerns	0.33	3.08	n/a
Vehicle collisions with deer	-2 = Not at all concerned (7%), -1 (10%); 0 = neutral (24%); 1 (25%); 2 = Very concerned (32%)	0.66	1.23	0.76
Deer damage to crops, gardens, or landscaping	-2 = Not at all concerned (17%), -1 (18%); 0 = neutral (28%); 1 (17%); 2 = Very concerned (18%)	0.04	1.33	0.82
Deer damage to forests	-2 = Not at all concerned (26%), -1 (19%); 0 = neutral (28%); 1 (15%); 2 = Very concerned (10%)	-0.37	1.29	0.74
Indirect	Continuous - composite variable of indirect concerns	1.54	4.67	n/a
Disease transmission related to deer	-2 = Not at all concerned (11%), -1 (12%); 0 = neutral (22%); 1 (26%); 2 = Very concerned (27%)	0.47	1.32	0.63
Current deer population sizes	-2 = Not at all concerned (10%), -1 (11%); 0 = neutral (29%); 1 (25%); 2 = Very concerned (23%)	0.40	1.25	0.64
Deer hunting opportunities	-2 = Not at all concerned (31%), -1 (11%); 0 = neutral (17%); 1 (16%); 2 = Very concerned (23%)	-0.14	1.57	0.76
Deer welfare	-2 = Not at all concerned (6%), -1 (8%); 0 = neutral (26%); 1 (29%); 2 = Very concerned (28%)	0.67	1.16	0.77
Managing deer in urban areas	-2 = Not at all concerned (14%), -1 (14%); 0 = neutral (32%); 1 (22%); 2 = Very concerned (17%)	0.15	1.27	0.50

Table 4.1 continued

Deer Attitudes	Continuous - composite variable of the items for *"In general, do you think of deer as:"*	0.71	0.96	n/a
Bad/Good	-2 = Very Bad (1%); -1 = slightly bad (4%); 0 = neither (28%); 1 = slightly good (20%); 2 = very good (42%)	1.02	1.02	0.81
Dangerous/Harmless	-2 = Very dangerous (4%); -1 = slightly dangerous (11%); 0 = neither (28%); 1 = slightly harmless (23%); 2 = very harmless (30%)	0.67	1.14	0.81
Detrimental/Beneficial	-2 = Very detrimental (4%); -1 = slightly detrimental (11%); 0 = neither (32%); 1 = slightly beneficial (22%); 2 = very beneficial (26%)	0.58	1.12	0.89
Nuisance/Asset	-2 = Very nuisance (6%); -1 = slightly nuisance (14%); 0 = neither (27%); 1 = slightly asset (21%); 2 = very asset (28%)	0.54	1.22	0.88
Hunting Beliefs	Continuous - composite variable of the items for "To what extent do you agree with the following statements about deer hunting?"	4.43	3.36	n/a
Hunting is the most effective way to control deer populations	-2 = Strongly disagree (3%); -1 (4%); 0 = neither (16%); 1 (29%); 2 = strongly agree (46%)	1.13	1.04	0.82
Hunters will harvest enough deer to control population numbers	-2 = Strongly disagree (4%); -1 (9%); 0 = neither (28%); 1 (29%); 2 = strongly agree (27%)	0.69	1.10	0.64
Most hunters are responsible and safe with their weapons	-2 = Strongly disagree (3%); -1 (7%); 0 = neither (20%); 1 (34%); 2 = strongly agree (33%)	0.90	1.05	0.73
Hunting is a humane way to control deer populations	-2 = Strongly disagree (3%); -1 (4%); 0 = neither (15%); 1 (28%); 2 = strongly agree (48%)	1.16	1.04	0.87
Hunting does not present a safety risk to myself or others*	-2 = Strongly disagree (6%); -1 (12%); 0 = neither (20%); 1 (25%); 2 = strongly agree (35%)	0.72	1.24	0.52
Hunting is an important part of Indiana's culture	-2 = Strongly disagree (2%); -1 (3%); 0 = neither (13%); 1 (25%); 2 = strongly agree (54%)	1.29	0.97	0.77

**Reverse-coded to align with the direction of other items. Original wording: "Hunting presents a safety risk to myself or others."*

I examined the marginal effects of independent variables on the predicted probabilities of rating each management method as ineffective, effective, or neither. I collapsed the two highest ("very effective," "effective") categories into one "effective" rating and the two lowest categories ("very ineffective," "ineffective") into one "ineffective" rating to reduce the complexity of my analysis. I present the marginal effect of a standard deviation change in significant predictor variables, as this allows us to compare the magnitude of each variable's effect on predicted probabilities of an ineffective, neither, and effective rating across models (Mize et al. 2019).

4.4 Results

4.4.1 Descriptive statistics

I received 1,806 survey responses with 500 undeliverable, deceased, or otherwise ineligible for a response rate of 33%. Survey respondents were 76% male and 23% female, overwhelmingly White/Caucasian (92%), with an average age of 60 and an average of 51 years of residency in Indiana (Table 4.2). Respondents self-identified primarily as either rural residents (43%) or urban residents (25%), with 12% identifying as primarily deer hunters and 12% as primarily farmers or ranchers (Table 4.2). When asked to select multiple options with which they self-identify, just over one third of respondents (37%) identified as a deer hunter. I refer to these residents throughout the paper as "hunters." Respondents were also asked whether they allow licensed hunting on their property. Respondents split equally between Yes (36%) and No (36%), with the remaining 28% indicating that either local ordinances prohibit hunting, or they don't own private land suitable for hunting (Table 4.2). I grouped these respondents into a "cannot allow hunting" category and refer to them as such throughout this paper. Most respondents held pluralist wildlife value orientations (42%), followed closely by traditionalist orientations (35%). Only 17% of respondents were categorized with a mutualist orientation with few respondents orienting as distanced from wildlife (6%).

Across my final sample, respondents showed positive satisfaction with deer management ($\bar{x}$ = 9.2, sd = 5.5, Table 4.1). Most respondents found existing deer management methods to be very effective (18% - 45%), effective (20% - 31%), or neither effective nor ineffective (15% -41%; Table 4.1). The average rating given to the IN-DNR for deer management was a 6.7 (sd = 2.1). Most respondents trusted the technical competency of the IN-DNR (24 – 33%) but reported

slightly lower trust in the agency's procedural fairness and value similarity (15% - 30%; Table 4.1). A third of respondents found IN-DNR sources of deer information to be somewhat trustworthy (32% - 34%) and 27% - 30% found these sources to be very trustworthy (Table 4.1). On items comprising my independent variables, respondents found licensed hunting and information provision to be acceptable or very acceptable (23% - 26%), were split on the acceptability of culling and CHAPs (15-19% unacceptable, 13-19% acceptable), and found both contraception and trap-and-relocate methods to be very unacceptable (43% and 38%, Table 4.1). Most respondents were concerned about deer-vehicle collisions (25% - 32%), not concerned about deer damage to forests (19% - 26%) and split in their concern about deer-related damage to crops, gardens, or landscaping (17-18% concerned and not concerned, Table 4.1). Respondents were neutral (22% - 32%) or concerned (22 – 29%) about most indirect deer-related issues except for hunting opportunities (31% not concerned, Table 4.1). Most respondents held positive (20% - 42%) or neutral (27 - 32%) attitudes towards deer and agreed with beliefs about hunting (25% - 54%, Table 4.1).

4.4.2 Predictors of satisfaction

Significant predictors of satisfaction include management acceptability, deer-related concerns, general deer attitudes, beliefs about hunting, and respondents' characteristics which includes self-identity, wildlife value orientation, and whether they allowed hunting on their property. I summarize the effects of these predictors in groups of acceptability and concerns, other cognitions (attitudes and beliefs), and respondent characteristics.

Table 4.2. Observed proportions on characteristics of survey respondents (n = 1806) and overall proportions from the Indiana population

Variable	n	Sample proportion	Statewide proportion[a]
Primary Self-Identity	1771		
Farmer/Rancher		.12	.01[b]
Woodland Owner		.08	.04[c]
Deer Hunter		.12	.01[d]
Urban Area Resident		.25	.62[e]
Rural Resident		.43	.38[e]
Identifies as a deer hunter	1806	.37	.01[d]
Allows Hunting on Property	1761		
Yes		.36	n/a
No		.36	n/a
Cannot ("local ordinances prohibit hunting" + "I don't own private land suitable for hunting")		.28	n/a
Gender	1749		
Man		.76	.49
Woman		.23	.51
Ethnicity	1717		
White/Caucasian		.92	.62
Black/African American		.01	.12
Hispanic/LatinX		.00	.19
Asian/Asian American		.01	.06
Native American/Alaska Native		.00	.01
Pacific Islander		.00	.00
Household Income	1562		
< $50,000		.25	.43
$50,000 - $99,999		.38	.32
$100,000 - $199,999		.30	.20
> $200,000		.07	.05
Highest Education	1731		
High school or less		.32	.44
Associates degree or some college		.31	.29
College or graduate degree		.37	.27
Age	1806		
18 to 24		.01	.10
25 to 44		.15	.26
45 to 64		.39	.25
65 and older		.41	.17

[a]*Data from 2019 U.S. Census and American Community Survey, unless otherwise noted. Total Population of Indiana = 6.732 million*
[b]*2017 USDA Census of Agriculture, Indiana*
[c]*2018 USDA National Woodland Owner Survey*
[d]*2019 Indiana White-Tailed Deer Report*
[e]*Purdue University Extension Report, "Population Trends in Indiana." Proportions of the population living in urban counties and mixed rural or rural counties*

Acceptability and concerns

Acceptability of lethal management methods (licensed hunting, culling, and hunting programs) consistently increased overall satisfaction with deer management by 0.29-0.41 ($p < 0.0001$, all quantiles); this effect did not change over quantiles of satisfaction (Table 4.3). Acceptability of nonlethal management methods (contraception, translocation) also increased satisfaction with management by 0.16 at the predicted median ($p = 0.033$) and by 0.18 at the predicted 0.90 quantile ($p = 0.009$; Table 4.3).

Increasing concern about direct impacts from deer had little effect on satisfaction, whereas increasing concerns about indirect impacts—such as deer welfare, urban area management, disease, and hunting opportunities—increased satisfaction by 0.76 at the 0.90 quantile ($p = 0.003$). Difference tests revealed that at the 0.20 quantile of satisfaction, the effect of indirect deer concerns was negative—with a unit increase in indirect concerns decreasing satisfaction by 0.1—but this effect steadily became more positive, increasing satisfaction by over 0.2 at the 0.90 quantile (Figure 4.1b; difference Q20/Q90: $F(1, 1333) = 14.67$, $p = 0.0001$). Direct deer concerns show the inverse effect: for lower quantiles of satisfaction, increasing direct concerns increases satisfaction by 0.1-0.2, but this effect becomes negative for higher quantiles, decreasing satisfaction by 0.2 (Figure 4.1a; difference Q20/Q90: ($F(1, 1333) = 4.12$, $p = 0.043$).

The effects of these two variables were driven primarily by their relationship with the perceived efficacy of management approaches. Management acceptability, both lethal and nonlethal, significantly increased perceived efficacy of management across quantiles. When examining item-level effects, however, lethal and nonlethal acceptability ratings showed different relationships with the perceived efficacy of various management options. Residents with increasing acceptance of lethal management methods were more likely to rate all lethal management approaches as effective, and less likely to rate them neither or ineffective (Table 4.6). By comparison, increasing acceptability of nonlethal management increased the probability of rating alternative deer management approaches as effective (i.e., Deer Reduction Zones (DRZs), CHAPs, and information provision) and decreased the probability of ineffective ratings (Table 4.6).

While direct deer concerns did not significantly affect any satisfaction components, indirect deer concerns significantly increased perceptions of management efficacy by 0.07 at the median ($p = 0.026$) and by 0.11 at the 90^{th} quantile ($p = 0.005$; Table 4.4). An item-level analysis

revealed that as concern about indirect deer concerns increased, residents were more likely to rate hunting and culling methods as ineffective ($p = 0.021, 0.003$; Table 4.6). They were also more likely than residents with lower levels of indirect deer concerns to rate alternative lethal methods of DRZs and CHAPs as effective, on average ($p = 0.012, 0.000$; Table 4.6). In the case of DRZs, however, increasing indirect deer concerns also increased the probability of an ineffective rating. Examining the marginal effects visually, I see that although the probability of an ineffective rating starts off low at low levels of indirect deer concerns (<0.05), it increases steadily with increasing indirect deer concerns and eventually exceeds the probability of a 'neither' rating to over 0.2 (Figure 4.2).

Table 4.3. Quantile Regression results for predictors of overall satisfaction with deer management. Base value of categorical variables in parenthese

	Effect at Satisfaction Quantile					
	10th		50th		90th	
Variable	**b**	**se**	**b**	**se**	**b**	**se**
Management Acceptability						
Lethal	0.405**	0.103	0.322**	0.06	0.290**	0.061
Nonlethal	0.174	0.103	0.158*	0.07	0.183*	0.09
Deer Concerns						
Direct	0.713	0.472	0.177	0.221	-0.53	0.336
Indirect	-0.576	0.458	-0.08	0.201	0.762*	0.285
Primary Self-Identity (Rural Resident)						
Farmer/Rancher	-1.217	1.072	-0.935	0.612	-0.78	0.746
Woodland Owner	1.627	0.861	-0.222	0.652	0.204	0.803
Deer Hunter	-1.570	0.976	-0.68	0.689	-0.574	0.814
Urban Resident	-0.469	0.769	-1.109*	0.498	-0.457	0.537
Wildlife Value Orientation (Traditionalist)						
Mutualist	0.847	0.962	1.462*	0.569	0.945	0.668
Pluralist	1.254*	0.602	1.113*	0.421	-0.01	0.466
Distanced	0.385	1.134	0.255	0.803	0.376	0.88
Organizational Membership (None)						
Hunting	0.362	1.071	0.771	1.027	-0.208	0.684
Environmental	0.01	1.327	1.079	0.774	0.944	0.773
Animal Welfare	0.923	1.029	0.483	0.578	0.841	0.859
Allows Hunting (Yes)						
No	0.85	0.73	0.713	0.443	0.752	0.53
Cannot	1.634	0.918	1.253*	0.499	0.796	0.563
College Graduate	-0.017	0.588	0.043	0.405	0.826	0.429
Hunter	1.437	0.851	0.193	0.487	0.296	0.429
Gender	-0.257	0.795	-0.681	0.428	-0.175	0.415
Deer Attitudes	0.614	0.374	0.665*	0.234	0.368	0.25
Hunting Beliefs	0.203	0.111	0.491**	0.063	0.673**	0.072
Political Ideology	-0.003	0.199	-0.205	0.139	-0.059	0.127
Constant	-0.067	1.062	6.394**	0.612	11.230**	0.704

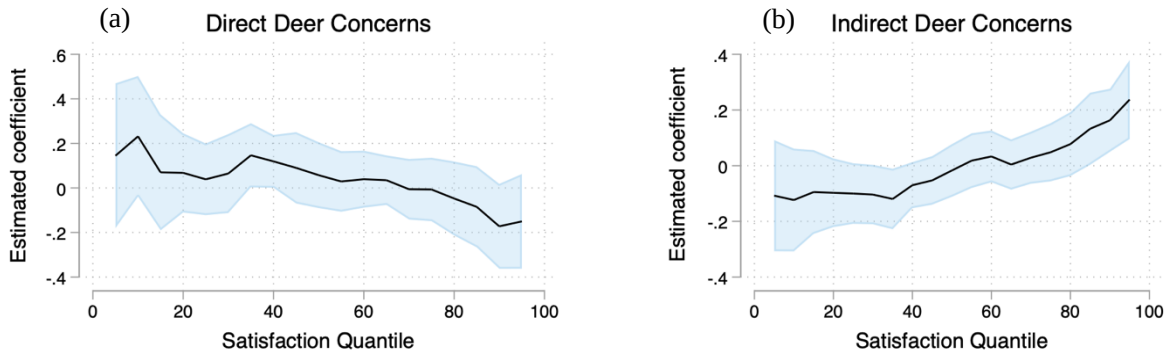


Figure 4.1. Effect of (a) direct and (b) indirect deer-related concerns across quantiles of overall satisfaction with deer management.

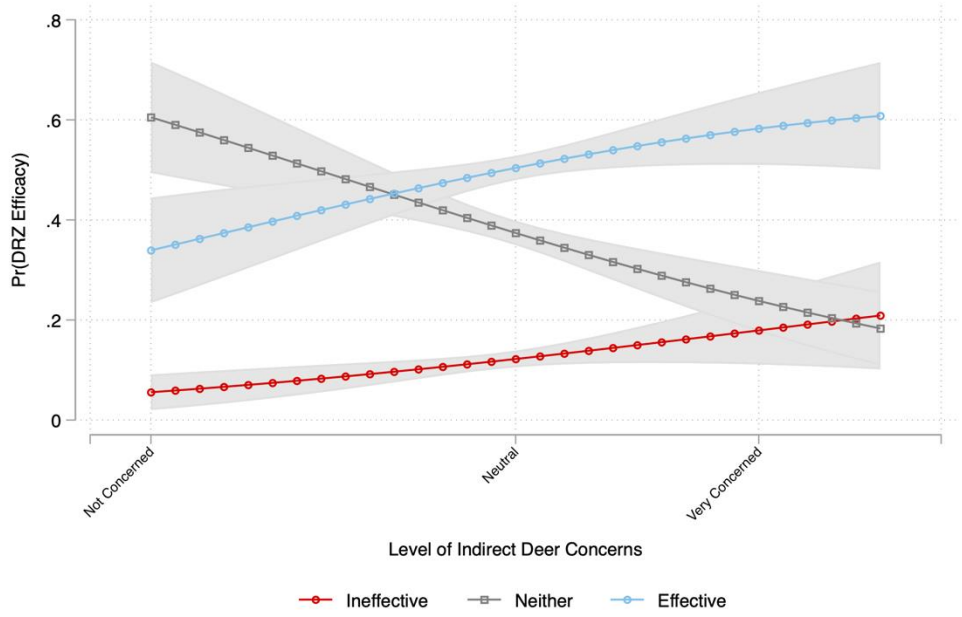


Figure 4.2. Average marginal effect of a respondents' level of indirect deer concerns on their rating of a Deer Reduction Zones management approach as ineffective (red), neither (grey), or effective (blue).

Among other components of satisfaction, indirect concerns also significantly reduced respondents' overall ratings of the IN-DNR by 0.12 at the 0.1 quantile (p = 0.04; Table 4.4). Although median levels of agency and informational trust increased with increased management acceptability ratings, respondent cognitions and characteristics affected trust components of satisfaction more strongly than do acceptability or concerns (Table 4.5).

Other cognitions – attitudes and beliefs

General attitudes toward deer and beliefs about hunting had strong effects on overall satisfaction with deer management (Table 4.3). At the median of satisfaction, increasingly positive attitudes toward deer increased satisfaction by 0.67 (p =0.001), and a unit increase in agreement with hunting increased satisfaction by 0.5 (p = 0.000). The effect of attitudes toward deer did not significantly differ across quantiles of satisfaction, but the effect of hunting beliefs strengthened with increasing levels of satisfaction (difference Q10/Q90: F (1, 1333) = 4.73, p = 0.03; Q50/Q90: F (1, 1333) = 8.34, p = 0.004).

The effect of hunting beliefs on IN-DNR performance and management efficacy ratings mirrored their effects on overall satisfaction, increasing each by 0.12 and 0.33 at the median and 0.13 and 0.40 at the 90^{th} quantile of performance and efficacy ratings, respectively (all p = 0.000; Table 4.4). At the item level, fundamental beliefs about hunting showed significant effects on the efficacy ratings of all management methods. Increasing agreement with positive beliefs about hunting decreased the probability of rating all lethal methods as ineffective by 0.02 to 0.03 (p = 0.000 to 0.029) or as neither effective nor ineffective by 0.07 to 0.1 (p = 0.000), while increasing the probability of rating them as effective by 0.1 to 0.13 (p = 0.000; Table 4.6). Increasingly positive beliefs about hunting also increased the probability of rating information provision as effective by 0.01 (p = 0.000).

While hunting beliefs exerted significant effects across each component of the satisfaction index, attitudes toward deer most significantly affected ratings of the IN-DNR. Increasingly positive attitudes about deer increased ratings of the IN-DNR's performance by 0.5 at the 0.10 quantile (p = 0.003) and by 0.24-0.25 at the median and 0.90 quantile (p = 0.004, 0.005; Table 4.4). Positive attitudes toward deer also increased median levels of agency and informational trust by 0.09 (p = 0.010, 0.017; Table 4.5). Attitudes toward deer only significantly increased management efficacy at the 0.1 quantile of these ratings, by 0.4 (p = 0.013; Table 4.4). At the item

level, however, increasingly positive deer attitudes increased the probability of rating licensed hunting as effective by 0.04, on average ($p = 0.000$), while decreasing the probability of rating hunting as ineffective by 0.01 ($p = 0.011$) or neither by 0.02 ($p = 0.013$; Table 4.6). Increasingly positive attitudes also increased the probability of rating information provided by IN-DNR as effective by 0.5 on average ($p = 0.001$; Table 4.6).

Respondent characteristics

The most influential respondent characteristics on overall satisfaction were primary self-identity, allowing hunting on one's property, and wildlife value orientation. Compared to respondents identifying as primarily rural residents, those who identified as urban residents showed over one point less satisfaction with deer management at the median ($p = 0.013$; Table 4.3). Residents who could not allow hunting on their property due to unsuitable land or legal restrictions were, at the median, 1.3 points more satisfied with deer management than residents who allowed hunting ($p = 0.007$, Table 4.3). Residents who held pluralist or mutualist value orientations showed median levels of satisfaction 1.1- or 1.5-points greater, respectively, than predicted for those with traditionalist value orientations ($p = 0.004, 0.002$; Table 4.3).

Among the components of satisfaction, residents identifying as farmers or ranchers rated the IN-DNR 0.8 points lower than did rural residents at the median ($p = 0.001$) and 1.3 points lower at the 0.10 quantile ($p = 0.014$). They also exhibited median informational trust 0.3 points lower than rural residents ($p = 0.006$; Table 4.3). Of all management methods, respondent self-identities showed significant marginal effects on the efficacy ratings of DRZs (Table 4.6). Farmers/ranchers and urban residents, separately, were more likely than woodland owners, deer hunters, and rural residents to rate DRZs as ineffective (all $p < 0.05$, urban/woodland owner: $p = 0.07$). Urban residents were also more likely than rural residents to rate CHAPs as ineffective ($p= 0.05$, Table 4.6).

Residents who could not allow hunting showed significantly higher ratings of the IN-DNR's performance and significantly higher trust in the agency across quantiles, compared to residents who allowed hunting (all $p < 0.05$; Tables 4.4, 4.5). Although allowing hunting did not significantly affect the composite management efficacy variable, at the item-level, residents who could not allow hunting were significantly less likely to rate licensed hunting as ineffective than other residents ($p = 0.008$ cannot/no; $p = 0.024$ cannot/yes; Table 4.6).

Compared to traditionalist value orientations, pluralists showed higher median levels of trust in the IN-DNR as a management agency by 0.18 ($p = 0.011$) and as an information source by 0.14 ($p = 0.05$; Table 4.5). Trust components of satisfaction were also affected by respondent status as a college graduate or a deer hunter. At median trust levels, college graduates were 0.20 and 0.16 points more trusting of the IN-DNR and its information, respectively, than non-college-graduates ($p = 0.002, 0.009$; Table 5). Deer hunters, in contrast, were significantly less trusting of the IN-DNR than non-deer hunters, by 0.2 points at the median ($p = 0.027$, Table 4.5).

Table 4.4. Quantile regression results on performance and service quality components of the satisfaction index. Effects are presented at 10th, 50th, and 90th quantiles

	DNR Score						Management Efficacy					
	10th		50th		90th		10th		50th		90th	
Variable	**b**	**se**	**b**	**se**	**b**	**se**	**b**	**se**	**b**	**se**	**b**	**se**
Management Acceptability												
Lethal	0.047	0.044	0.061*	0.024	0.033	0.022	0.279**	0.049	0.224**	0.031	0.116*	0.038
Nonlethal	0.055	0.039	-0.002	0.029	-0.024	0.03	0.170*	0.059	0.192**	0.033	0.122*	0.043
Deer Concerns												
Direct	0.082	0.066	0.007	0.03	-0.027	0.021	0.051	0.052	-0.038	0.035	-0.051	0.041
Indirect	-0.120**	0.036	-0.01	0.023	0.038	0.021	0.001	0.042	0.073*	0.024	0.114*	0.037
Primary Self-Identity (Rural Resident)												
Farmer/Rancher	-1.266*	0.506	-0.782*	0.282	-0.116	0.206	-0.936	0.523	-0.098	0.331	-0.068	0.371
Woodland Owner	0.616	0.498	0.07	0.223	0.138	0.258	0.05	0.369	-0.183	0.319	0.162	0.459
Deer Hunter	-1.522	0.853	-0.19	0.239	-0.112	0.238	-0.313	0.458	-0.273	0.344	-0.408	0.294
Urban Resident	0.168	0.269	-0.325	0.217	0.019	0.22	-0.191	0.38	-0.347	0.212	-0.318	0.325
Wildlife Value Orientation (Traditionalist)												
Mutualist	0.208	0.462	0.363	0.199	0.554	0.295	-0.108	0.389	0.19	0.3	-0.166	0.47
Pluralist	0.428	0.344	0.229	0.166	0.299	0.175	0.219	0.287	-0.175	0.203	-0.288	0.28
Distanced	-0.259	0.459	0.292	0.303	0.085	0.369	-0.446	0.566	-0.367	0.284	-0.629	0.466
Organizational Membership (None)												
Hunting	-0.529	0.849	-0.233	0.264	-0.328	0.271	0.377	0.364	-0.046	0.424	0.562	0.304
Environmental	0.514	0.492	0.221	0.293	-0.403	0.234	-0.058	0.613	0.361	0.318	-0.397	0.381
Animal Welfare	0.378	0.471	0.254	0.24	0.106	0.353	-0.724	0.487	-0.435	0.261	-0.488	0.34
Allows Hunting (Yes)												
No	0.535	0.371	0.364*	0.177	0.531*	0.174	0.247	0.344	0.157	0.205	0.275	0.272
Cannot	0.787	0.472	0.701*	0.229	0.443*	0.175	0.451	0.412	0.151	0.243	-0.052	0.311

Table 4.4 continued

College Graduate	0.006	0.263	0.046	0.16	-0.059	0.158	0.237	0.265	-0.164	0.179	-0.35	0.224
Hunter	-0.152	0.36	0.086	0.216	-0.305	0.18	0.803*	0.347	0.4	0.209	0.151	0.274
Gender	-0.209	0.245	-0.216	0.197	-0.050	0.2	-0.168	0.394	0.038	0.215	0.306	0.294
Deer Attitudes	0.463*	0.169	0.240*	0.088	0.249*	0.093	0.403*	0.166	0.154	0.119	0.256	0.142
Hunting Beliefs	0.059	0.053	0.119**	0.027	0.126**	0.027	0.135*	0.048	0.330**	0.038	0.395**	0.049
Political Ideology	-0.056	0.088	-0.038	0.046	-0.016	0.072	-0.007	0.084	-0.075	0.068	0.048	0.074
Constant	3.471**	0.499	5.982**	0.256	7.900**	0.301	-1.777*	0.602	0.936*	0.356	3.632**	0.374

Stars indicate significance levels: * $p < 0.05$; ** $p < 0.001$

Table 4.5. Quantile regression results on trust components of the satisfaction index. Effects are presented at 10th, 50th, and 90th quantiles.

	Agency Trust						Informational Trust					
	10th		50th		90th		10th		50th		90th	
Variable	**b**	**se**	**b**	**se**	**b**	**se**	**b**	**se**	**b**	**se**	**b**	**se**
Management Acceptability												
Lethal	0.037*	0.016	0.041**	0.011	0.015	0.01	0.045*	0.019	0.018	0.011	0.007	0.006
Nonlethal	0.038	0.02	0.029*	0.013	0.008	0.014	-0.005	0.02	0.056**	0.016	0.007	0.007
Deer Concerns												
Direct	-0.029	0.027	0.016	0.017	-0.006	0.017	0.029	0.022	0.014	0.013	-0.0004	0.007
Indirect	0.003	0.02	-0.006	0.011	0.014	0.012	-0.015	0.013	-0.001	0.011	-0.0002	0.005
Primary Self-Identity (Rural Resident)												
Farmer/Rancher	-0.19	0.174	-0.153	0.136	0.095	0.159	-0.22	0.175	-0.291*	0.127	-0.207	0.146
Woodland Owner	0.218	0.174	0.066	0.127	0.193	0.13	0.21	0.141	0.095	0.114	0.004	0.055
Deer Hunter	-0.309	0.255	-0.021	0.112	-0.023	0.121	-0.191	0.186	0.008	0.101	-0.014	0.06
Urban Resident	-0.189	0.164	0.048	0.071	0.035	0.097	0.020	0.087	-0.013	0.084	0.01	0.043
Wildlife Value Orientation (Traditionalist)												
Mutualist	-0.065	0.177	0.162	0.105	0.068	0.119	0.074	0.113	0.193	0.111	0.079	0.081
Pluralist	0.069	0.145	0.179*	0.069	0.128	0.081	0.118	0.096	0.138*	0.058	0.051	0.062
Distanced	0.15	0.196	0.163	0.137	-0.073	0.16	0.056	0.202	0.205	0.141	0.07	0.117
Organizational Membership (None)												
Hunting	-0.331	0.305	-0.066	0.116	-0.259	0.141	-0.053	0.173	0.072	0.113	0.027	0.083
Environmental	0.228	0.16	0.144	0.117	0.099	0.121	0.289	0.154	0.261*	0.115	0.051	0.069
Animal Welfare	0.06	0.278	0.094	0.108	0.046	0.126	0.122	0.195	0.19	0.131	-0.001	0.073
Allows Hunting (Yes)												
No	-0.024	0.135	0.074	0.091	0.222*	0.094	0.209	0.109	0.058	0.068	0.017	0.053
Cannot	0.325*	0.148	0.209*	0.093	0.241*	0.102	0.287*	0.117	0.124	0.089	0.009	0.051

Table 4.5 continued

College Graduate	0.166	0.106	0.197*	0.065	0.165*	0.072	0.037	0.076	0.157*	0.058	0.039	0.044
Hunter	-0.318	0.183	-0.200*	0.097	-0.08	0.137	0.026	0.118	-0.07	0.082	-0.042	0.055
Gender	0.217	0.114	0.055	0.069	0.007	0.086	-0.056	0.082	-0.022	0.069	-0.004	0.047
Deer Attitudes	0.077	0.072	0.086*	0.038	0.023	0.04	0.079	0.041	0.090*	0.042	0.023	0.023
Hunting Beliefs	0.014	0.019	0.065**	0.013	0.059**	0.016	0.014	0.014	0.073**	0.013	0.023	0.018
Political Ideology	-0.024	0.038	-0.016	0.016	-0.019	0.025	-0.045	0.027	-0.043*	0.02	-0.004	0.012
Constant	-0.645*	0.196	0.065	0.113	1.130**	0.148	-0.428*	0.189	0.482**	0.096	1.759**	0.181

*Stars indicate significance levels: * $p < 0.05$; ** $p < 0.001$*

Table 4.6. Marginal effects of a standard deviation change in significant predictor variables on predicted probabilities of efficacy ratings. Only significant results are presented: * $p < 0.05$; ** $p < 0.001$.

	Licensed Hunting			Culling			DRZ			CHAP			Providing Information		
Predictor Variable	Ineffective	Neither	Effective	Ineffective	Neither	Effective	Ineffective	Neither	Effective	Ineffective	Neither	Effective	Ineffective	Neither	Effective
Acceptability, Lethal Control		-0.02*	0.03**	-0.04**	-0.06**	0.10**	-0.03**	-0.05**	0.08**	-0.06**	-0.07**	0.12**			
Acceptability, Nonlethal Control				-0.03**			-0.03**	0.04*		-0.05**		0.04*	-0.062**	-0.055**	0.118**
Direct deer concerns				-0.02*			-0.03*					-0.04*			
Indirect deer concerns	0.03*	-0.03*		0.04*	-0.05*		0.03*	-0.07**	0.04*		-0.06**	0.07**	-0.031*	-0.052**	0.083**
General deer attitudes	-0.01*	-0.02*	0.04**											-0.033*	0.048**
Hunting beliefs	-0.03**	-0.07**	0.10**	-0.03**	-0.09**	0.11**	-0.02*	-0.10**	0.12**	-0.03*	-0.10**	0.13**		-0.077**	0.092**
College Graduate			0.04*			0.06*					0.06*				
Woman		-0.04*					0.05*								
Allows Hunting															
Cannot vs. Yes	-0.04*									-0.06*					
Cannot vs. No	-0.04*														
Organizational Membership															
Hunting vs. None		-0.09*	0.10*		-0.09*	0.10*									
Environmental vs. Hunting															
Respondent Self-Identity															
WLO vs. Farmer/Rancher							-0.08*								
Deer Hunter vs. Farmer/Rancher							-0.10*								
Deer Hunter vs. WLO						-0.12*									
Rural Resident vs. Farmer/Rancher							-0.08*								
Urban Resident vs. Deer Hunter							0.08*								
Rural vs. Urban Resident							-0.07*			-0.056*					
Value Orientation															
Pluralist vs. Traditionalist											0.66*	-0.061*			
Distanced vs. Traditionalist														0.147*	
Distanced vs. Mutualist														0.163*	-0.136*

4.5 Discussion

4.5.1 Drivers and dynamics of satisfaction

I formulated and analyzed a holistic measure of resident satisfaction with deer management. Satisfaction was strongly influenced by residents' acceptability ratings of lethal and nonlethal management methods, their deer-related concerns, their underlying cognitions about deer (e.g., attitudes and beliefs), and their individual characteristics. Further, perceived efficacy of deer management methods, as a proxy for quality of the deer management service, was most significantly affected by residents' acceptability levels and deer-related concerns. In contrast, IN-DNR performance, agency trust, and informational trust were influenced to a greater degree by attitudes toward deer, hunting beliefs, and resident characteristics. I discuss these effects in detail and their implications for understanding satisfaction with wildlife management more broadly.

Residents' acceptability of deer management methods significantly influenced their perceived efficacy of such methods, but in different ways. As residents rated lethal methods increasingly acceptable, their perceived efficacy of all lethal methods also increased. But increasing acceptability of nonlethal methods mostly affected respondents' perceived efficacy of alternative management strategies, even alternative hunting programs like DRZs or CHAPs. Normative beliefs, specifically those related to wildlife use or hunting, have consistently explained significant variation in the acceptability of lethal and nonlethal management approaches (Loker et al. 1999, Fulton et al. 2004, Whittaker et al. 2006, Bruskotter et al. 2009, Urbanek et al. 2012, 2015). My analysis confirmed a consistently strong relationship between beliefs about hunting and perceived management efficacy, and such beliefs were moderately correlated with lethal (0.23) and nonlethal (0.28) management acceptability ratings. Intuitively, supportive beliefs about the effectiveness, humaneness, safety, and cultural importance of hunting—the components included in my composite variable—should lead to beliefs in the efficacy of lethal deer management approaches (as they typically involve some form of hunting). Alternatively, residents may be unaware of the effectiveness of various management approaches, especially nonlethal or alternative methods (Kilpatrick et al. 2007). Underlying beliefs and attitudes about deer then become important cognitive factors influencing how residents appraise the efficacy and acceptability of unfamiliar management approaches (Whittaker et al. 2006, Fishbein and Ajzen 2010).

Cognitive conditions of perceived control and psychological distance can also explain the complex relationships that I found between deer-related concerns and components of satisfaction. Residents who reported high concerns about direct deer impacts to crops, forests, or gardens likely experienced them regularly and were therefore psychologically closer than other residents to these impacts (Kruglanski and Higgins 2007). Such psychological proximity may increase resident skepticism of an agency's capacity to mitigate the impacts experienced and thereby decrease overall satisfaction (Spence et al. 2012, Singh et al. 2017). Among the most satisfied quantile that I modeled (0.90), increasing concern about direct deer impacts (e.g., forest damage, crop damage, vehicle collisions) decreased overall satisfaction. But increasing concern about indirect deer issues (e.g., deer welfare, urban area management, disease transmission, population sizes, and hunting opportunities) increased overall satisfaction. This counterintuitive result may be associated with a lack of perceived control over such indirect deer issues, in which case residents would rely more on the agency and its management methods to address their concerns (Rotter 1996).

Perceived efficacy in deer management and agency performance became even more nuanced when considering individual characteristics, namely, self-identity and allowing hunting on one's property. Consistent with findings from the preceding paragraph, a lack of perceived control over deer management on one's land may underly the higher satisfaction and trust in the IN-DNR demonstrated by residents who could not allow hunting, compared to residents who could decide whether to allow licensed hunting on their properties. However, these "cannot allow hunting" residents showed consistently lower concerns about direct and indirect deer impacts than other residents. Therefore, residents who perceive little control over deer impacts and remain psychologically distanced from deer management trust in and rely upon the managing agency more than those who have control over their own lands.

Greater knowledge of and familiarity with science and technology or government programs and policies tends to breed skepticism rather than confidence (Durant 1999, Poortinga and Pidgeon 2003, Bauer 2009, Dow 2021). On the other hand, being unfamiliar but perceiving shared values with governing institutions often predicts trust and confidence in those institutions (Poortinga and Pidgeon 2003). In my study, residents who self-identified as a farmer/rancher or an urban resident were the most skeptical of current deer management methods. They were significantly more likely than other groups to rate alternative hunting programs, DRZs and CHAPs, as ineffective. Among urban residents, this skepticism likely relates to experience with or awareness of these programs,

which are often applied in urban areas where licensed hunting is logistically challenging. Among all self-identified groups in my study, farmers/ranchers perceived the lowest level of shared values with the IN-DNR which may partially explain their lower perceived efficacy of alternative hunting programs. My results therefore suggest that sectors of the public who have less familiarity with wildlife management agencies and do not see their values reflected in management decisions will be less trusting in and less satisfied with management than others.

A recent study by Schroeder et al. (2021) found that social identities and value orientations significantly influence trust in wildlife management agencies. Livestock producers exhibited lower agency trust compared to hunters and the public and respondents with traditionalist value orientations were less trusting than all others. My results confirm that residents who hunt deer or identify as a farmer/rancher are less trusting of the DNR and its information than nonhunters and other identities, respectively. But I also found that agency and informational trust were higher for all wildlife value orientations other than traditionalists, and that trust increases among residents with positive attitudes toward deer. Other studies show that the effects of demographic characteristics on respondents' acceptability of lethal wildlife management become dampened by their attitudes towards and beliefs about a species (Bruskotter et al. 2009), but this relationship has not been closely examined in either trust or satisfaction frameworks. With all four of these variables—self-identity, wildlife value orientation, attitudes toward deer, and hunting beliefs—included in my model, pluralist value orientation showed double the effect of attitudes toward deer on increasing agency trust, and farmer/rancher identity showed an effect three times larger in magnitude than that of attitudes toward deer on decreasing informational trust. My findings suggest that even when considering cognitive variables, respondent values and identities retain a critical influence on their trust in wildlife agencies.

The relationship between farmers/ranchers or hunters and agency trust warrants further examination. Previous studies have found that farmers' trust in government erodes when farmers perceive the institutions in question to be physically or socially distant from them, even if those institutions actively support agricultural interests (Lubell 2007, Hall and Pretty 2008). Close personal contact with resource agency staff have predicted public trust and satisfaction with services, programs, or management strategies across social groups (Needham and Vaske 2008, Young et al. 2016). Social trust, built on these consistent interpersonal interactions, proves more important than institutional trust for farmer participation in environmental programs (Selinske et

al. 2015) and acceptance of high transaction costs (Mettepenningen et al. 2011) like those associated with managing deer on their land. Farmers and ranchers in my sample rated the IN-DNR's deer management performance significantly lower than other self-identities and placed significantly less trust in its information. Such poor ratings and distrust may ensue after experiencing frequent crop damage, exhibiting frustration with deer impacts (Stinchcomb et al. 2022), or lacking personal interactions with the IN-DNR and its information. Interpersonal communication and contact increases farmers' trust in conservation-based management and their participation in decision-making processes (Breetz et al. 2005). Thus, wildlife agency staff should make regular personal contact with farming and ranching constituents to gain their trust and improve deer management on private lands.

The low trust placed in wildlife management agencies by hunters may at the surface seem counterintuitive. Schroeder et al. (2021) found hunters to have higher levels of trust in wildlife management agencies than livestock producers (but lower than the wider public) and suggested that such trust arises out of high levels of interaction with agency staff and perceived value similarity with the agency. Yet even hunters who have substantial personal interactions with agency staff can disagree with specific management strategies, and hunters also tend to carry higher expectations for the agency's ability to manage deer than non-hunters and other residents (Schroeder et al. 2017). Consequently, when hunters perceive a gap between their expectations and the condition of the deer population or hunting opportunities, they become less trusting and, by definition, less satisfied with management. In my study, significantly higher proportions of hunters were very concerned about hunting and perceived deer populations to be low compared to non-hunters, which suggests that hunters did not perceive their needs as being met by the IN-DNR. Not surprisingly, hunters were therefore less trusting of and less satisfied with deer management than the non-hunting public.

The above evidence suggests that regular interpersonal interactions between wildlife agencies and members of the public is critical. Increasing contact, communication, and transparency will help to increase residents' perceived control over management (Slagle et al. 2013), participation in public decision-making processes (Willcox and Giuliano 2014), perceived fairness of management (Young et al. 2016), and overall trust in managing agencies (Manfredo et al. 2017, Schmidt et al. 2018). Communication should include information about how individuals can avoid or reduce risks from wildlife, how management agencies are mitigating these risks, and

the benefits a species, or its management, can provide (Slagle et al. 2013, Bruskotter and Wilson 2014). Because bi-directional communication, power-sharing, and knowledge integration contribute to long-term trust (Denize and Young 2007, Young et al. 2016), interpersonal relationships and norms of knowledge exchange between agencies and the public should be further investigated.

4.5.2 Limitations of my approach

I recommend caution when interpreting my results to broader populations, particularly in urban contexts. Compared to census data for Indiana, my sample contained significantly greater proportions of white/Caucasian, male, well-educated, high-income, and rural-dwelling residents (Table 4.2). These differences are directly attributable to my sampling strategy, which intentionally targeted rural forestland and agricultural properties, as well as existing customers of the Indiana DFW. I encourage future research to focus on non-traditional wildlife constituents in urban areas and compare their perceptions, needs, and concerns with those from more traditional constituents in rural areas.

My respondents may also have been motivated to complete the survey, including those with very positive views about deer and deer management who want their voice to be heard, and those with very negative views who also want to be heard. Since ours was the first survey to reach non-customers of the Indiana Department of Fish & Wildlife, I expect that both extremes exist in my sample. Finally, due to the breadth of my survey, responses may exhibit satisficing behavior in which respondents select answers that do not reflect their thoughtful opinion but rather get the survey done quickly. These remain common issues with survey-based research for which a strategic and standardized remedy has not yet been developed (Dillman 2012, Dillman et al. 2014, Stedman et al. 2019)

Although I had planned to analyze determinants of resident trust in deer management and perceptions of agency performance, my interest in satisfaction as a multidimensional construct largely arose after survey development. Therefore, I did not measure components of satisfaction *a priori* in my survey. Future research would benefit from developing and testing similar indices prior to implementation in a study population (Hinkin 1995, Clark and Watson 1995, Reise et al. 2000). Furthermore, while moderate to high correlations are preferred to ensure variables composing an index are measuring the same or similar constructs (Clark and Watson 1995), my

data showed relatively low correlation between management efficacy and the remaining index variables (0.21-0.25). As such, perceived performance or service quality and trust in agency and its information may be different constructs influenced by different variables. Whereas normative judgements and concerns about deer—related to psychological conditions of accessibility, perceived control, and psychological distance—affected performance and quality measures, demographic characteristics exerted the strongest influences on trust. Therefore, future research may need to treat these two components of satisfaction as distinct concepts but synthesize them together.

4.5.3 Utility for wildlife management

Even if performance and trust represent separate constructs, it remains important for wildlife and resource management agencies to quantify the determinants of public satisfaction with their services and governance. Examining variation in the what and the why of public (dis)satisfaction is crucial to improving wildlife and resource management services and approaches (Kelly 2005, Selinske et al. 2015, Coleman et al. 2019). But survey questions about satisfaction with wildlife management continue to use unidimensional scales like a rating of one to ten. Replacing or supplementing these performance scores with a series of survey questions that capture multiple dimensions of satisfaction with and trust in wildlife agencies would thus allow researchers to analyze and better explain the variation in subjective ratings among their respondents.

Subjective perceptions have proven more critical than objective conditions in determining people's satisfaction with governance and resource management (Gutek et al. 1983). Assessing social and cognitive variables—as opposed to incidences of human-wildlife conflict, impacts from deer, or harvest successes—will allow wildlife agencies to better understand and manage (dis)satisfaction across a wider sector of the public. As Pomeranz et al. (2021) recently noted, good governance based in public trust thinking constitutes a continual practice for wildlife agencies, rather than a clear objective to be achieved. Expanding agency conceptions of public trust and satisfaction will also help to expand the customer service model that agencies consider in their administration of wildlife resources. These expansions represent an initial step towards practicing a more inclusive, beneficiary model of wildlife governance (Decker et al. 2016, 2019).

4.5.4 Future research needs

Future research on satisfaction with wildlife management should aim to incorporate multiple measures of satisfaction directly into their surveys or interviews including perceived agency performance, service quality, agency trust, and informational trust. They should also associate satisfaction measures with key variables I did not fully capture, such as perceived control, psychological distance from wildlife impacts, personal experiences with agency staff, frequency of interaction with agency information, and evaluation of its content. Doing so will help to validate and advance the multidimensional conception of satisfaction used here and elsewhere (Hendee 1974, Van Ryzin 2007, Park and Blenkinsopp 2011, Stern and Coleman 2015). To do so will require agencies to increase their capacities for and investment in social science research (Forstchen and Smith 2014, Bennett et al. 2017, AFWA and WMI 2019, Morales et al. 2021, Niemiec et al. 2021).

Agencies should also consider how public satisfaction varies over space to elicit information that cannot be obtained through conventional statistical analyses. For example, satisfaction and acceptability of wildlife management varies depending on the scale at which they are assessed (i.e., township vs. region; Kilpatrick et al. 2007). Satisfaction may also vary with urbanization (Patterson et al. 2003, Ericsson et al. 2018), land cover, and estimated deer population densities (Delisle et al. forthcoming), yet current designation of management units fails to address spatial variation in social satisfaction (Swihart et al. 2020). Although species ecology drives most wildlife management strategies, social perceptions of those strategies create challenges like public backlash that can only be addressed by integrating ecological management with social science. An integrated analysis of the social, geographical, and ecological determinants affecting wildlife populations and human perceptions could help agencies decide where and at which spatial extents public satisfaction with their management strategies should be addressed.

4.6 References

AFWA (Association of Fish and Wildlife Agencies) and WMI (The Wildlife Management Institute). 2019. Fish and Wildlife Relevancy Roadmap: Enhanced Conservation Through Broader Engagement (v1.0). M. Dunfee, A. Forstchen, E. Haubold, M. Humpert, J. Newmark, J. Sumners, and C. Smith. 2019 (eds). AFWA. Wash. D.C. 128 Pages.

Ariely, G. 2013. Public administration and citizen satisfaction with democracy: cross-national evidence. *International Review of Administrative Sciences* 79:747–766.

Bauer, M. W. 2009. The evolution of public understanding of science—Discourse and comparative evidence. *Science, Technology and Society* 14:221–240.

Bennett, N. J., R. Roth, S. C. Klain, K. Chan, P. Christie, D. A. Clark, G. Cullman, D. Curran, T. J. Durbin, G. Epstein, A. Greenberg, M. P. Nelson, J. Sandlos, R. Stedman, T. L. Teel, R. Thomas, D. Veríssimo, and C. Wyborn. 2017. Conservation social science: Understanding and integrating human dimensions to improve conservation. *Biological Conservation* 205:93–108.

Bovaird, T., and E. Löffler. 2003. Evaluating the quality of public governance: Indicators, models and methodologies. *International Review of Administrative Sciences* 69:313–328.

Breetz, H. L., K. Fisher-Vanden, H. Jacobs, and C. Schary. 2005. Trust and communication: Mechanisms for increasing farmers' participation in water quality trading. *Land Economics* 81:170–190.

Brown, S. E., and G. R. Parker. 1997. Impact of white-tailed deer on forest communities within Brown County State Park, Indiana. *Proceedings of the Indiana Academy of Science* 106:39–52.

Brown, T. L., D. J. Decker, and C. P. Dawson. 1978. Willingness of New York farmers to incur white-tailed deer damage. *Wildlife Society Bulletin* 6:235–239.

Bruskotter, J. T., J. J. Vaske, and R. H. Schmidt. 2009. Social and cognitive correlates of Utah residents' acceptance of the lethal control of wolves. *Human Dimensions of Wildlife* 14:119–132.

Bruskotter, J. T., and R. S. Wilson. 2014. Determining where the wild things will be: Using psychological theory to find tolerance for large carnivores. *Conservation Letters* 7:158–165.

Cade, B. S., and B. R. Noon. 2003. A gentle introduction to quantile regression for ecologists. *Frontiers in Ecology and the Environment* 1:412–420.

Chanter, D. O., and D. F. Owen. 1976. Nature reserves: A customer satisfaction index. *Oikos* 27:165.

Clark, L. A., and D. Watson. 1995. Constructing validity: Basic issues in objective scale development. *Psychological Assessment* 7:309–319.

Coleman, E. A., J. Manyindo, A. R. Parker, and B. Schultz. 2019. Stakeholder engagement increases transparency, satisfaction, and civic action. *Proceedings of the National Academy of Sciences* 116:24486–24491.

Cronbach, L.J. 1951. Coefficient alpha and the internal structure of tests. *Psychometrika* 16:297–324

Curtis, J., and L. Lynch. 2001. Explaining deer population preferences: An analysis of farmers, hunters and the general public. *Agricultural and Resource Economics Review* 30:44–55.

Decker, D. J., A. B. Forstchen, W. F. Siemer, C. A. Smith, R. K. Frohlich, M. V. Schiavone, P. E. Lederle, and E. F. Pomeranz. 2019. Moving the paradigm from stakeholders to beneficiaries in wildlife management. *The Journal of Wildlife Management* 83:513–518.

Decker, D., C. Smith, A. Forstchen, D. Hare, E. Pomeranz, C. Doyle-Capitman, K. Schuler, and J. Organ. 2016. Governance principles for wildlife conservation in the 21st century. *Conservation Letters* 9:290–295.

Denize, S., and L. Young. 2007. Concerning trust and information. *Industrial Marketing Management* 36:968–982.

Dillman, D.A. 2012. Introduction to special issue of survey practice on item nonresponse. *Survey Practice* 5(2):1–3.

Dillman, D.A., J.D. Smyth, and L.M. Christian. 2014. *Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method.* 4th Edition. Wiley.

Dow, J. P. 2021. Household factors affecting confidence in financial institutions. *Applied Economics Letters*:1–4.

Durant, J. 1999. Participatory technology assessment and the democratic model of the public understanding of science. *Science and Public Policy* 26:313–319.

Ericsson, G., C. Sandström, and S. J. Riley. 2018. Rural-urban heterogeneity in attitudes towards large carnivores in Sweden, 1976-2014. Pages 190–205 *in* T. Hovardas, editor. *Large Carnivore Conservation and Management: Human Dimensions*. Routledge.

Fishbein, M., and I. Ajzen. 2010. *Predicting and Changing Behavior: The Reasoned Action Approach*. Taylor & Francis: Psychology Press.

Ford, J. K., S. J. Riley, T. K. Lauricella, and J. A. Van Fossen. 2020. Factors affecting trust among natural resources stakeholders, partners, and strategic alliance members: A meta-analytic investigation. *Frontiers in Communication* 5:9.

Forstchen, A. B., and C. A. Smith. 2014. The essential role of human dimensions and stakeholder participation in states' fulfillment of public trust responsibilities. *Human Dimensions of Wildlife* 19:417–426.

Fulton, D. C., K. Skerl, E. M. Shank, and D. W. Lime. 2004. Beliefs and attitudes toward lethal management of deer in Cuyahoga Valley National Park. *Wildlife Society Bulletin* 32:1166–1176.

Gruntorad, M. P., J. J. Lusk, M. P. Vrtiska, and Christopher. J. Chizinski. 2020. Identifying factors influencing hunter satisfaction across hunting activities in Nebraska. *Human Dimensions of Wildlife* 25:215–231.

Gutek, B. A., H. Allen, T. R. Tyler, R. R. Lau, and A. Majchrzak. 1983. The importance of internal referents as determinants of satisfaction. *Journal of Community Psychology* 11:111–120.

Hall, J., and J. Pretty. 2008. Then and now: Norfolk farmers' changing relationships and linkages with government agencies during transformations in land management. *Journal of Farm Management* 13(26):393-418.

Hendee, J. C. 1974. A multiple-satisfaction approach to game management. *Wildlife Society Bulletin* 2:11.

Hendee, J.C., and D.R. Potter. 1971. Human behavior and wildlife management: needed research. *Transactions of the North American Wildlife and Natural Resource Conference* 36:383-396

Hicks, J. R. 2017. Mixed emotions: A qualitative exploration of northern Illinois whitetail deer-related decision making. *Journal of Outdoor Recreation and Tourism* 18:113–121.

Hinkin, T. R. 1995. A review of scale development practices in the study of organizations. *Journal of Management* 21:967–988.

INDFW (Indiana Division of Fish & Wildlife). 2011. *Urban deer technical guide*. Indiana Department of Natural Resources, Indianapolis, IN.

Inglehart, R., and P. Norris. 2016. Trump, Brexit, and the rise of populism: Economic have-nots and cultural backlash. HKS Working Paper No. RWP16-026. *SSRN*. http://dx.doi.org/10.2139/ssrn.2818659

Jacobson, C. A., J. F. Organ, D. J. Decker, G. R. Batcheller, and L. Carpenter. 2010. A conservation institution for the 21st century: Implications for state wildlife agencies. *The Journal of Wildlife Management* 74:203–209.

Kaeding, D. 2021, October 29. Wisconsin tribes seek federal injunction to block fall wolf hunt even as recent order bars a season. https://www.wpr.org/wisconsin-tribes-seek-federal-injunction-block-fall-wolf-hunt-even-recent-order-bars-season.

Kelly, J. M. 2005. The dilemma of the unsatisfied customer in a market model of public administration. *Public Administration Review* 65:76–84.

Kilpatrick, H. J., A. M. Labonte, and J. S. Barclay. 2007. Acceptance of deer management strategies by suburban homeowners and bowhunters. *The Journal of Wildlife Management* 71:2095–2101.

Kim, S., and J. Lee. 2012. E-Participation, transparency, and trust in local government. *Public Administration Review* 72:819–828.

King, A. D. 2002. Without deer there is no culture, nothing. *Anthropology & Humanism* 27:133–164.

Koenker, R., and G. Bassett. 1978. Regression quantiles. *Econometrica* 46:33.

Kruglanski, A. W., and E. T. Higgins, editors. 2007. *Social Psychology: Handbook of Basic Principles*. 2nd ed. Guilford Press, New York.

Loker, C. A., D. J. Decker, and S. J. Schwager. 1999. Social acceptability of wildlife management actions in suburban areas: 3 cases from New York. *Wildlife Society Bulletin* 27:152–159.

Long, J.S., and J. Freese. 2006. *Regression Models for Categorical Dependent Variables Using Stata*. 2nd ed. College Station, TX: Stata Press.

Lubell, M. 2007. Familiarity breeds trust: Collective action in a policy domain. *The Journal of Politics* 69:237–250.

Manfredo, M. J., T. L. Teel, and K. L. Henry. 2009. Linking society and environment: A multilevel model of shifting wildlife value orientations in the western United States. *Social Science Quarterly* 90:407–427.

Manfredo, M. J., T. L. Teel, L. Sullivan, and A. M. Dietsch. 2017. Values, trust, and cultural backlash in conservation governance: The case of wildlife management in the United States. *Biological Conservation* 214:303–311.

Marcoux, A., and S. Riley. 2010. Driver knowledge, beliefs, and attitudes about deer–vehicle collisions in southern Michigan. *Human–Wildlife Interactions* 4:7.

McIntosh, D., and P. A. Wright. 2017. Emotional processing as an important part of the wildlife viewing experience. *Journal of Outdoor Recreation and Tourism* 18:1–9.

Mettepenningen, E., V. Beckmann, and J. Eggers. 2011. Public transaction costs of agri-environmental schemes and their determinants—Analysing stakeholders' involvement and perceptions. *Ecological Economics* 70:641–650.

Mize, T. D., L. Doan, and J. S. Long. 2019. A general framework for comparing predictions and marginal effects across models. *Sociological Methodology* 49:152–189.

Needham, M. D., and J. J. Vaske. 2008. Hunter perceptions of similarity and trust in wildlife agencies and personal risk associated with Chronic Wasting Disease. *Society & Natural Resources* 21:197–214.

Niemiec, R. M., R. Gruby, M. Quartuch, C. T. Cavaliere, T. L. Teel, K. Crooks, J. Salerno, J. N. Solomon, K. W. Jones, M. Gavin, A. Lavoie, A. Stronza, L. Meth, A. Enrici, K. Lanter, C. Browne, J. Proctor, and M. Manfredo. 2021. Integrating social science into conservation planning. *Biological Conservation* 262:109298.

Park, H., and J. Blenkinsopp. 2011. The roles of transparency and trust in the relationship between corruption and citizen satisfaction. *International Review of Administrative Sciences* 77:254–274.

Patterson, M. E., J. M. Montag, and D. R. Williams. 2003. The urbanization of wildlife management: Social science, conflict, and decision making. *Urban Forestry & Urban Greening* 1:171–183.

Poortinga, W., and N. F. Pidgeon. 2003. Exploring the dimensionality of trust in risk regulation. *Risk Analysis* 23:961–972.

Pruitt, H. P., B. B. Boley, G. J. D'angelo, B. P. Murphy, and M. D. Mcconnell. 2021. Importance—satisfaction analysis of deer management cooperative members. *Wildlife Society Bulletin* 45:85–96.

Reise, S. P., N. G. Waller, and A. L. Comrey. 2000. Factor analysis and scale revision. *Psychological Assessment* 12:287–297.

Richmond, T. 2021, October 22. Judge issues injunction blocking Wisconsin fall wolf hunt. https://apnews.com/article/environment-and-nature-wisconsin-lawsuits-madison-scott-walker-c08117dbcc2389817ff7a2ce93d2166b.

Riley, S. J., J. K. Ford, H. A. Triezenberg, and P. E. Lederle. 2018. Stakeholder trust in a state wildlife agency. *The Journal of Wildlife Management* 82:1528–1535.

Rotter, J.B. 1966. Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs* 80:1–28.

Sauzet, O., O. Razum, T. Widera, and P. Brzoska. 2019. Two-part models and quantile regression for the analysis of survey data with a spike: The example of satisfaction with health care. *Frontiers in Public Health* 7(146). DOI 10.3389/fpubh.2019.00146

Schmidt, J., D. Clark, N. Lokken, J. Lankshear, and V. Hausner. 2018. The role of trust in sustainable management of land, fish, and wildlife populations in the Arctic. *Sustainability* 10:3124.

Schroeder, S. A., D. C. Fulton, J. S. Lawrence, and S. D. Cordts. 2017. How hunter perceptions of wildlife regulations, agency trust, and satisfaction affect attitudes about duck bag limits. *Human Dimensions of Wildlife* 22:454–475.

Schroeder, S. A., A. C. Landon, D. C. Fulton, and L. E. McInenly. 2021. Social identity, values, and trust in government: How stakeholder group, ideology, and wildlife value orientations relate to trust in a state agency for wildlife management. *Biological Conservation* 261:109285.

Selinske, M. J., J. Coetzee, K. Purnell, and A. T. Knight. 2015. Understanding the motivations, satisfaction, and retention of landowners in private land conservation programs. *Conservation Letters* 8:282–289.

Singh, A. S., A. Zwickle, J. T. Bruskotter, and R. Wilson. 2017. The perceived psychological distance of climate change impacts and its influence on support for adaptation policy. *Environmental Science & Policy* 73:93–99.

Sjölander-Lindqvist, A., M. Johansson, and C. Sandström. 2015. Individual and collective responses to large carnivore management: the roles of trust, representation, knowledge spheres, communication and leadership. *Wildlife Biology* 21:175–185.

Slagle, K., R. Zajac, J. Bruskotter, R. Wilson, and S. Prange. 2013. Building tolerance for bears: A communications experiment. *The Journal of Wildlife Management* 77:863–869.

Smith, J. W., J. E. Leahy, D. H. Anderson, and M. A. Davenport. 2013. Community/agency trust and public involvement in resource planning. *Society & Natural Resources* 26:452–471.

Spence, A., W. Poortinga, and N. Pidgeon. 2012. The psychological distance of climate change. *Risk Analysis* 32:957–972.

Stedman, R. C., N. A. Connelly, T. A. Heberlein, D. J. Decker, and S. B. Allred. 2019. The end of the (research) world as we know it? Understanding and coping with declining response rates to mail surveys. *Society & Natural Resources* 32(10):1139–1154.

Stern, M. J., and K. J. Coleman. 2015. The multidimensionality of trust: Applications in collaborative natural resource management. *Society & Natural Resources* 28:117–132.

Stinchcomb, T. R., Z. Ma and Z. Nyssa. 2022. Complex human-deer interactions challenge conventional management approaches: the need to consider power, trust, and emotion. *Ecology and Society* 27 (1):13. [online] URL: https://www.ecologyandsociety.org/vol27/iss1/art13/

Stroman, D. A., and U. P. Kreuter. 2014. Perpetual conservation easements and landowners: Evaluating easement knowledge, satisfaction and partner organization relationships. *Journal of Environmental Management* 146:284–291.

Swihart, R.K., J.N. Caudell, J.M. Brooke, and Z. Ma. 2020. A flexible model-based approach to delineate wildlife management units. *Wildlife Society Bulletin* 44:77-85.

Tian-Cole, S., J. L. Crompton, and V. L. Willson. 2002. An empirical investigation of the relationships between service quality, satisfaction and behavioral intentions among visitors to a wildlife refuge. *Journal of Leisure Research* 34:1–24.

Urbanek, R. E., C. K. Nielsen, M. A. Davenport, and B. D. Woodson. 2012. Acceptability and conflict regarding suburban deer management methods. *Human Dimensions of Wildlife* 17:389–403.

Urbanek, R. E., C. K. Nielsen, M. A. Davenport, and B. D. Woodson. 2015. Perceived and desired outcomes of suburban deer management methods. *The Journal of Wildlife Management* 79:647–661.

Van Ryzin, G. 2007. Pieces of a Puzzle: Linking government performance, citizen satisfaction, and trust. *Public Performance & Management Review* 30:521–535.

Whittaker, D., J. J. Vaske, and M. J. Manfredo. 2006. Specificity and the cognitive hierarchy: Value orientations and the acceptability of urban wildlife management actions. *Society & Natural Resources* 19:515–530.

Willcox, A. S., and W. M. Giuliano. 2014. Explaining cattle rancher participation in wildlife conservation technical assistance programs in the southeastern United States. *Rangeland Ecology & Management* 67:629–635.

Young, J. C., K. Searle, A. Butler, P. Simmons, A. D. Watt, and A. Jordan. 2016. The role of trust in the resolution of conservation conflicts. *Biological Conservation* 195:196–202.

CHAPTER 5. TARGETING THE SOCIAL FEASIBILITY OF WILDLIFE MANAGEMENT: ACCEPTABILITY AND CONFLICT OVER WHITE-TAILED DEER *(ODOCOILEUS VIRGINIANUS)* IN INDIANA

5.1 Abstract

In North America, human values for, emotions toward, and interests in wildlife continue to diversify. Diverse interests produce social conflicts over wildlife that complicate the ability of wildlife agencies to garner broad public support and funding for their efforts. Understanding the social feasibility of wildlife management strategies is thus essential to reduce social conflicts and public backlash toward agencies. The Potential for Conflict Index$_2$ is a useful tool to assess social conflicts over wildlife management methods. Mapping the spatial pattern of conflicts comprises another tool that allows agencies to target areas for public engagement strategies. But these two tools have yet to be combined for wildlife management. Using data from a 2021 survey of Indiana residents about white-tailed deer (*Odocoileus virginianus;* n = 1806), I analyzed PCI$_2$ values among stakeholder identity groups and political ideologies regarding the acceptability of six possible management methods, three lethal and three nonlethal. I then calculated PCI$_2$ values within each 8x8 mi (12.9x12.9 km) cell of a statewide grid and conducted a hotspot analysis to map areas of high and low social conflict over each management method. Conflict potential varied with resident self-identities and management methods but showed more consistent covariation with political ideologies. Political data may thus be more reliable and accessible than stakeholder categories for agencies to predict levels of social conflict over wildlife management. Hotspots of conflict over lethal methods clustered around urban areas, indicating that the managing agency should focus on engaging with urban residents about deer management. My method can be enhanced by expanding data collection to achieve an even geographic distribution of survey respondents and conducting geostatistical analyses to determine what variables influence the distribution of social conflicts. Future analyses of the spatial relationships between social conflicts and ecological variables may advance agencies toward the social-ecological integration necessary for effective wildlife governance.

5.2 Introduction

As human-wildlife interactions become increasingly complex across the U.S. (Dietsch et al. 2016, Manfredo et al. 2020, Stinchcomb et al. 2022), wildlife agencies are striving to incorporate more diverse social values and perspectives into management planning (AFWA and WMI 2019). Addressing the needs of all possible 'beneficiaries' remains a tenet of the Public Trust Doctrine and a principle of good governance (Decker et al. 2016, Hare et al. 2017). Although scholars posit that understanding local knowledge and integrating this into decision-making are essential for expanding support for wildlife management (Robbins 2006, Armitage et al. 2011, Assche et al. 2017, Bélisle et al. 2018), most wildlife agencies still face limited social science capacities, narrow funding streams, and embedded institutional cultures that hinder close and consistent engagement with their publics (Jacobson et al. 2010, Pomeranz et al. 2021). Thus, state agencies across the country need to undergo sweeping institutional reforms before collaborative and participatory ideals of good, public trust governance can be effectively achieved (Pomeranz et al. 2021).

Amid institutional change, survey-based research provide crucial tools for managers to begin assessing social diversity and integrating public needs into the planning process. Surveys are widely used among wildlife agencies to assess public perceptions of wildlife, preferences for management, use of public lands, or attitudes towards a proposed policy change. Social scientists develop indices from survey responses using various statistical techniques for factor analysis or clustering (Gerbing and Anderson 1988, Reise et al. 2000). Two indices, the Wildlife Value Orientation scale (Fulton et al. 1996) and the Potential for Conflict Index (Manfredo et al. 2003) are widely applied to human-wildlife interactions, but other relevant indices provide composite measures of ecosystem services, economic value, recreational specialization, and agency trust (Scott et al. 2005, Johns et al. 2014, Stern and Coleman 2015, Brock et al. 2017). Such analyses can be useful heuristic tools for determining the predictors of an abstract construct like wildlife value orientations, assessing economic utility and its influence on recreation behaviors, or evaluating and visualizing the potential for social conflicts over wildlife management approaches.

Since survey data are typically linked to addresses or geographical coordinates, they can be used to map social variation over space. Subsequent geospatial analysis tie variation in social data to environmental variables like landcover, development, elevation, plant and animal distributions, or cultural and political boundaries—variation that non-geographic statistical analyses cannot capture. For instance, acceptance of carnivore populations or their management

in Europe varies with social-ecological interaction of landcover type (rural vs. developed, montane vs. lowland), place-based traditions like shepherding or hunting, and local histories with wildlife (Gangaas et al. 2015, Piédallu et al. 2016). In Nepal, negative attitudes towards tigers spatially correlated with low socioeconomic statuses, fewer educational opportunities, and increased sociocultural marginalization, rather than with the distribution of livestock attacks (Carter et al. 2014). Other studies have used survey data to map and predict human tolerances toward wildlife (Struebig et al. 2018), mismatches in social and ecological dynamics that challenge management approaches (Dressel et al. 2018); successes and failures that identify facilitating conditions for collaborative governance (Bergsten et al. 2014); and ecosystem services and disservices in human-wildlife systems (Ceauşu et al. 2019).

Social 'landscapes' that include perceptions, attitudes, behaviors, and political or economic dynamics can profitably be integrated with biophysical landscape and ecological factors (e.g., wildlife population densities, distributions, and migrations) to develop models of anthropogenic resistance (Ghoddousi et al. 2021) or 'spatial coexistence' (Carter et al. 2020). Integrating the social and ecological dimensions into a single spatial model allows managers to identify where alignment or mismatches exist among wildlife population dynamics, habitat conditions, social tolerance or feasibility, and policy approaches, then target local areas and communities for management interventions (Dressel et al. 2018). Disregarding spatial diversity and local contexts, on the other hand, can "lead even highly advanced management approaches…into panacea traps" (Dressel et al. 2018:109, Zimmermann et al. 2021). Because attitudes towards wildlife populations and their impacts or benefits do not evenly nor predictably distribute across landscapes and social groups, neglecting to analyze this socio-spatial variation can hinder public support for conservation and management actions and thus reduce their efficacy (Carter et al. 2020).

Prior to 2018, the social landscape around white-tailed deer (*Odocoileus virginianus*) in the state of Indiana remained largely unquantified. Empirical social research has since found that Indiana residents hold complex values, attitudes, emotions, and beliefs about white-tailed deer that do not sort nicely into specific stakeholder categories (Stinchcomb et al. 2022). Rather, these perceptions about deer often conflict with one another, both within and among demographic categories like gender, stakeholder identities, political ideologies, or hunter status. Moreover, public satisfaction with existing management strategies, and trust in the regulating agency, comprise complex constructs that depend on peoples' cognitions, identities, values, and familiarity

or experiences with the agency (chapter 4). Here, I seek to understand how the acceptability of deer management options varies across social categories and geographic gradients. Visualizing where and among whom the greatest controversy occurs can help managers elicit fine-scale drivers of people's attitudes towards management and target strategies to minimize backlash over their decisions.

5.2.1 Potentials for social conflict over wildlife

To quantify the level of conflict or consensus among social groups over wildlife attitudes and management approaches, Vaske et al. (2010) developed a second-generation Potential for Conflict Index (PCI_2). Using survey response scales, the PCI_2 calculates the ratio of responses on either side of a scale's center point so that maximum conflict ($PCI_2 = 1$) occurs when responses are evenly split between the two extreme values of the scale and total consensus ($PCI_2 = 0$) occurs when all responses fall on a single value in the scale (Engel et al. 2017, Liordos et al. 2017, Vaske 2018). The PCI_2 also allows for the specification of a distance function to include or exclude the neutral value of a response scale, depending on empirical/theoretical utility, and power functions to give more weight to larger differences between individual perceptions. For example, a person who rates hunting as very acceptable (+1) may not perceive conflict with someone who rates it as somewhat negative (-1), but feel threatened by someone who rates it as very negative (-2) because they may advocate against hunting. Raising the PCI_2 scores to a power larger than one accounts for such nonlinear perceptions of the response scale (Vaske et al. 2010). Levels of consensus using the PCI_2 can be compared across an entire sample population or among certain subpopulations like gender or stakeholder identities. Moreover, PCI_2 values can be presented graphically to facilitate the interpretation of statistical results. A detailed description of the program for calculating, graphing, and comparing PCI_2 values can be found at https://sites.warnercnr.colostate.edu/jerryv/potential-conflict-index/

Scholars have applied the PCI_2 to examine levels of social conflict/consensus over: lethal control of predators under different severities of encounter (Sponarski et al. 2015, Engel et al. 2017, Vaske 2018, Heneghan and Morse 2019); illegal killing of carnivores in Scandanavia (Gangaas et al. 2015); management methods for avian species exerting impacts such as crop damage, urban structure fouling, and disease transmission (Liordos et al. 2017); feral or invasive species management options on islands (Sharp et al. 2011, Lohr and Lepczyk 2014); and hunter

responses to chronic wasting disease and support for its management (Vaske et al. 2006). Many of these studies compare conflict potentials among subpopulation characteristics including general attitudes towards the wildlife species, value orientations, country or region, stakeholder classification, or hunting status.

Despite the proliferation of large ungulate populations in North America and public controversies surrounding both lethal and nonlethal methods of population control, few studies have quantified the potentials for social conflict over ungulate management approaches. In the case of white-tailed deer, intergroup conflict often arises from different wildlife values and concerns about deer-related impacts (Connelly et al. 1987, Lischka et al. 2008, Campa III et al. 2011, Johnson and Horowitz 2014). While hunters tend to hold concerns about deer population sizes and hunting opportunities, agricultural producers and woodland owners are concerned about damage to their lands, and urban residents carry substantial concern for both public health and deer welfare (Stinchcomb et al. 2022). Deer hunters, however, can disagree within their own group about whether licensed hunting should increase, what weapons are effective or acceptable, what types and how many deer they should be permitted to hunt, and whether deer culling or sharpshooting should occur (Stewart 2011).

Although conflict over the details of licensed hunting can infiltrate communities and stakeholder groups, contraception, or fertility control, remains the most controversial management method for white-tailed deer (Messmer et al. 1997, Loker et al. 1999, Stewart 2011, Urbanek et al. 2012). This controversy usually centers in urban communities with diverse interests and moves beyond a simple clash of wildlife values (Kirkpatrick and Turner 1997, Urbanek et al. 2012). Those who support contraception tend to live in urban/suburban areas, oppose hunting as inhumane or unsafe, and worry about deer suffering unnatural deaths, while those who oppose it may also live in urban/suburban areas, but experience frequent damage from deer, support licensed hunting, and worry about the costs and adverse effects of contraception (Kirkpatrick and Turner 1997, Messmer et al. 1997, Urbanek et al. 2015). In addition to attitudes and beliefs, scholars have found conflicts over deer management to vary by personal experiences with deer and deer damage (Curtis and Lynch 2001), gender (Lauber et al. 2001, Dougherty et al. 2003), education, age, or location of residence (Lischka et al. 2008), and moral or political ideologies and power dynamics (Peterson et al. 2002, Vesic 2011).

Since mitigating social conflict remains crucial for effective wildlife management and good governance (Dickman 2010, Redpath et al. 2013, Pomeranz et al. 2021), social and spatial analyses should be combined to better understand the cross-scalar variability of public attitudes and how wildlife management can be tailored to both social and ecological conditions (Dressel et al. 2018). In this study, I quantify potentials for conflict over deer management approaches among Indiana residents and translate them into hotspots of social conflict across the state. In so doing, I advance the utility of the PCI_2 for wildlife management and provide managers with a practical tool to identify areas of high public conflict and improve the overall social feasibility of deer management in Indiana.

5.3 Methods

5.3.1 Data Collection

To quantify Indiana residents' perceptions of deer management and the Indiana Department of Natural Resources (IN-DNR), I implemented a statewide survey from June to September 2021. Prior to data collection, my study design was approved by the Institutional Review Board of Purdue University. I sampled 6,000 residents randomly within a 2x4 stratified design. The higher-order stratum separated residents equally into 3,000 customers of the Indiana Division of Fish and Wildlife (DFW) and 3,000 non-customers (non-DFW). Within each of these strata, I randomly sampled 750 tax parcel addresses from four landscape types: forest, farmland, developed area, and 'integration.' I drew the 'integration' sub-sample from addresses within 6.4x6.4 km (4x4 mi) grids used in ongoing studies by colleagues to collect ecological data. I used ESRI ArcPro software to sample each stratum. Data were obtained from the IndianaMap geospatial database, the Indiana Department of Local Government and Finance, and the DFW. Addresses were checked for duplicates, blanks, and public or corporate ownership and re-sampled as necessary.

Survey dissemination followed Dillman's (2014) Tailored-Design Method. I sent all questionnaires via postal mail with an option to take the survey online indicated on a cover letter. Each sampled resident was sent a pre-notification postcard, followed a week later by a survey packet, and a reminder postcard sent to non-respondents two weeks after first contact. I conducted

three mailings in total, with the final two mailings sent to residents who had not yet responded via mail or online.

I checked for non-response bias by comparing key demographic characteristics of my sample to the corresponding census data for Indiana. I used chi-squared tests to determine whether significant differences existed between my sample proportions and those expected at the state level. I consider the implications of non-response bias in my Discussion.

5.3.2 Potential for Conflict Indices

I calculated and analyzed potentials for social conflict over deer management methods in Indiana. Survey respondents evaluated the acceptability of six potential management methods in their areas: (i) increased licensed hunting; (ii) culling or sharpshooting; (iii) Community Hunting Access Programs (CHAPs); (iv) contraception; (v) translocation; and (vi) providing information. I measured each management method on a 5-point scale including a neutral value from "very unacceptable" (-2) to "neither" (0) to "very acceptable" (2). The IN-DNR currently uses licensed hunting, culling or sharpshooting, CHAPs, and providing information to manage deer in Indiana. Contraception and translocation options are not currently used, but they have been tested on white-tailed deer in Indiana and elsewhere and are commonly discussed as non-lethal methods for managing ungulate populations (Sanborn et al. 1994, Swihart and DeNicola 1995, DeNicola et al. 1996, DeNicola et al. 1997a, b, Rutberg et al. 2004, Walter et al. 2010, Demarais et al. 2012).

I compare mean responses and PCI_2 values across these management methods for two demographic groups of interest: respondents' primary self-identity and their political ideology. While self-identities allow respondents to categorize themselves into a deer stakeholder category, political ideology provides an accessible way for managers to predict attitudes towards deer management using voter registration databases. The self-identity question asked respondents "What is your primary identity? Check one that you identify with the most:" (i) farmer or grower; (ii) rancher or livestock producer; (iii) woodland owner; (iv) deer hunter; (v) urban area resident; (vi) rural area resident. Since I had only 42 responses (2%) in the rancher category, I combined farmers/growers and rancher/livestock producers into one "farmer/rancher" category for analysis. To elicit political ideology, I asked respondents "Which of the following best describes your views?" on a 7-point scale: (i) strongly liberal; (ii) liberal; (iii) slightly liberal; (iv) middle-of-the-road; (v) slightly conservative; (vi) conservative; and (vii) strongly conservative. For analysis, I

combined strongly liberal and liberal into a "Liberal" category, middle-of-the-road and slightly conservative into "Moderate;" and conservative and highly conservative into "Conservative." The slightly liberal option had no responses.

I used one-way analysis of variance (ANOVA) to compare the mean acceptability levels of each management method among respondent self-identities and political ideologies. Although scholars and statisticians debate the application of ANOVA to Likert-scale ordinal data (e.g., Jamieson 2004, Carifio and Perla 2008), others have proven ANOVA to be highly robust to non-normally distributed data, skewness, and Likert scales (Pearson 1931, Boneau 1960, Norman 2010). Since ANOVA examines differences between means, the Central Limit Theorem applies, showing that with sufficient group sizes (some say > 10), the group means approach normality regardless of their original distribution (Norman 2010). Additionally, while Likert-scale questions may be ordinal in nature, this ordinality derives from an underlying latent characteristic that can only be inferred (Gaito 1980). Likert scales can be (and frequently are) treated as intervals in parametric analyses without invalidating any conclusions about the numbers or their means and deviations (Norman 2010).

Following Sponarski et al. (2015), I used Bonferroni *post hoc* tests to determine significant differences in means among groups at adjusted p-values of 0.005 for self-identity (10 comparisons) and 0.0167 for political ideology (3 comparisons). When my data violated the homogeneity of variance assumption, I used Welch's ANOVA with a Games-Howell post-hoc test for group differences. This pairwise testing method is robust to differences in group sample sizes and error variances (Games and Howell 1976, Stoline 2012). I used R v.4.1.2 for all ANOVA testing.

I calculated PCI_2 values for each self-identity and political ideology under each management method using a Microsoft Excel spreadsheet available on the website cited in the introduction. The underlying equation for calculating PCI_2 is based on the average distance of an individual's response from all other responses to that question. Mathematically:

$$\Delta x = \frac{\sum d_{x,y}}{Max} = \frac{\sum f(r_{x,}\, r_y)}{Max} = sum\ x\ for\ x \neq y$$

where r = an individual's response, d = the distance between x and other responses, Δx = normalized distance of response x, and Max = maximum possible sum of response values (Vaske

et al. 2010). The PCI_2 averages Δx across all values of x. I used a distance function that excludes the neutral value from PCI_2 calculations and a power of 1.5 to allow for nonlinear perceptions of the differences between scale values. From a psychological perspective, a nonlinear power function allows for a more realistic calculation of PCI_2 values and does not conflict with the linearity assumption of ANOVA because ANOVA only compares mean acceptability levels among groups, not PCI_2 values within groups.

I tested for differences in PCI_2 values between pairs of groups using the difference test provided on the PCI_2 website. This test uses simulated standard deviations to test for differences in observed PCI_2 values:

$$d = \frac{|PCI_a - PCI_b|}{\sqrt{(PCI_{aSD})^2 - (PCI_{bSD})^2}}$$

where PCI_a = observed PCI_2 for the first sample or group, PCI_b = observed PCI_2 for a second sample or group, PCI_{aSD} = standard deviation of the simulated PCI_2 distribution for the first sample or group, and PCI_{bSD} = standard deviation of the simulated PCI2 distribution for the second sample or group (Vaske et al. 2010:249). Following Sponarski et al. (2015) and Engel et al. (2017), I compared the resulting d value to critical values of a standard normal distribution, at an alpha level of 0.05. If $d > 1.96$, I deemed the difference between PCI_2 values significant (Vaske et al. 2010).

I plotted PCI_2 values by group and management method on a bubble graph. The bubble's size represents within-group conflict over a management method, with larger sizes indicating higher intragroup conflict. The center of each bubble lies on the mean response for that group, which is plotted on the y-axis. The vertical distance between bubbles thus represents the degree of inter-group conflict or consensus over a management method.

5.3.3 Mapping social conflict potentials

I created heat maps of social conflict over deer management across Indiana using respondent acceptability ratings for my six deer management methods: culling, licensed hunting, CHAPs, contraception, translocation, and providing advice or information. Since I aimed to map areas where the difference between respondent's acceptability values was highest, a conventional hot-spot analysis—which determines areas where high values are surrounded by other high values

or low values by other low values—did not work for my purpose. Following Brown et al. (2017) and Moore et al. (2017), I overlayed a 12.9 x 12.9 km (8 x 8 mi) grid over my final survey sample derived from a 6.4 x 6.4 km (4 x 4 mi) statewide grid created by the IN-DNR and used by my colleagues for ecological sampling (Caudell and Vaught 2017). After testing several grid sizes, I chose a 12.9x12.9 km cell area to balance the number of points within each grid cell with the spatial resolution required to assess local trends in conflict potentials (Moore et al. 2017).

Using responses from the sample points within each grid cell, I calculated the mean and frequency distribution of acceptability responses and the PCI_2 value for each management method. I then used the gridded PCI_2 values in a hot-spot analysis to visualize where grid cells with high potentials for social conflict were surrounded by other grids with high social conflict potentials and, by opposition, areas where social conflict was low. Grid cells with no sample points or only one sample point were excluded from the hotspot analysis to avoid zero inflation. I created one heat map for each of the six management methods.

I chose a fixed distance band method for the hotspot analysis tool to analyze the spatial relationships among gridded PCI_2 values. I used the Incremental Spatial Autocorrelation analysis to determine the optimal search distance for each management method. The hotspot analysis tool calculates the Getis-Ord Gi* statistic as a z-score (Getis and Ord, 1992). Large, positive z-scores with small p-values indicate significant clustering of high PCI_2 values and produce a hotspot on the map. Large, negative z-scores with small p-values indicate significant clustering of low PCI_2 values and produce coldspots. Based on the distances at which z-scores peaked for each method, and opting for more regional rather than local clustering, I used a distance band of 32 miles (51.5 km). Significant hot- and coldspots were mapped with color gradients to indicate the level of confidence in the statistic: 90%, 95%, or 99% confidence. I overlaid my final heat maps with the boundaries of Regional Management Units (RMUs) for deer to illustrate how social conflict could impact Indiana's deer management strategy.

5.4 Results

5.4.1 Descriptive statistics

I received 1,806 complete survey responses with 500 undeliverable, deceased, or otherwise ineligible for a response rate of 33%. Responses were relatively well distributed across the state, with some clustering evident near major cities (Figure 5.1). Survey respondents were 76% male and 23% female, overwhelmingly White/Caucasian (92%), with an average age of 60 and an average of 51 years of residency in Indiana (Table 5.1). Over a third of respondents had at least a college degree (37%) and another third had a high school diploma or less (32%, Table 5.1).

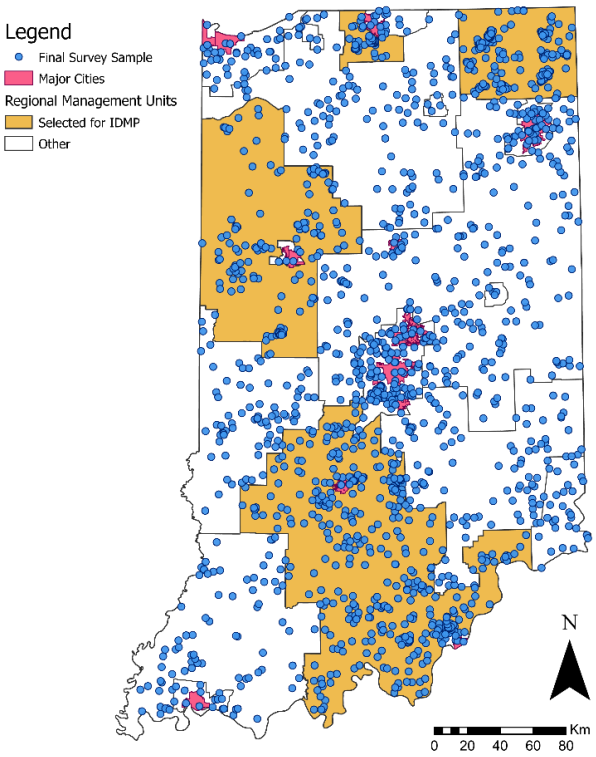


Figure 5.1. Distribution of survey responses across Indiana, overlayed on Regional Management Units for deer and incorporated areas of the 15 largest cities by population. IDMP = Integrated Deer Management Project.

Respondents self-identified primarily as either rural residents (43%) or urban residents (25%), with 12% identifying as primarily deer hunters and 12% as primarily farmers or ranchers (Table 5.1). Most respondents reported a conservative political ideology (59%), with 22% aligning with a moderate ideology and just 12% aligning with a liberal ideology (Table 5.1). Just under half of respondents found licensed hunting (49%) and information provision (47%) to be acceptable management methods (Table 5.2). Respondents were split on the acceptability of culling and CHAP methods, with 35% rating culling as unacceptable, 34% rating culling as acceptable, 33% rating CHAPs as unacceptable, and 32% rating CHAPs as acceptable (Table 5.2). Contraception and translocation were the least acceptable management methods among respondents, with 43% rating contraception as very unacceptable and 38% rating translocation as very unacceptable (Table 5.2).

5.4.2 Potentials for conflict among self-identified stakeholder groups

Self-identified stakeholder groups showed differences in mean acceptability ratings across nearly all deer management methods, except for providing information which was acceptable for all groups (means = 0.24 – 0.58). The greatest differences occurred for nonlethal methods of contraception and translocation. Deer hunters rated these nonlethal methods as significantly less acceptable than all other groups ($\bar{x}_{cont}$ = -1.66; $\bar{x}_{trans}$ = -1.33; $p_{all-contrasts} < 0.001$). Urban residents rated contraception and translocation as significantly more acceptable than all other groups, but their average rating was still slightly unacceptable ($\bar{x}_{cont}$ = -0.27; $\bar{x}_{trans}$ = -0.16; $p_{all-contrasts} < 0.001$). Farmers, woodland owners, and rural residents all rated nonlethal methods as unacceptable on average (Figure 5.2).

Mean acceptability ratings for lethal methods also differed between self-identity groups. Farmers showed significantly greater acceptability of deer culling, on average, than either deer hunters or woodland owners ($\bar{x}_{farm}$=0.26; $\bar{x}_{hunt}$=-0.57; $\bar{x}_{wlo}$= -0.28; p < 0.005). Deer hunters also rated culling as significantly less acceptable than did rural and urban residents ($\bar{x}_{hunt}$=-0.57; $\bar{x}_{urban}$=-0.02; $\bar{x}_{rural}$= 0.05; p < 0.001). Licensed hunting was the most acceptable management method across self-identity groups (Figure 5.2). Mean levels of acceptability differed significantly, however, between farmers and hunters, with farmers rating hunting as more acceptable than hunters themselves ($\bar{x}_{farm}$=0.67; $\bar{x}_{hunt}$= 0.18; p = 0.001). Acceptability of CHAP programs was neutral, on average (Figure 5.2), but woodland owners showed significantly lower acceptability of CHAPs than urban residents ($\bar{x}_{wlo}$=-0.33; $\bar{x}_{urb}$= 0.03; p < 0.05). Levels of inter-group conflict were thus highest for culling, contraception, and translocation methods (Figure 5.2). Licensed hunting also showed potential conflict between farmers and hunters.

Table 5.1. Observed proportions on characteristics of survey respondents (N = 1806) and overall proportions from the Indiana population.

	N	Sample Proportion	Statewide Proportion[a]
Primary Self-Identity	1771		
Farmer/Rancher		.12	0.01[b]
Woodland Owner		.08	0.04[c]
Deer Hunter		.12	0.01[d]
Urban/Suburban Resident		.25	0.62[e]
Rural Resident		.43	0.38[e]
Political Ideology	1679		
Liberal		.12	0.17[f]
Moderate		.22	0.38[f]
Conservative		.59	0.39[f]
Gender	1749		
Man		.76	0.49
Woman		.23	0.51
Ethnicity	1717		
White/Caucasian		.92	0.62
Black/African American		.01	0.12
Hispanic/LatinX		.00	0.19
Asian/Asian American		.01	0.06
Native American		.00	0.01
Pacific Islander		.00	0
Household Income	1562		
< $50,000		.25	0.43
$50,000 - $99,999		.38	0.32
$100,000 – 199,999		.30	0.2
> $200,000		.07	0.05
Highest Education	1731		
High School or less		.32	0.44
Associate degree or some college		.31	0.29
College or graduate degree		.37	0.27
Age	1806		
18 to 24		.01	0.1
25 to 44		.15	0.26
45 to 64		.39	0.25
65 and older		.41	0.17

[a]*Data from 2019 U.S. Census and American Community Survey, unless otherwise noted. Total Population of Indiana = 6.732 million*
[b]*2017 USDA Census of Agriculture, Indiana*
[c]*2018 USDA National Woodland Owner Survey*
[d]*2019 Indiana White-Tailed Deer Report*
[e]*Purdue Extension Report, "Population Trends in Indiana." Proportions of the population living in urban counties and mixed rural or rural counties*
[f]*2018 Gallup Poll, state ideological identification.*

Table 5.2. Summary statistics for respondent acceptability ratings of six potential deer management methods in Indiana (N = 1806)

Variable Name	Variable description and value levels	n	Proportion of responses
Management Acceptability	*To manage deer populations in your local area, how unacceptable or acceptable do you consider the following potential actions?*		
Licensed hunting	Increasing licensed hunting in my area	1749	
	-2 = Very Unacceptable		0.14
	-1		0.10
	0 = Neither		0.23
	1		0.23
	2 = Very Acceptable		0.26
Culling	Culling deer populations in my area	1732	
	-2 = Very Unacceptable		0.20
	-1		0.15
	0 = Neither		0.28
	1		0.19
	2 = Very Acceptable		0.15
CHAPs	Creating a Community Hunting Access Program for my area	1722	
	-2 = Very Unacceptable		0.18
	-1		0.15
	0 = Neither		0.33
	1		0.17
	2 = Very Acceptable		0.13
Contraception	Using contraception to control deer fertility in my area	1732	
	-2 = Very Unacceptable		0.43
	-1		0.16
	0 = Neither		0.22
	1		0.09
	2 = Very Acceptable		0.08
Translocation	Trapping & relocating deer from my area to another in Indiana	1740	
	-2 = Very Unacceptable		0.38
	-1		0.18
	0 = Neither		0.22
	1		0.11
	2 = Very Acceptable		0.08
Information	Providing advice or information about deer to members of my community	1733	
	-2 = Very Unacceptable		0.08
	-1		0.09
	0 = Neither		0.33
	1		0.24
	2 = Very Acceptable		0.23

Potentials for conflict within each self-identity group was highest for hunters over increases in licensed hunting (PCI_2 = 0.43), and lowest for hunters over contraception methods (PCI_2 = 0.08). Farmers also showed relatively high intragroup conflict over culling, hunting, and contraception methods (PCI_2 range 0.30 – 0.36). Compared to farmers, intragroup conflict over culling and translocation was significantly different for urban and rural residents and intragroup conflict over contraception was significantly lower for hunters than for all other groups (Figure 5.2). Hunters also showed significantly higher intragroup conflict over licensed hunting than all other groups and significantly lower conflict over translocation than urban and rural residents (Figure 5.2). Intragroup conflict over CHAP programs was significantly lower for urban residents than for farmers and hunters (Figure 5.2).

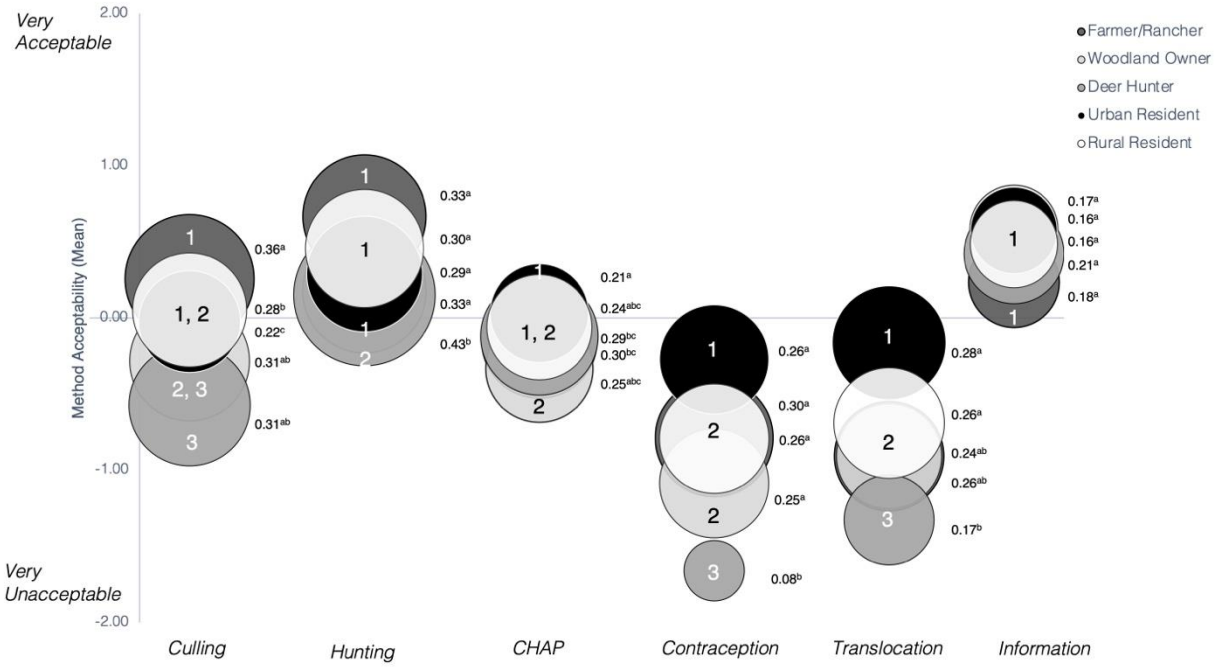


Figure 5.2. Mean acceptability levels of six potential deer management options and Potentials for Conflict (PCI_2) among respondents' primary self-identities. Bubble size represents PCI_2 value, which is provided to the right of each bubble. Superscript letters (^{a,b,c}) on PCI_2 values represent significant differences in conflict potentials among the five groups. Numbers within bubbles (1, 2, 3) represent significant differences among mean group acceptability responses ($p < 0.05$). Shading indicates group affiliation.

5.4.3 Potentials for conflict among political ideologies

Unlike respondent self-identities, respondent political ideologies did not differ in acceptability ratings of culling (Figure 5.3). Contraception again produced the greatest differences in mean acceptability ratings, with liberals showing the highest average acceptability ($\bar{x}$ = 0.01), followed distantly by moderates ($\bar{x}$ = -0.76) and then conservatives ($\bar{x}$ = -0.96; $p_{all-contrasts}$ < 0.001). Conservatives and moderates rated translocation as significantly less acceptable than liberals ($\bar{x}_{cons}$= -0.79; $\bar{x}_{mod}$ = -0.63; $\bar{x}_{lib}$= -0.18; p < 0.001), but mean acceptability between the former two groups did not differ. Similarly, liberals rated licensed hunting as significantly less acceptable than both conservatives and moderates ($\bar{x}_{lib}$= 0.02; $\bar{x}_{mod}$ = 0.21; $\bar{x}_{cons}$= 0.51; p < 0.001). Liberals also rated CHAP programs as less acceptable than did conservatives ($\bar{x}_{lib}$= -0.33; $\bar{x}_{cons}$= 0.00; p = 0.002). Although providing information was again acceptable across groups, on average, its ratings differed significantly between liberals and conservatives, with liberals showing the highest acceptability of this method ($\bar{x}$ = 0.71) and conservatives the lowest ($\bar{x}$ = 0.42; p = 0.003). The greatest conflict over deer management methods among respondent political ideologies thus occurred for contraception, translocation, and licensed hunting.

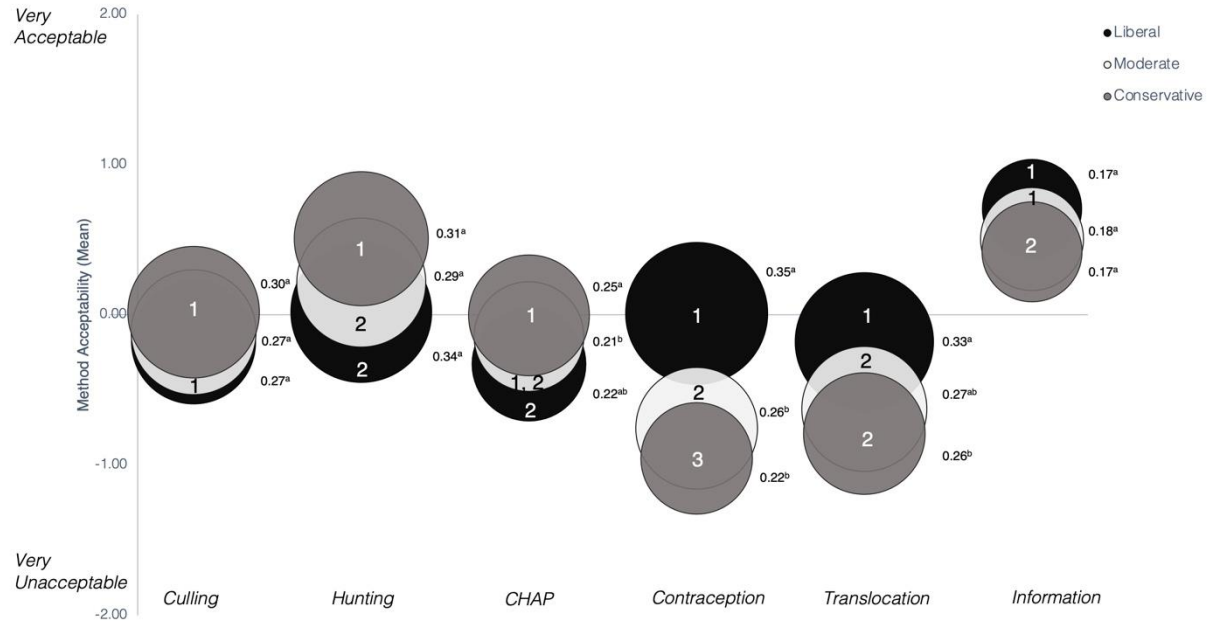


Figure 5.3. Mean acceptability levels of six potential deer management options and Potentials for Conflict (PCI_2) for liberal, moderate and conservative respondents. Bubble size represents PCI_2 value, which is provided to the right of each bubble. Superscript letters (^{a,b,c}) on PCI_2 values represent significant differences in conflict potentials among the five groups. Numbers within bubbles (1, 2, 3) represent significant differences among mean group acceptability responses (p < 0.05). Shading indicates group affiliation.

Levels of conflict within each political ideology group were lower (i.e., greater consensus) than those within stakeholder self-identities. Liberals showed the highest intragroup conflict over licensed hunting and contraception (each PCI_2 = 0.34-0.35). Their conflict over contraception was significantly higher than that of both other ideologies (Figure 5.3). For all groups, the lowest PCI_2 occurred for providing information about deer management (PCI_2 range = 0.17-0.18).

5.4.4 Hotspots of social conflict over deer management

I found the largest and most significant hotspots of social conflict over deer management for culling, licensed hunting, and contraception methods. The largest hotspot for culling appeared in southern Indiana, with 87% concentrated within a single RMU (Figure 5.4a). Another significant culling hotspot with 90-95% confidence occurred in northeast Indiana, crossing the border of two RMUs (Figure 5.4a). Conflict over licensed hunting was also significant in this area, but only a few grid cells showed high conflict potentials in southern Indiana. The largest hotspot for hunting appeared in central Indiana, concentrated in the Indianapolis metropolitan area, which comprises its own RMU, but spilling over into two RMUs to the east (Figure 5.4b). Following from the findings above, social conflict over CHAP method was relatively low. A single hotspot of six grid cells with 90-95% confidence emerged in northeast Indiana (Figure 5.4c), overlapping with a section of the corresponding hotspots for licensed hunting and culling.

For all lethal methods, significant cold spots were found in three main regions. These occurred in the west-central area and the southwest tip of the state, with a few cells in the southeast showing low social conflict with 90% confidence (Figure 5.4a,b,c). Cold spots with 95% confidence appeared in the southwest for culling, the west-central for hunting, and the east-central for CHAPs. Most cold spots fell within a single RMU, except for one or two grid cells of the west-central hotspots crossing RMU borders for both culling and hunting methods.

Among nonlethal methods, the largest and most significant hotspot of social conflict appeared for contraception in the southwest corner of the state (Figure 5.4d). This hotspot spanned almost the entirety of a small RMU and crossed into its western neighbor. Smaller hotspots appeared for both contraception and translocation methods in the northern region of the Indianapolis metropolitan area in central Indiana (Figures 5.4d, 5.4e). Additional hotspots occurred for translocation near the southern border of the state and, for contraception, in the south-central

region. The information provision method showed a few areas of significant social conflict, mainly in south-central and northwestern Indiana (Figure 5.4f).

Areas of low social conflict differed across nonlethal management methods. For contraception, a few cold spots occurred in northern rural areas, whereas a more concentrated cold spot with 90-95% confidence appeared for translocation in the west-central part of the state (Figures 5.4d, 5.4e). Just four grid cells showed cold spots with 90-95% confidence for information provision, all of which appeared in central Indiana (Figure 5.4f). These areas of low social conflict over nonlethal methods were mostly within a single RMU, except for one or two cold spot cells that crossed an RMU border for each management method.

Figure 5.4. Hotspots of high social conflict and coldspots of low social conflict over deer management methods. Culling (a), licensed hunting (b), and Community Hunting Access Programs (c) are lethal methods. Contraception (d), translocation (e), and providing information (f) are nonlethal methods. Data are overlaid with survey response points and Regional Management Units for deer.

5.5 Discussion

Previous scholarship demonstrates that stakeholder identities explain differences in the acceptability of wildlife management methods (Messmer et al. 1997, Bruskotter et al. 2009, Lohr and Lepczyk 2014, Liordos et al. 2017, van Eeden et al. 2019). My findings confirm that acceptability of deer management methods varies with resident self-identities, producing conflicts both within and among stakeholder groups. But the patterning of certain conflicts may be unexpected by wildlife managers. Deer hunters, for example, showed the highest level of intragroup conflict over licensed hunting among all identity groups. This counterintuitive result likely stems from mixed beliefs among hunters about increased hunting activity and its effects on crowding, availability of game, and access to private hunting lands (Heberlein 2002, Larson et al. 2014). Contrary to the literature describing urban-to-rural divides over hunting (Heberlein and Ericsson 2005, Ericsson et al. 2018, Wilkins et al. 2019), rural and urban residents in my study did not differ in their acceptability of lethal deer management methods. Urban residents, however, did show greater acceptability of nonlethal methods than any other identity group. Due to these conflicts, social identities and stakeholder categorizations may not be the most reliable indicator for predicting social acceptability of wildlife management.

Political ideologies can also influence trust in wildlife agencies (Manfredo et al. 2017, Schroeder et al. 2021), and interact with wildlife values and information sources to influence risk perceptions and attitudes toward wildlife (Nardi et al. 2020). I found that political ideologies produced expected differences in the social acceptability of deer management. Residents with liberal ideologies reported opposing and significantly different mean acceptability levels from those with conservative ideologies across all management methods, except culling. Political values tend to be stable over time, particularly at ideological extremes (Zaller 1991, Goren 2005). Social identities, in contrast, often vary with the object in consideration, e.g., the wildlife species vs. a policy goal (Lute and Gore 2014) and individuals may identify with multiple, intersecting social groups (McCubbin and Van Patter 2021). How individuals define their identities may also differ from how managers typically delineate stakeholder groups (Stinchcomb et al. 2022). Thus, political ideology may be a more consistent predictor of the acceptability of wildlife management than stakeholder identities. When examining social acceptance or tolerance, managers should consider residents' political ideologies and how these influence the processing of information about the impacts and benefits of wildlife populations (Hart and Nisbet 2012). Data on variables

like political ideology and voter registration are regularly collected by national surveys and are often publicly available. Exploiting this information could help agencies strategically implement wildlife management methods based on political distributions within their state.

I next mapped potentials for social conflict across the state to examine what regional or landscape-level forces might underly the spatial clustering of social conflicts. Past controversies over deer culls have arisen around Bloomington in south-central Indiana (Knackmuhs et al. 2019, Knackmuhs and Farmer 2017). My largest and most significant hotspot of social conflict occurred in this location and over the culling method. Additional hotspots over hunting and CHAP methods concentrated around the cities of Indianapolis in central Indiana and Fort Wayne in the northwest. Hunting in urban areas is logistically challenging, due to local ordinances, covenants of homeowners' associations, and plots with small acreage. Urban residents also feel greater risks to personal safety from hunting (Kilpatrick and Walter 1997, DeNicola et al. 2000, Kilpatrick et al. 2007), perceive deer management as biased towards hunting interests (Stinchcomb et al. 2022), and tend to have less experience with hunting than rural residents (Shaw et al. 1978, Manfredo and Zinn 1996, Heberlein and Ericsson 2005). However, an urban concentration of hotspots conflicts with my finding that self-identified urban residents do not differ from rural residents in their acceptability of nor levels of intragroup conflict over lethal management methods. Political affiliations, on the other hand, better aligned with the distribution of social conflicts. Liberal affiliations tend to concentrate in large urban areas with smaller cities being more politically mixed, and suburban fringes becoming increasingly conservative (Gimpel et al. 2020). I found that liberal-leaning residents were less accepting of licensed hunting and CHAP programs, on average, than other political ideologies, potentially leading to higher conflict with moderate and conservative residents in urban areas. Fort Wayne, an area where hotspots occurred for all lethal methods, is the second largest city behind Indianapolis with a population of 263,886 (U.S. Census Bureau 2020). Yet politically, its residents lean more moderate and conservative than those of Indianapolis, with a small patch of liberal precincts near the city center (Dottle 2019). Although Fort Wayne is inside an Urban Deer Reduction Zone, leading to potentially more exposure to hunting, the diversity of attitudes towards hunting among its residents has led to mixed acceptance of increased hunting activity (Stewart 2011). Whereas many rural landowners participate in hunting or engage directly with hunters, proportionately fewer urban residents participate in hunting despite their proximity to special hunting opportunities like Urban Deer Reduction Zones

or CHAPs (Stewart 2011, Wilkins et al. 2019). Thus, high social conflicts in and around cities are likely driven by the interaction between differential experiences with lethal wildlife management and conflicting political ideologies.

The PCI_2 typically describes the potential for conflict or consensus to occur among groups of people over a particular management strategy (Vaske et al. 2010). Yet, when mapping PCI_2 values over space, its values can depict both potentials for conflict and existing levels of conflict, depending on the local context. For example, I observed the most significant hotspot of conflict over nonlethal methods at the southeastern corner of the state, classified as both mixed-rural and rural (Purdue Extension 2013). Residents in this region likely work and recreate in or experience the social-political culture of Cincinnati, Ohio, just over the eastern border. Contraceptive methods for managing deer have been tested and debated in the Cincinnati area for several years (Smith 2015, DeNicola and DeNicola 2021). I expect Indiana residents in this southeast corner to have direct experience with the debates surrounding fertility control in deer populations and report the side on which they fall; the hotspot therefore likely represents existing levels of conflict over contraception. In contrast, hotspots near areas like Indianapolis, where contraception has not been tested, likely depict *potentials* for conflict to arise based on the opinions of residents rather than their immediate experiences. Nevertheless, both hotspots inform wildlife managers that contraception is not socially feasible under existing social conditions in these regions.

Public support, or a lack of public opposition, is critical for effective policy implementation (Sanborn et al. 1994), but the public often lacks awareness about the cost, implementation, and efficacy of various wildlife management methods (Kilpatrick et al. 2007, Walter et al. 2010). Nonlethal methods face the additional challenge of conflicting public perceptions about their humaneness and effects on hunting traditions (Curtis et al. 1993, Kilpatrick and Walter 1997). Lethal methods also face challenges of changing public values for wildlife and declining hunter populations (Manfredo et al. 2009, Jacobson et al. 2010, Price Tack et al. 2018). Agencies recognize the need to expand funding for wildlife management beyond license revenues and equipment taxes, but this requires a shift in agency values and a shift in the interests that managers consider (Jacobson et al. 2010, Serfass et al. 2018, AFWA and WMI 2019). Urban residents are an emerging target for broadening public support for wildlife and natural resource management (Davies et al. 2004, McCance et al. 2017). But, as my study highlights, urbanites represent a diverse and conflict-laden demographic. Although spatial conflict levels were insignificant in most

urban areas for nonlethal methods, the demographic and ideological composition of these regions suggests that conflict may still emerge in metropolitan or mixed-rural areas. These social conflict potentials add to the challenge of managing humans and wildlife in urban areas, due to diverse demographics, municipal authority, varying land use or zoning, lower hunting opportunities, and greater concerns about hunting among urban residents. Along with increased awareness and engagement about lethal management methods, nonlethal methods need to be part of the management equation in urban areas because both social and ecological feasibility are required for effective wildlife management (Lischka et al. 2018, Brown et al. 2019, Clifford et al. 2022). Depending on agency funding and the dynamics of local wildlife populations, urban areas could serve as test grounds for mixed lethal and nonlethal management strategies.

Associating regions of social conflict with units of wildlife management aids with the integration of social information into management planning (Moore et al. 2017, Brown et al. 2019). In Indiana, Regional Management Units were delineated based on models of deer mortality, habitat characteristics, and landcover including levels of urban development (Swihart et al. 2020). These units do not capture social variation over space because wildlife management strategies remain driven by the ecology of the species and landscape. Conflicting or negative social perceptions of wildlife management, however, can create unique challenges like public opposition toward agencies, voter-mandated management actions, and exacerbated human-wildlife conflict (Minnis 1998, Williamson 1998, Redpath et al. 2013, Manfredo et al. 2017). If the human dimensions remain unaddressed by wildlife agencies, social conflicts will increase the politicization of wildlife management (Ditmer et al. 2022) and decrease the efficacy of management strategies, especially those related to reducing human-wildlife conflicts (Dickman 2010, Bhatia et al. 2020). My hotspot analysis highlighted areas of social consensus (coldspots) where management methods will receive little public opposition and areas of high social conflict (hotspots) where management likely will be met with public backlash and controversy. My analysis thus identified areas where agencies can target their public outreach and engagement efforts, especially for lethal methods like culling and licensed hunting which are widely applied but may not be socially accepted. Using social data mapped over space, agencies can follow the methods employed to delineate wildlife management units (e.g., Swihart et al. 2020) and create social management units that encompass regions where public perceptions, ideologies, and conflict levels are similar. Managers can then analyze the conditions within social and ecological units

simultaneously to determine the most appropriate and feasible management strategy for each region.

I recommend caution when interpreting my results to broader populations, particularly in urban contexts. Compared to census data for Indiana, my sample contained significantly greater proportions of white/Caucasian, male, well-educated, high-income, and rural-dwelling residents (Table 5.2). These differences are directly attributable to my sampling strategy, which intentionally targeted rural forestland and agricultural properties, as well as existing customers of the Indiana DFW. I encourage future research to focus on non-traditional wildlife constituents in urban areas and compare their perceptions directly with those from more traditional constituents in rural areas. My analysis was further limited by the size of grid cells used for the hotspot analysis. Grid cells with only one data point were excluded from the hotspot analysis because of a zero PCI_2 value, which limited my ability to detect significant hot and cold spots in very rural areas of the state (Figure 4a-f). Additionally, the size and location of hotspots can shift with the grid cell size and search distance chosen during analysis. Compared to other distances, a search distance of 51.5 km (32 mi) optimized the spatial autocorrelation of PCI_2 values across management methods, and a 12.9 x 12.9 km cell area appeared to balance the number of single-point grid cells with the detectability of PCI_2 variation at a relatively local level. My method can be enhanced first by expanding data collection and nonresponse efforts to achieve a more even distribution of survey responses across the state; and second by systematically conducting hotspot analyses with multiple grid sizes to determine the sensitivity of findings to different spatial resolutions. Researchers should include agency personnel in this process to determine the most appropriate distances at which to analyze the social landscape of wildlife management. Despite these limitations, my application of the original grid used for ecological sampling across the state will facilitate the future integration of social data with data on deer population densities and habitat use.

Future studies should advance my spatial analyses of social conflict over wildlife management and integrate this information with ecological variables. Wildlife management depends on data like wildlife population densities, movement, and habitat use, and these factors influence human interactions with wildlife. While other studies have mapped the influence of population and landscape variables on human-wildlife conflicts (Carter et al. 2014, Struebig et al. 2018, Carter et al. 2020, Sharma et al. 2020, Tripathy et al. 2021), the influence of these variables on social conflicts over wildlife has yet to be assessed. Since the persistence of social conflicts hinders

effective wildlife governance (Dickman 2010, Pomeranz et al. 2021), and those conflicts are typically driven by ideological, values-based differences (Bruskotter et al. 2009, Schroeder et al. 2021), areas of conflict over management methods should also be associated with spatial data on voter behavior and wildlife value orientations. Still, tailoring wildlife management strategies to both social and ecological conditions remains practically challenging. Effective social-ecological integration requires continued collaborations between wildlife biologists and social scientists, in spaces that promote reflexivity (Atkins 2004), relational thinking (Haraway 1988, Cruikshank 2005, Latour 2005), and negotiation of epistemological differences (Fielding 2012, Angelstam et al. 2013). In practice, however, interdisciplinary research faces limited funding, training, leadership, and acceptance within agencies and even academic institutions (Jacobson et al. 2022, Teel et al. 2022). Although these institutional barriers persist, agencies can work to increase their social science capacities and shift their institutional cultures toward recognizing the importance of social data and local knowledge (Bélisle et al. 2018, Manfredo et al. 2019, Morales et al. 2021, Jacobson et al. 2022). Geospatial analyses provide one practical and relatively accessible tool for wildlife managers to begin integrating complex social and ecological landscapes and viewing the relationships between humans and wildlife through cross-scalar and cross-disciplinary lenses (Fielding 2012, Teixeira 2016).

5.6 References

AFWA (Association of Fish and Wildlife Agencies) and WMI (The Wildlife Management Institute). 2019. Fish and Wildlife Relevancy Roadmap: Enhanced Conservation Through Broader Engagement (v1.0). M. Dunfee, A. Forstchen, E. Haubold, M. Humpert, J. Newmark, J. Sumners, and C. Smith. 2019 (eds). AFWA. Wash. D.C. 128 Pages.

Angelstam, P., K. Andersson, M. Annerstedt, R. Axelsson, M. Elbakidze, P. Garrido, P. Grahn, K. I. Jönsson, S. Pedersen, P. Schlyter, E. Skärbäck, M. Smith, and I. Stjernquist. 2013. Solving Problems in Social–Ecological Systems: Definition, Practice and Barriers of Transdisciplinary Research. *AMBIO* 42(2):254–265.

Armitage, D., F. Berkes, A. Dale, E. Kocho-Schellenberg, and E. Patton. 2011. Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. *Global Environmental Change* 21(3):995–1004.

Assche, K. V., R. Beunen, and M. Duineveld. 2017. The will to knowledge: natural resource management and power/knowledge dynamics. *Journal of Environmental Policy & Planning* 19(3):245–250.

Atkins, P. 2004. Interdisciplinarity and positionality. *Interdisciplinary Science Reviews* 29(1):2–5.

Bélisle, A.C., Asselin, H., LeBlanc, P., Gauthier, S., 2018. Local knowledge in ecological modeling. *Ecology & Society* 23:art14. https://doi.org/10.5751/ES-09949-230214

Bergsten, A., D. Galafassi, and Ö. Bodin. 2014. The problem of spatial fit in social-ecological systems: detecting mismatches between ecological connectivity and land management in an urban region. *Ecology and Society* 19(4).

Bhatia, S., S. M. Redpath, K. Suryawanshi, and C. Mishra. 2020. Beyond conflict: exploring the spectrum of human–wildlife interactions and their underlying mechanisms. *Oryx* 54(5):621–628.

Boneau, C. A. 1960. The effects of violations of assumptions underlying the t test. *Psychological Bulletin* 57: 49–64.

Brock, M., G. Perino, and R. Sugden. 2017. The warden attitude: An investigation of the value of interaction with everyday wildlife. *Environmental and Resource Economics* 67(1):127–155.

Brown, G., C. McAlpine, J. Rhodes, D. Lunney, R. Goldingay, K. Fielding, S. Hetherington, M. Hopkins, C. Manning, M. Wood, A. Brace, L. Vass, and L. Swankie. 2019. Integration of social spatial data to assess conservation opportunities and priorities. *Biological Conservation* 236:452–463.

Bruskotter, J. T., J. J. Vaske, and R. H. Schmidt. 2009. Social and Cognitive Correlates of Utah Residents' Acceptance of the Lethal Control of Wolves. *Human Dimensions of Wildlife* 14(2):119–132.

Campa III, H., S. J. Riley, S. R. Winterstein, T. L. Hiller, S. A. Lischka, and J. P. Burroughs. 2011. Changing landscapes for white-tailed deer management in the 21st century: Parcelization of land ownership and evolving stakeholder values in Michigan. *Wildlife Society Bulletin* 35(3):168–176.

Carifio, L., and R. Perla. 2008. Resolving the 50-year debate around using and misusing Likert scales. *Medical Education* 42: 1150–1152.

Carter, N. H., S. J. Riley, A. Shortridge, B. K. Shrestha, and J. Liu. 2014. Spatial Assessment of Attitudes Toward Tigers in Nepal. *AMBIO* 43(2):125–137.

Carter, N., M. A. Williamson, S. Gilbert, S. A. Lischka, L. R. Prugh, J. J. Lawler, A. L. Metcalf, A. L. Jacob, B. J. Beltrán, A. J. Castro, A. Sage, and M. Burnham. 2020. Integrated spatial analysis for human–wildlife coexistence in the American West. *Environmental Research Letters* 15(2):021001.

Caudell, J. N. and O. D. L. Vaught. 2018. 2017 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, Indiana.

Ceauşu, S., R. A. Graves, A. K. Killion, J.-C. Svenning, and N. H. Carter. 2019. Governing trade-offs in ecosystem services and disservices to achieve human–wildlife coexistence. *Conservation Biology* 33(3):543–553.

Clifford, K. R., A. E. Cravens, and C. N. Knapp. 2022. Responding to Ecological Transformation: Mental Models, External Constraints, and Manager Decision-Making. *BioScience* 72(1):57–70.

Connelly, N. A., D. J. Decker, and S. Wear. 1987. Public tolerance of deer in a suburban environment: Implications for management and control. Page 13, *Proceedings of the third eastern wildlife damage control conference*.

Cruikshank, J. (2005). *Do Glaciers Listen: Local Knowledge, Colonial Encounters, & Social Imagination.* Vancouver, BC: University of British Columbia Press

Curtis, J., and L. Lynch. 2001. Explaining Deer Population Preferences: An Analysis of Farmers, Hunters and the General Public. *Agricultural and Resource Economics Review* 30(1):44–55.

Curtis, P. D., D. J. Decker, R. J. Stout, M. E. Richmond, and C. A. Loker. 1993. Human Dimensions of Contraception in Wildlife Management. *Contraception in Wildlife Management* 7:247–255.

Davies, R. G., L. M. Webber, and G. S. Barnes. 2004. Urban wildlife management - it's as much about people! Pages 38–43 *in* D. Lunney and S. Burgin, editors. *Urban Wildlife: More than meets the eye*. Royal Zoological Society of New South Wales, Mosman NSW, Australia.

Decker, D., C. Smith, A. Forstchen, D. Hare, E. Pomeranz, C. Doyle-Capitman, K. Schuler, and J. Organ. 2016. Governance Principles for Wildlife Conservation in the 21st Century: Governance principles for wildlife conservation. *Conservation Letters* 9(4):290–295.

Demarais, S., L. Cornicelli, R. Kahn, E. Merrill, C. Miller, J. M. Peek, W. F. Porter, and G. A. Sargeant. 2012. Ungulate management in national parks of the United States and Canada. The Wildlife Society Technical Review 12-05. The Wildlife Society, Bethesda, Maryland, USA.

DeNicola, A.J., D.J. Kesler, and R.K. Swihart. 1996. Ballistics of a biobullet delivery system. *Wildlife Society Bulletin* 24:301-305.

DeNicola, A.J., D.J. Kesler, and R.K. Swihart. 1997a. Remotely delivered prostaglandin F2 implants terminate pregnancy in white-tailed deer. *Wildlife Society Bulletin* 25:527-531.

DeNicola, A.J., D.J. Kesler, and R.K. Swihart. 1997b. Dose determination and efficacy of remotely delivered norgestomet implants on contraception of white-tailed deer. *Zoo Biology* 16:31-37.

DeNicola, A. J., K. C. VerCauteren, P. D. Curtis, and S. E. Hygnstrom. 2000. Managing white-tailed deer in suburban environments: a technical guide. Cornell Cooperative Extension Information Bulletin, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, USA.

DeNicola, A. J., and V. L. DeNicola. 2021. Ovariectomy as a management technique for suburban deer populations. *Wildlife Society Bulletin* 45(3): 445-455.

Dickman, A. J. 2010. Complexities of conflict: The importance of considering social factors for effectively resolving human-wildlife conflict. *Animal Conservation* 13(5):458–466.

Dietsch, A. M., T. L. Teel, and M. J. Manfredo. 2016. Social values and biodiversity conservation in a dynamic world. *Conservation Biology* 30(6):1212–1221.

Ditmer, M. A., R. M. Niemiec, G. Wittemyer, and K. R. Crooks. 2022. Socio-ecological drivers of public conservation voting: restoring gray wolves to Colorado, USA. *Ecological Applications* e2532.

Dottle, R. 2019. Where Democrats and Republicans live in your city. [online]. ABC News Internet Ventures:FiveThirtyEight. Accessed Feb 9, 2022. https://projects.fivethirtyeight.com/republicans-democrats-cities/

Dougherty, E. M., D. C. Fulton, and D. H. Anderson. 2003. The influence of gender on the relationship between wildlife value orientations, beliefs, and the acceptability of lethal deer control in Cuyahoga Valley National Park. *Society & Natural Resources* 16(7):603–623.

Dressel, S., G. Ericsson, and C. Sandström. 2018. Mapping social-ecological systems to understand the challenges underlying wildlife management. *Environmental Science & Policy* 84:105–112.

Engel, M.T., Vaske, J.J., Bath, A.J., Marchini, S., 2017. Attitudes toward jaguars and pumas and the acceptability of killing big cats in the Brazilian Atlantic Forest: An application of the Potential for Conflict Index2. *Ambio* 46, 604–612. https://doi.org/10.1007/s13280-017-0898-6

Engel, M. T., J. J. Vaske, A. J. Bath, and S. Marchini. 2017. Attitudes toward jaguars and pumas and the acceptability of killing big cats in the Brazilian Atlantic Forest: An application of the Potential for Conflict Index2. *Ambio* 46(5):604–612.

Ericsson, G., C. Sandström, and S. J. Riley. 2018. Rural-urban heterogeneity in attitudes towards large carnivores in Sweden, 1976-2014. Pages 190–205 *in* T. Hovardas, editor. *Large Carnivore Conservation and Management: Human Dimensions*. Routledge.

Fielding, N. G. 2012. Triangulation and mixed methods designs: Data integration with new research technologies. *Journal of Mixed Methods Research* 6(2):124–136.

Fulton, D. C., M. J. Manfredo, and J. Lipscomb. 1996. Wildlife value orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife* 1(2):24–47.

Gaito, J. 1980. Measurement scales and statistics: Resurgence of an old misconception. *Psychological Bulletin* 87: 564–567

Games, P. A., and J. F. Howell. 1976. Pairwise multiple comparison procedures with unequal n's and/or variances: A monte carlo study. *Journal of Educational Statistics* 1(2): 113-125.

Gangaas, K. E., B. P. Kaltenborn, and H. P. Andreassen. 2015. Environmental attitudes associated with large-scale cultural differences, not local environmental conflicts. *Environmental Conservation* 42(1):41–50.

Gerbing, D. W., and J. C. Anderson. 1988. An updated paradigm for scale development incorporating unidimensionality and its assessment. *Journal Of Marketing Research* 25:186–192.

Getis, A. and J.K. Ord. 1992. The analysis of spatial association by use of distance statistics. *Geographical Analysis* 24(3).

Ghoddousi, A., E. K. Buchholtz, A. M. Dietsch, M. A. Williamson, S. Sharma, N. Balkenhol, T. Kuemmerle, and T. Dutta. 2021. Anthropogenic resistance: accounting for human behavior in wildlife connectivity planning. *One Earth* 4(1):39–48.

Gimpel, J. G., N. Lovin, B. Moy, and A. Reeves. 2020. The urban–rural gulf in American political behavior. *Political Behavior* 42(4):1343–1368.

Goren, P. 2005. Party identification and core political values. *American Journal of Political Science* 49(4):881–896.

Haraway, D. 1988. Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies* 14(3), 575–99.

Hare, D., D. J. Decker, C. A. Smith, A. B. Forstchen, and C. A. Jacobson. 2017. Applying public trust thinking to wildlife governance in the United States: Challenges and potential solutions. *Human Dimensions of Wildlife* 22(6):506–523.

Hart, P. S., and E. C. Nisbet. 2012. Boomerang effects in science communication: How Motivated reasoning and identity cues amplify opinion polarization about climate mitigation policies. *Communication Research* 39(6):701–723.

Heberlein, T. A. 2002. Too many hunters or not enough deer? Human and biological determinants of hunter satisfaction and quality. *Human Dimensions of Wildlife* 7(4):229–250.

Heberlein, T. A., and G. Ericsson. 2005. Ties to the countryside: Accounting for urbanites attitudes toward hunting, wolves, and wildlife. *Human Dimensions of Wildlife* 10(3):213–227.

Heneghan, M. D., and W. C. Morse. 2019. Acceptability of management actions and the potential for conflict following human-black bear encounters. *Society & Natural Resources* 32(4):434–451.

Jacobson, C. A., J. F. Organ, D. J. Decker, G. R. Batcheller, and L. Carpenter. 2010. A conservation institution for the 21st century: Implications for state wildlife agencies. *The Journal of Wildlife Management* 74(2):203–209.

Jacobson, C. A., L. Sullivan, M. Gasta, M. J. Manfredo, J. Camuso, P. Novotny, R. Jacobson, and K. Witthaus. 2022. State fish and wildlife agency culture: Access points to leverage major change. *Conservation Science and Practice* 4(2).

Jamieson, S. 2004. Likert scales: How to (ab)use them. *Medical Education* 38: 1217–1218.

Johns, G., D. J. Lee, V. (Bob) Leeworthy, J. Boyer, and W. Nuttle. 2014. Developing economic indices to assess the human dimensions of the South Florida coastal marine ecosystem services. *Ecological Indicators* 44:69–80.

Johnson, B. B., and L. S. Horowitz. 2014. Beliefs about ecological impacts predict deer acceptance capacity and hunting support. *Society & Natural Resources* 27(9):915–930.

Kilpatrick, H. J., A. M. Labonte, and J. S. Barclay. 2007. Acceptance of deer management strategies by suburban homeowners and bowhunters. *The Journal of Wildlife Management* 71(6):2095–2101.

Kilpatrick, H. J., and W. D. Walter. 1997. Urban deer management: A community vote. *Wildlife Society Bulletin* 25(2):388–391.

Kirkpatrick, J. F., and J. W. Turner. 1997. Urban deer contraception: The seven stages of grief. *Wildlife Society Bulletin* 25(2):6.

Knackmuhs, E., J. Farmer, and D. Knapp. 2019. The relationship between narratives, wildlife value orientations, attitudes, and policy preferences. *Society & Natural Resources* 32(3):303–321.

Knackmuhs, E., and J. R. Farmer. 2017. Factors influencing trust in a wildlife management agency: A case study of deer management in Bloomington, Indiana. *Journal of Park & Recreation Administration* 35(3):48–64.

Larson, L. R., R. C. Stedman, D. J. Decker, W. F. Siemer, and M. S. Baumer. 2014. Exploring the social habitat for hunting: Toward a comprehensive framework for understanding hunter recruitment and retention. *Human Dimensions of Wildlife* 19(2):105–122.

Latour, B. 2005. Reassembling the social: An introduction to Actor-Network Theory. Oxford University Press, NewYork.

Lauber, T. B., M. L. Anthony, and B. A. Knuth. 2001. Gender and ethical judgements about suburban deer management. *Society & Natural Resources* 14(7):571–583.

Liordos, V., V. J. Kontsiotis, M. Georgari, K. Baltzi, and I. Baltzi. 2017. Public acceptance of management methods under different human–wildlife conflict scenarios. *Science of The Total Environment* 579:685–693.

Lischka, S. A., S. J. Riley, and B. A. Rudolph. 2008. Effects of impact perception on acceptance capacity for white-tailed deer. *The Journal of Wildlife Management* 72(2):502–509.

Lischka, S. A., T. L. Teel, H. E. Johnson, S. E. Reed, S. Breck, A. Don Carlos, and K. R. Crooks. 2018. A conceptual model for the integration of social and ecological information to understand human-wildlife interactions. *Biological Conservation* 225:80–87.

Lohr, C. A., and C. A. Lepczyk. 2014. Desires and management preferences of stakeholders regarding feral cats in the Hawaiian Islands. *Conservation Biology* 28(2):392–403.

Loker, C. A., D. J. Decker, and S. J. Schwager. 1999. Social acceptability of wildlife management actions in suburban areas: 3 cases from New York. *Wildlife Society Bulletin* 27(1):152–159.

Lute, M. L., and M. L. Gore. 2014. Stewardship as a path to cooperation? Exploring the role of identity in intergroup conflict among Michigan wolf stakeholders. *Human Dimensions of Wildlife* 19(3):267–279.

Manfredo, M. J., J. Salerno, L. Sullivan, and J. Berger. 2019. For US wildlife management, social science needed now more than ever. *BioScience*:biz122.

Manfredo, M. J., T. L. Teel, A. W. Don Carlos, L. Sullivan, A. D. Bright, A. M. Dietsch, J. Bruskotter, and D. Fulton. 2020. The changing sociocultural context of wildlife conservation. *Conservation Biology* 34(6):1549–1559.

Manfredo, M. J., T. L. Teel, and K. L. Henry. 2009. Linking society and environment: A multilevel model of shifting wildlife value orientations in the western United States. *Social Science Quarterly* 90(2):407–427.

Manfredo, M. J., T. L. Teel, L. Sullivan, and A. M. Dietsch. 2017. Values, trust, and cultural backlash in conservation governance: The case of wildlife management in the United States. *Biological Conservation* 214:303–311.

Manfredo, M. J., and H. C. Zinn. 1996. Population change and its implications for wildlife management in the New West: A case study of Colorado. *Human Dimensions of Wildlife* 1(3):62–74.

Manfredo, M., J. Vaske, and T. Teel. 2003. The Potential for Conflict Index: A graphic approach to practical significance of human dimensions research. *Human Dimensions of Wildlife* 8(3):219–228.

McCance, E. C., D. J. Decker, A. M. Colturi, R. K. Baydack, W. F. Siemer, P. D. Curtis, and T. Eason. 2017. Importance of urban wildlife management in the United States and Canada. *Mammal Study* 42(1):1–16.

McCubbin, S. G., and L. E. Van Patter. 2021. Trophy hunters & crazy cat ladies: Exploring cats and conservation in North America and Southern Africa through intersectionality. *Gender, Place & Culture* 28(9):1327–1350.

Messmer, T. A., L. Cornicelli, D. J. Decker, and D. G. Hewitt. 1997. Stakeholder acceptance of urban deer management techniques. *Wildlife Society Bulletin* 25(2):360–366.

Minnis, D. L. 1998. Wildlife policy-making by the electorate: An overview of citizen-sponsored ballot measures on hunting and trapping. *Wildlife Society Bulletin* 26(1):75–83.

Moore, S. A., G. Brown, H. Kobryn, and J. Strickland-Munro. 2017. Identifying conflict potential in a coastal and marine environment using participatory mapping. *Journal of Environmental Management* 197:706–718.

Morales, N. A., A. R. Gramza, W. A. Carr, and K. E. Wallen. 2021. Can wildlife management agencies do more to increase and maintain social science capacity? *The Wildlife Professional* (September/October):50–53.

Nardi, A., B. Shaw, D. Brossard, and D. Drake. 2020. Public attitudes toward urban foxes and coyotes: the roles of perceived risks and benefits, political ideology, ecological worldview, and attention to local news about urban wildlife. *Human Dimensions of Wildlife* 25(5):405–420.

Norman, G. 2010. Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Sciences Education* 15: 625-632.

Pearson, E. S. 1931. The analysis of variance in the case of non-normal variation. *Biometrika* 23: 114–133.

Peterson, M. N., T. R. Peterson, M. J. Peterson, R. R. Lopez, and N. J. Silvy. 2002. Cultural conflict and the endangered Florida Key deer. *The Journal of Wildlife Management* 66(4):947.

Piédallu, B., P.-Y. Quenette, C. Mounet, N. Lescureux, M. Borelli-Massines, E. Dubarry, J.-J. Camarra, and O. Gimenez. 2016. Spatial variation in public attitudes towards brown bears in the French Pyrenees. *Biological Conservation* 197:90–97.

Pomeranz, E. F., D. Hare, D. J. Decker, A. B. Forstchen, C. A. Jacobson, C. A. Smith, and M. V. Schiavone. 2021. Successful wildlife conservation requires good governance. *Frontiers in Conservation Science* 2:76.

Price Tack, J. L., C. P. McGowan, S. S. Ditchkoff, W. C. Morse, and O. J. Robinson. 2018. Managing the vanishing North American hunter: a novel framework to address declines in hunters and hunter-generated conservation funds. *Human Dimensions of Wildlife* 23(6):515–532.

Purdue Extension. 2013. Defining rural Indiana - The first step. Report EC-766-W. Center for Rural Development, Purdue University Extension. https://ag.purdue.edu/agecon/fambiz/Documents/defining_rural_indiana.pdf

Redpath, S. M., J. Young, A. Evely, W. M. Adams, W. J. Sutherland, A. Whitehouse, A. Amar, R. A. Lambert, J. D. C. Linnell, A. Watt, and R. J. Gutiérrez. 2013. Understanding and managing conservation conflicts. *Trends in Ecology & Evolution* 28(2):100–109.

Reise, S. P., N. G. Waller, and A. L. Comrey. 2000. Factor analysis and scale revision. *Psychological Assessment* 12(3):287–297.

Robbins, P. 2006. The politics of barstool biology: Environmental knowledge and power in greater Northern Yellowstone. *Geoforum* 37(2):185–199.

Rutberg, A. T., R. E. Naugle, L. A. Thiele, and I. K. M. Liu. 2004. Effects of immunocontraception on a suburban population of white-tailed deer Odocoileus virginianus. *Biological Conservation* 116(2):243–250.

Sanborn, W. A., R. H. Schmidt, and H. C. Freeman. 1994. Policy considerations for contraception in wildlife management. Page 7 *Proceedings of the 16th Vertebrate Pest Conference*. University of California Davis.

Schroeder, S. A., A. C. Landon, D. C. Fulton, and L. E. McInenly. 2021. Social identity, values, and trust in government: How stakeholder group, ideology, and wildlife value orientations relate to trust in a state agency for wildlife management. *Biological Conservation* 261:109285.

Scott, D., R. B. Ditton, J. R. Stoll, and T. L. Eubanks. 2005. Measuring specialization among birders: Utility of a self-classification measure. *Human Dimensions of Wildlife* 10(1):53–74.

Serfass, T. L., R. P. Brooks, and J. T. Bruskotter. 2018. North American Model of Wildlife Conservation: Empowerment and exclusivity hinder advances in wildlife conservation. *Canadian Wildlife Biology & Management* 7(2):101–118.

Sharma, P., N. Chettri, K. Uddin, K. Wangchuk, R. Joshi, T. Tandin, A. Pandey, K. S. Gaira, K. Basnet, S. Wangdi, T. Dorji, N. Wangchuk, V. S. Chitale, Y. Uprety, and E. Sharma. 2020. Mapping human–wildlife conflict hotspots in a transboundary landscape, Eastern Himalaya. *Global Ecology and Conservation* 24:e01284.

Sharp, R. L., L. R. Larson, and G. T. Green. 2011. Factors influencing public preferences for invasive alien species management. *Biological Conservation* 144(8):2097–2104.

Shaw, W.W., Carpenter, E.H., Arthur, L.M., Gum, R.L., & Witter, D.J. 1978. The American disposition toward hunting in 1976. *Wildlife Society Bulletin* 6:33-35

Smith, C. B. 2015. "Deer sterilization: When compassion, sport, need and science collide." Cincinnati.com, The Enquirer [online]. USA Today Network. Accessed March 3, 2022. URL: https://www.cincinnati.com/story/news/2015/12/26/cincinnati-deer-sterilization-fertility-control-clifton/76779622/

Sponarski, C. C., J. J. Vaske, and A. J. Bath. 2015. Attitudinal differences among residents, park staff, and visitors toward coyotes in Cape Breton Highlands National Park of Canada. *Society & Natural Resources* 28(7):720–732.

Stern, M. J., and K. J. Coleman. 2015. The multidimensionality of trust: Applications in collaborative natural resource management. *Society & Natural Resources* 28(2):117–132.

Stewart, C. M. 2011. Attitudes of urban and suburban residents in Indiana on deer management. *Wildlife Society Bulletin* 35(3):316–322.

Stinchcomb, T., Z. Ma, and Z. Nyssa. 2022. Complex human-deer interactions challenge conventional management approaches: the need to consider power, trust, and emotion. *Ecology and Society* 27(1).

Stoline, M. R. 2012. The status of multiple comparisons: Simultaneous estimation of all pairwise comparisons in one-way ANOVA designs. *The American Statistician* 35(3):134-141.

Struebig, M. J., M. Linkie, N. J. Deere, D. J. Martyr, B. Millyanawati, S. C. Faulkner, S. C. Le Comber, F. M. Mangunjaya, N. Leader-Williams, J. E. McKay, and F. A. V. S. John. 2018. Addressing human-tiger conflict using socio-ecological information on tolerance and risk. *Nature Communications* 9(1):3455.

Swihart, R.K., and A.J. DeNicola. 1995. Modeling the impacts of contraception on populations of white-tailed deer. Pages 151-163 in J.B. McAninch, ed., Urban deer: A manageable resource? Proceedings of the 1993 Symposium of the North Central Section, The Wildlife Society, 175pp.

Swihart, R.K., Caudell, J.N., Brooke, J.M., Ma, Z. 2020. A flexible model-based approach to delineate wildlife management units. *Wildlife Society Bulletin* 44(1):77–85.

Teel, T. L., B. Bruyere, A. Dayer, K. E. Stoner, C. Bishop, J. Bruskotter, S. Freeman, J. Newmark, C. Jager, and M. J. Manfredo. 2022. Reenvisioning the university education needs of wildlife conservation professionals in the United States. *Conservation Science and Practice* 4(2).

Teixeira, S. (2016). Qualitative Geographic Information Systems (GIS): An untapped research approach for social work. *Qualitative Social Work*, 17(1): 9-23

Tripathy, B. R., X. Liu, M. Songer, L. Kumar, S. Kaliraj, N. D. Chatterjee, W. M. S. Wickramasinghe, and K. K. Mahanta. 2021. Descriptive spatial analysis of human-elephant conflict (HEC) distribution and mapping HEC hotspots in Keonjhar Forest Division, India. *Frontiers in Ecology and Evolution* 9(2021):art640624.

Urbanek, R. E., C. K. Nielsen, M. A. Davenport, and B. D. Woodson. 2012. Acceptability and conflict regarding suburban deer management methods. *Human Dimensions of Wildlife* 17(6):389–403.

Urbanek, R. E., C. K. Nielsen, M. A. Davenport, and B. D. Woodson. 2015. Perceived and desired outcomes of suburban deer management methods. *The Journal of Wildlife Management* 79(4):647–661.

U.S. Census Bureau. 2020. QuickFacts Fort Wayne city, Indiana. [online]. United States Census Bureau. Accessed Feb 9, 2022. https://www.census.gov/quickfacts/fortwaynecityindiana

van Eeden, L. M., T. M. Newsome, M. S. Crowther, C. R. Dickman, and J. Bruskotter. 2019. Social identity shapes support for management of wildlife and pests. *Biological Conservation* 231:167–173.

Vaske, J. J. 2018. Visualizing consensus in human dimensions data: The potential for conflict index $_2$. *Human Dimensions of Wildlife* 23(1):83–89.

Vaske, J. J., & Manfredo, M. J. 2012. Social psychological considerations in wildlife management. Pages 43-57 *in* D. J. Decker, S. J. Riley, & W. F. Siemer, editors. *Human Dimensions of Wildlife Management* (2nd ed). Baltimore, MD: John Hopkins University Press

Vaske, J. J., J. Beaman, H. Barreto, and L. B. Shelby. 2010. An extension and further validation of the Potential for Conflict Index. *Leisure Sciences* 32(3):240–254.

Vaske, J. J., M. D. Needham, P. Newman, M. J. Manfredo, and J. Petchenik. 2006. Potential for Conflict Index: Hunters' responses to Chronic Wasting Disease. *Wildlife Society Bulletin* 34(1):44–50.

Vesic, J. 2013. The political ecology of wildlife conservation: the case of white-tailed deer in southern Ontario.

Walter, W. D., M. J. Lavelle, J. W. Fischer, T. L. Johnson, S. E. Hygnstrom, and K. C. VerCauteren. 2010. Management of damage by elk (*Cervus elaphus*) in North America: A review. *Wildlife Research* 37(8):630.

Wilkins, E. J., N. W. Cole, H. M. Miller, R. M. Schuster, A. A. Dayer, J. N. Duberstein, D. C. Fulton, Howard. W. Harshaw, and A. H. Raedeke. 2019. Rural-urban differences in hunting and birdwatching attitudes and participation intent. *Human Dimensions of Wildlife* 24(6):530–547.

Williamson, S. J. 1998. Origins, history, and current use of ballot initiatives in wildlife management. *Human Dimensions of Wildlife* 3(2):51–59.

Zaller, J. 1991. Information, values, and opinion. *American Political Science Review* 85(4):1215–1237.

Zimmermann, A., P. Johnson, A. E. de Barros, C. Inskip, R. Amit, E. C. Soto, C. A. Lopez-Gonzalez, C. Sillero-Zubiri, R. de Paula, S. Marchini, J. Soto-Shoender, P. G. Perovic, S. Earle, C. J. Quiroga-Pacheco, and D. W. Macdonald. 2021. Every case is different: Cautionary insights about generalisations in human-wildlife conflict from a range-wide study of people and jaguars. *Biological Conservation* 260:109185.

CHAPTER 6. CONCLUSION

Here, I examined the social dimensions of white-tailed deer management in Indiana. I studied residents' values, beliefs, attitudes, and emotions related to deer, their satisfaction with deer management, and their potentials to conflict with others over deer management methods. I highlighted the interconnection between cognitions and emotions about deer, which has only recently emerged as a recommended focus of research in the human dimensions of wildlife (Jacobs et al. 2012, Sponarski et al. 2015). My findings urge researchers and practitioners to recognize human emotion as a driver of normative judgements (like acceptability of management methods), behaviors, and shifts in attitudes or beliefs about wildlife and wildlife management. I then highlighted the importance and multidimensionality of social conflict over wildlife management. Reducing social conflict is necessary for broadening public support for wildlife management (Redpath et al. 2015, Pooley et al. 2017), but managers require practical tools to facilitate their understanding of social conflicts and their strategies to address them (McNie 2006, Cook et al. 2013). I developed one quantitative index and expanded upon another to understand the drivers of public (dis)satisfaction with deer management and the social and geographic distributions of potential conflicts over management methods. These analyses offer agencies preliminary tools to address public opposition to their management strategies and begin integrating social dimensions into their management planning.

I found that emotions toward, public satisfaction with, and social conflicts over deer management are all highly complex. But this complexity is not constrained to the human-deer system in Indiana. Complexity is a fundamental characteristic of social-ecological systems (Rogers 2013, Preiser et al. 2018) and a feature of human-wildlife interactions across taxa and across cultures (Dickman 2010, Carter et al. 2014, Dressel et al. 2018). Ecological variables undoubtedly add to the complexity of human-wildlife interactions (Nyhus 2016, Lischka et al. 2018). The social dimensions of deer management captured herein still need to be analyzed with ecological variables to determine how public perceptions and conflicts interact with deer population densities and habitat use. Effective social-ecological integration, however, faces epistemological, institutional, and practical barriers.

Although understanding complex systems requires both quantitative and qualitative methods, the social and natural sciences remain "siloed" into solving problems using their own

frameworks, methods, and understandings (Anglestam et al. 2013). Transforming these "silos" into a "beer tent"[1] requires framing common problems, brokering knowledge among colleagues, and practicing reflexivity (Atkins 2004, Anglestam et al. 2013). Institutional structures also bear responsibility for incomplete integration practices. For instance, funding priorities tend to elevate quantitative data practices over qualitative work and modeling approaches over participatory research (Cornwall and Jewkes 1999, Anglestam et al. 2013). Grant applications therefore use integration as a buzzword to obtain funding, without having a clear plan for how the social and ecological dimensions will be combined (Barnaud and Van Paassen 2013). Finally, the "soft skills" required for effective collaboration, innovation, and leadership remain sorely absent from higher education curricula (Succi and Canovi 2020, Teel et al. 2021). Future integrated collaborations should reflect regularly on researcher assumptions, biases, and positions, develop a detailed plan for the collection and integration of social and ecological data, seek alternative funding streams, and provide team members with opportunities for interdisciplinary training.

From the agency side, integrating social science into wildlife management planning remains difficult in practice (Niemiec et al. 2021). Several shifts in the practice of wildlife management are needed before the social science and the findings thereof can be incorporated into management decisions (Jacobson et al. 2022). First, social scientists should help wildlife practitioners and administrators understand concepts like emotion, trust, and satisfaction and their importance for improving the governance of wildlife as a public trust resource. Second, agencies should continue to hire social scientists to facilitate the collection and interpretation of data on the human dimensions of wildlife management (Morales et al. 2021). Third, funding structures for agency research and institutional cultures need to accept and accommodate social science that investigates human-wildlife interactions beyond traditional wildlife users and large game species using a variety of methods that can adequately capture social complexity. Like social-ecological integration, the burdens of change should not be borne only by researchers or agency personnel (Lélé and Norgaard 2005). Agencies cannot broaden public interest in wildlife nor diversify their conception of wildlife 'customers' without fundamental changes in the existing wildlife management institution (Jacobson et al. 2010, Decker et al. 2016).

[1] A beer tent has open sides and no walls. It allows for the unimpeded mingling of researchers from diverse disciplines. The beer also facilitates collaboration. I credit this apt analogy to my M.S. adviser, Dr. Todd J. Brinkman.

Wildlife management is a value-based practice. In every decision, managers choose what values to prioritize over others (Decker et al. 2019). Specific approaches like structured decision making exist to help practitioners evaluate the interests involved in or affected by a wildlife management decision (Runge et al. 2020). This approach also allows managers to weigh social versus ecological goals, alternatives, and outcomes. But how do managers incorporate complex, abstract social variables into a structured planning process? If complexity highlights anything, it is that human cognition, emotion, and behavior are difficult to reduce to exclusive categories like wildlife stakeholders. Adaptive governance, which emphasizes bi-directional learning processes and continual revision of management strategies, offers a strategy to better accommodate complexity in natural resource and wildlife management (Folke et al. 2005, Armitage et al. 2009). But adaptive governance faces its own barriers including an aversity to uncertainty, an unwillingness to share power and knowledge with local people, and a lack of training, leadership, and policy champions (Manolis et al. 2009, Davidson 2010, Assche et al. 2017). Although guidance exists on how agencies might overcome institutional and practical barriers (e.g., AFWA and WMI 2019), these guides do not outline how agencies should operationalize constructs like public satisfaction, nor specific techniques with which institutional and operational changes can be implemented. Still, continuing efforts to conduct rigorous, participatory social research about human-wildlife interactions and working to incorporate the findings of such research into wildlife management strategies will help agencies adapt to coupled changes in the social-ecological systems which they are entrusted to manage. After all, good governance is a practice rather than a measurable objective to be achieved (Pomeranz et al. 2021).

6.1 References

AFWA (Association of Fish and Wildlife Agencies) and WMI (The Wildlife Management Institute). 2019. *Fish and Wildlife Relevancy Roadmap: Enhanced conservation through broader engagement (v. 1.0)*. M. Dunfee, A. Forstchen, E. Haubold, M. Humpert, J. Newmark, J. Sumners, and C. Smith. 2019 (eds). AFWA. Wash. D.C. 128 Pages.

Angelstam, P., K. Andersson, M. Annerstedt, R. Axelsson, M. Elbakidze, P. Garrido, P. Grahn, K. I. Jönsson, S. Pedersen, P. Schlyter, E. Skärbäck, M. Smith, and I. Stjernquist. 2013. Solving Problems in Social–Ecological Systems: Definition, Practice and Barriers of Transdisciplinary Research. *AMBIO* 42(2):254–265.

Armitage, D. R., R. Plummer, F. Berkes, R. I. Arthur, A. T. Charles, I. J. Davidson-Hunt, A. P. Diduck, N. C. Doubleday, D. S. Johnson, M. Marschke, P. McConney, E. W. Pinkerton, and E. K. Wollenberg. 2009. Adaptive co-management for social– ecological complexity. *Frontiers in Ecology and the Environment* 7(2):95–102. https://doi.org/10.1890/070089

Assche, K. V., R. Beunen, M. Duineveld, and M. Gruezmacher. 2017. Power/knowledge and natural resource management: Foucaultian foundations in the analysis of adaptive governance. *Journal of Environmental Policy & Planning* 19(3):308–322.

Atkins, P. 2004. Interdisciplinarity and positionality. *Interdisciplinary Science Reviews* 29(1):2–5.

Barnaud, C., and A. Van Paassen. 2013. Equity, power games, and legitimacy: Dilemmas of participatory natural resource management. *Ecology and Society*, *18*(2). https://doi.org/10.5751/ES-05459-180221

Carter, N. H., A. Viña, V. Hull, W. J. McConnell, W. Axinn, D. Ghimire, and J. Liu. 2014. Coupled human and natural systems approach to wildlife research and conservation. *Ecology and Society* 19(3):art43.

Cook, C. N., M. B. Mascia, M. W. Schwartz, H. P. Possingham, and R. A. Fuller. 2013. Achieving conservation science that bridges the knowledge-action boundary. *Conservation Biology: The Journal of the Society for Conservation Biology* 27(4):669–678.

Cornwall, A., and R. Jewkes. 1995. What is participatory research? *Social Science & Medicine*, *41*(12):1667–1676.

Davidson, D. J. 2010. The Applicability of the Concept of Resilience to Social Systems: Some Sources of Optimism and Nagging Doubts. *Society & Natural Resources* 23(12):1135–1149.

Decker, D. J., A. B. Forstchen, W. F. Siemer, C. A. Smith, R. K. Frohlich, M. V. Schiavone, P. E. Lederle, and E. F. Pomeranz. 2019. Moving the paradigm from stakeholders to beneficiaries in wildlife management. *The Journal of Wildlife Management* 83(3):513–518.

Decker, D., C. Smith, A. Forstchen, D. Hare, E. Pomeranz, C. Doyle-Capitman, K. Schuler, and J. Organ. 2016. Governance Principles for Wildlife Conservation in the 21st Century. *Conservation Letters* 9(4):290–295.

Dressel, S., G. Ericsson, and C. Sandström. 2018. Mapping social-ecological systems to understand the challenges underlying wildlife management. *Environmental Science & Policy* 84:105–112.

Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive Governance of Social-Ecological Systems. *Annual Review of Environment and Resources*, *30*(1), 441–473. https://doi.org/10.1146/annurev.energy.30.050504.144511

Jacobs, M. H., J. J. Vaske, and J. M. Roemer. 2012. Toward a Mental Systems Approach to Human Relationships with Wildlife: The Role of Emotional Dispositions. *Human Dimensions of Wildlife* 17(1):4–15.

Jacobson, C. A., J. F. Organ, D. J. Decker, G. R. Batcheller, and L. Carpenter. 2010. A Conservation Institution for the 21st Century: Implications for State Wildlife Agencies. *The Journal of Wildlife Management* 74(2):203–209.

Jacobson, C. A., L. Sullivan, M. Gasta, M. J. Manfredo, J. Camuso, P. Novotny, R. Jacobson, and K. Witthaus. 2022. State fish and wildlife agency culture: Access points to leverage major change. *Conservation Science and Practice* 4(2).

Lélé, S., and R. B. Norgaard. 2005. Practicing Interdisciplinarity. *BioScience* 55(11):967–975.

Lischka, S. A., T. L. Teel, H. E. Johnson, S. E. Reed, S. Breck, A. Don Carlos, and K. R. Crooks. 2018. A conceptual model for the integration of social and ecological information to understand human-wildlife interactions. *Biological Conservation* 225:80–87.

Manolis, J. C., K. M. Chan, M. E. Finkelstein, S. Stephens, C. R. Nelson, J. B. Grant, and M. P. Dombeck. 2009. Leadership: a New Frontier in Conservation Science. *Conservation Biology* 23(4):879–886.

McNie, E. C. 2007. Reconciling the supply of scientific information with user demands: an analysis of the problem and review of the literature. *Environmental Science & Policy* 10(1):17–38.

Morales, N. A., A. R. Gramza, W. A. Carr, and K. E. Wallen. 2021. Can wildlife management agencies do more to increase and maintain social science capacity? *The Wildlife Professional*(September/October):50–53.

Niemiec, R. M., R. Gruby, M. Quartuch, C. T. Cavaliere, T. L. Teel, K. Crooks, J. Salerno, J. N. Solomon, K. W. Jones, M. Gavin, A. Lavoie, A. Stronza, L. Meth, A. Enrici, K. Lanter, C. Browne, J. Proctor, and M. Manfredo. 2021. Integrating social science into conservation planning. *Biological Conservation* 262:109298.

Nyhus, P. J. 2016. Human–Wildlife Conflict and Coexistence. *Annual Review of Environment and Resources* 41(1):143–171.

Pomeranz, E. F., D. Hare, D. J. Decker, A. B. Forstchen, C. A. Jacobson, C. A. Smith, and M. V. Schiavone. 2021. Successful Wildlife Conservation Requires Good Governance. *Frontiers in Conservation Science* 2:76.

Pooley, S., M. Barua, W. Beinart, A. Dickman, G. Holmes, J. Lorimer, A. J. Loveridge, D. W. Macdonald, G. Marvin, S. Redpath, C. Sillero-Zubiri, A. Zimmermann, and E. J. Milner-Gulland. 2017. An interdisciplinary review of current and future approaches to improving human–predator relations. *Conservation Biology* 31(3):513–523.

Preiser, R., R. Biggs, A. De Vos, and C. Folke. 2018. Social-ecological systems as complex adaptive systems: organizing principles for advancing research methods and approaches. *Ecology and Society* 23(4).

Redpath, S. M., S. Bhatia, and J. Young. 2015. Tilting at wildlife: reconsidering human–wildlife conflict. *Oryx* 49(2):222–225.

Rogers, K., R. Luton, H. Biggs, R. (Oonsie) Biggs, S. Blignaut, A. Choles, C. Palmer, and P. Tangwe. 2013. Fostering Complexity Thinking in Action Research for Change in Social–Ecological Systems. *Ecology and Society* 18(2).

Runge, M. C., S. J. Converse, J. E. Lyons, and D. R. Smith (Eds). 2020. Structured Decision Making. Baltimore: Johns Hopkins University Press.

Sponarski, C. C., J. J. Vaske, and A. J. Bath. 2015. The Role of Cognitions and Emotions in Human–Coyote Interactions. *Human Dimensions of Wildlife* 20(3):238–254.

Succi, C., and M. Canovi. 2020. Soft skills to enhance graduate employability: comparing students and employers' perceptions. *Studies in Higher Education* 45(9):1834–1847.

Teel, T. L., B. Bruyere, A. Dayer, K. E. Stoner, C. Bishop, J. Bruskotter, S. Freeman, J. Newmark, C. Jager, and M. J. Manfredo. 2022. Reenvisioning the university education needs of wildlife conservation professionals in the United States. *Conservation Science and Practice* 4(2).

APPENDIX A. INTERVIEW PROTOCOLS

Farmer/Woodland Owner Protocol

Interviewer:_____

Pseudonym of Interviewee: _____

Date: _____/_____/_____

Time: _____:_____ AM / PM

Introduction verbiage: I appreciate you taking the time to do an interview with me. Thank you in advance. My name is Taylor Stinchcomb and I am a doctoral student at Purdue University working with Dr. Zhao Ma in the Department of Forestry and Natural Resources. Our research is part of a larger collaboration with the Indiana Department of Natural Resources to improve deer management

A few things about the process:

This interview is entirely voluntary and should take about 60 minutes. Everything you tell me during the interview will be kept strictly confidential. Your name will not be revealed to anyone beyond myself and Dr. Ma. For the purpose of data coding and analysis, it will be really helpful for me to record this conversation. I will not share this recording with anyone outside our research team. You can tell me to stop recording or stop this interview at any time. Do you feel comfortable with recording?

Again, thank you for your willingness to participate in this interview. Do you have any questions before we begin?

Background information

I'd like to start by getting to know a little more about you. Where are you from?

(1) How long have you (or your family) lived in Indiana?
    (a) Where do you live currently? What type of land (farm? forest? sub/urban?)
    (b) How long have you (or your family) owned your current forest property?

(2) What is your educational background?
    (a) Where did you go to school?
    (b) *If attended college:* What did you study?
(3) Where do you work? What do you do for a living?
    (a) How long have you been in your current position?
    (b) What is your role?
(4) How do you usually commute to work? (Personal vehicle, bus, bike?)
(5) What is the approximate distance between your home and work?
    (a) What kind of roads do you travel on? Are they mostly paved or unpaved? Highway or county roads?
(6) Do you drive long distances (over 100 miles) in Indiana or to neighboring states?
    (a) *Provide reference distances*, e.g., the distance from Lafayette to South Bend is ~110 miles, Lafayette to Gary is ~100 miles, Lafayette to Chicago, IL is ~120, Indianapolis to Bloomington is ~50 mi, Bloomington to Evansville is ~120, Indianapolis to Cincinnati or Louisville is ~115 mi,
    (b) Could you tell me the reason(s) for this commute/travel?
(7) How much time do you spend per day outside working on your farm/forest property?
(8) Do you spend any other time outdoors, other than managing your farm/forest? How often? (In a typical week)
    (a) What do you do? Where do you go?
    (b) Do you expect to see wildlife (including deer) while you are _____(*outdoor activity mentioned*)?
    (c) How does seeing wildlife affect your outdoor experience?
(9) Do you or anyone in your household hunt for deer?
    (a) *If No:* How do you feel towards hunting in general?
    (b) What are your opinions about hunting deer?
        (i) What about deer hunting do you dislike/like?
    (c) *If Yes:* Who hunts in your family?
        (i) Why do they hunt? (Meat, trophy, or other?)
        (ii) How often do they hunt for deer?

(10) How important are _____[activities mentioned] to you?

(a) Which of these are the most important related to deer or deer issues? Which would you most closely identify with?

Your knowledge about White Tailed Deer

(11) Would you tell me what you know about White Tailed Deer populations in Indiana?

(12) When was the last time you saw a White Tailed Deer?

(a) About how often do you see White Tailed Deer? Weekly, monthly, a few times per year?

(b) How do you feel about seeing deer so often/rarely?

(13) Where do you typically notice the presence of deer?

(a) Do you sight them or see them live sometimes?

(b) Do you see road kills sometimes?

(c) Do you notice tracks or signs of browsing when you walk around your property?

(d) Do you see tracks or droppings outside your property, in public spaces?

(14) *If mostly on their farm/forestland:* Do you see deer anywhere else other than on your property?

(a) How/where do you see these deer or deer signs?

(b) Do you feel differently about these sightings?

(15) ***If commuter:*** You mentioned that you commute to work regularly. When was the last time you saw a deer during your commute?

(a) Are you concerned about hitting deer on your daily drive?

(b) Have you ever been in a collision with a deer? If so, when did this happen and where?

(c) How did this incident affect you?

(d) Did it affect how you think about deer or how you react when you see them?

(16) Have you noticed any changes in the deer population? (How many you see at one time? How they behave?)

(a) Do you feel the number/frequency has gone up or down/been more or less frequent over time in Indiana?

(b) How do deer populations in Indiana differ from other states where you've lived, worked, and hunted?

(c) How do you feel about these changes/differences?

(17) Would you tell me about a particularly memorable experience related to deer?

(a) Can you tell me about another positive/negative (*opposite of above*) experience you remember?

I'd like to learn a little more about your perspective and experiences as a farmer/forest landowner

(18) In general, when you see a deer come onto your property, what do you do?

(a) How do you react?

(b) How do you feel when you see them?

(19) Do your interactions with deer affect how you manage or use your land? How so?

(a) Could you tell me about a particularly memorable instance of modifying your practices in response to deer?

(20) Have these interactions changed since you've owned or managed your land?

(a) How do you feel about these changes?

(21) What would you say is your top concern about the deer populations?

(22) Do you have any other concerns about deer populations in Indiana that we haven't mentioned yet?

(a) Are you worried about diseases they carry? Ticks? Hitting deer on the roads?

Management philosophy--Your views about deer management in Indiana

(23) When I say "deer management" what does that mean to you?

(24) Who should be responsible for managing deer? (if they are not already)

(25) Whom should deer be managed for?

(a) What should be the goal of deer management agencies?

(26) Do you think that deer belong to anyone? Who "owns" deer?

(a) If deer come onto your land or yard, does this change who they belong to? How so?

(b) More generally, should individuals get to say what happens to a deer that comes onto their land? Why?

(27) Should the public be involved in deer management? How so?

(a) What would that involvement look like?

(b) Are you aware of any existing opportunities for the public to be involved in deer management?

(28) *If DNR has not been mentioned:* Do you know who (or what agency) is currently responsible for managing white tailed deer in Indiana?

(29) We've mentioned the DNR a few times. Have you ever interacted with anyone from the DNR before?

(a) Who do you interact with? Conservation Officers, wildlife biologists, foresters?

(b) Would you tell me more about that interaction? Are they positive/negative?

(30) In general, how well or poorly is the DNR managing deer populations? Why?

(31) What do you know about the information or data that goes into establishing deer quotas or reduction zones each year? *Who provides input during that process?*

(32) We've talked a little about hunting so far. How/in what ways do you interact with hunters?

(a) Do you have a particularly memorable interaction with hunters or hunting?

(b) Do hunters request access to your land? If so, how do you respond?

(c) Could you tell me a little more about your feelings towards hunting on your farm/forestland?

(33) What are your views on the use of hunting (*or similar lethal methods) to* manage deer populations? Is it effective or ineffective?

(a) What about these methods is good/bad for deer management?

(b) What challenges do you see to continuing hunting as a management tool?

(34) Do you know about any programs/initiatives *other than hunting* to manage white tailed deer in Indiana?

(a) What are your views on how effective this is at managing deer populations?

(35) Based on what we've discussed so far, do you see a need for White Tailed Deer to be managed (differently) in Indiana?

(a) If so, what is needed? i.e., do you want to see the number of deer increase or decrease? Do you want to see more protection from deer, such as barriers/fencing near farmland, yards, or roads?

Information on deer management--This is the final section of our conversation today.

(36) If you (were to) have a question or concern about deer, who or where would you go to *first* to find that information?
   (a) *If Yes:* Could you tell me about an experience with this person, organization, or information source? How do you feel about the experience? Was your question or concern answered?
   (b) *If No:* Whom would you talk to about your concern? Family, neighbor, colleague?

(37) How often do you read or hear about deer-related issues in Indiana?
   (a) When was the last time you read/heard information about deer?
   (b) What was the source of your information? Could you tell me more about this source?
   (c) About how often do you interact with/access this source?

(38) How do you feel about the information that is available or communicated about deer?
   (a) Do you find it useful or un-useful? What about the information is useful/un-useful?
   (b) Do you feel like information about deer-related issues is sufficient or insufficient? How so?
   (c) What more is needed if anything from this information?

(39) *If farmer:* Have you ever interacted with or received information from Purdue Extension services?
   (a) How would you evaluate that interaction/information?
   (b) Do they provide any information related to deer/deer management?

(40) Are you involved with any farmer/forest landowner organizations or local councils? Could you please describe your involvement?
   (a) What are your roles or responsibilities as a member?
   (b) Do deer come up as a topic of discussion? How often?

(c) If so, what is the goal (or concern) of your organization/council related to deer populations?

(d) What approach has your organization/council taken to address these issues?

(e) Is something more needed from deer management agencies to help your organization?

(f) As an organization/council, what more would you like to see from deer management agencies?

(41) *If woodland owner:* Could you tell me about your general connections with professional foresters in Indiana?

(a) How do you interact with Indiana foresters?

(b) What do you receive from foresters?

(c) Do they provide any information related to deer/deer management?

(42) Do you talk about your land management practices with other farmers/landowners? If so, whom and what do you discuss?

(a) Would you say that the views of other farmers/forest landowners in regards to deer are similar or different from your own? How so?

(43) What kind of deer information may be of interest to you?

We're just about done, but I'd like to ask one last question:

(44) Do you have any concerns regarding deer that are not being addressed?

(a) Are you worried about diseases carried by deer? Hitting a deer with your car? Deer eating your crops, landscaping, or garden plants?

(b) *If concerned:* what changes in deer management would you like to see to better address your concerns?

Those are all the questions I have. Is there anything else you would like to share about any of the topics we discussed?

Thank you so much for your time.

Hunter interview protocol

Interviewer:_____

Pseudonym of Interviewee: _____

Date: _____/_____/_____

Time: _____:_____ AM / PM

Introduction verbiage: I appreciate you taking the time to do an interview with me. Thank you in advance. My name is Taylor Stinchcomb and I am a doctoral student at Purdue University working with Dr. Zhao Ma in the Department of Forestry and Natural Resources. Our research is part of a larger collaboration with the Indiana Department of Natural Resources to improve deer management

A few things about the process:

This interview is entirely voluntary and should take about 60 minutes. Everything you tell me during the interview will be kept strictly confidential. Your name will not be revealed to anyone beyond myself and Dr. Ma. For the purpose of data coding and analysis, it will be really helpful for me to record this conversation. I will not share this recording with anyone outside our research team. You can tell me to stop recording or stop this interview at any time. Do you feel comfortable with recording?

Again, thank you for your willingness to participate in this interview. Do you have any questions before we begin?

Background information

I'd like to start by getting to know a little more about you. Where are you from?

(45) How long have you (or your family) lived in Indiana?
   (a) Where do you live currently? What type of land (farm? forest? sub/urban?)
   (b) How long have you (or your family) owned your current forest property?

(46) What is your educational background?
   (a) Where did you go to school?
   (b) *If attended college:* What did you study?

(47) Where do you work? What do you do for a living?
    (a) How long have you been in your current position?
    (b) What is your role?
(48) How do you usually commute to work? (Personal vehicle, bus, bike?)
(49) What is the approximate distance between your home and work?
    (a) What kind of roads do you travel on? Are they mostly paved or unpaved? Highway or county roads?
(50) Do you drive long distances (over 100 miles) in Indiana or to neighboring states?
    (a) *Provide reference distances*, e.g., the distance from Lafayette to South Bend is ~110 miles, Lafayette to Gary is ~100 miles, Lafayette to Chicago, IL is ~120, Indianapolis to Bloomington is ~50 mi, Bloomington to Evansville is ~120, Indianapolis to Cincinnati or Louisville is ~115 mi,
    (b) Could you tell me the reason(s) for this commute/travel?
(51) How much time do you spend outside in a typical week/day? (When it's not hunting season)
    (a) What do you do? Where do you go?
    (b) Do you expect to see wildlife (including deer) while you are _____(*outdoor activity mentioned*)?
    (c) How does seeing wildlife affect your outdoor experience?
(52) How important are _____[activities mentioned] to you?
    (a) Which of these are the most important related to deer or deer issues? Which would you most closely identify with?

Your knowledge about White Tailed Deer

(53) Would you tell me what you know about White Tailed Deer populations in Indiana?
(54) When was the last time you saw a White Tailed Deer?
    (a) About how often do you see White Tailed Deer? Weekly, monthly, a few times per year?
    (b) How do you feel about seeing deer so often/rarely?
(55) Where do you typically notice the presence of deer?
    (a) Do you sight them or see them live sometimes?

(b) Do you see road kills sometimes?

(c) Do you notice tracks or signs of browsing when you walk around your property?

(d) Do you see tracks or droppings outside your property, in public spaces?

(56) *If mostly on their own land:* Do you see deer anywhere else other than on your property?

(a) How/where do you see these deer or deer signs?

(b) Do you feel differently about these sightings?

(57) ***If commuter:*** You mentioned that you commute to work regularly. When was the last time you saw a deer during your commute?

(a) Are you concerned about hitting deer on your daily drive?

(b) Have you ever been in a collision with a deer? If so, when did this happen and where?

(c) How did this incident affect you?

(d) Did it affect how you think about deer or how you react when you see them?

(58) Have you noticed any changes in the deer population where you live? (How many you see at one time? How they behave?)

(a) Do you feel the number/frequency has gone up or down/been more or less frequent over time in Indiana?

(b) How do deer populations in Indiana differ from other states where you've lived, worked, and hunted?

(c) How do you feel about these changes/differences?

(59) Have you noticed changes in the populations **where you hunt**? How do they differ from deer populations where you live?

(60) Would you tell me about a particularly memorable experience related to deer?

(a) Can you tell me about another positive/negative (*opposite of above*) experience you remember?

(61) What would you say is your top concern about the deer populations?

(62) Do you have any other concerns about deer populations in Indiana that we haven't mentioned yet?

(a) Are you worried about diseases they carry? Ticks? Hitting deer on the roads?

Your perspective & experiences with hunting—I'd like to learn a little more about your hunting values and experiences

(63) How long have you been hunting for deer?
    (a) Do you hunt for other animals? If so, what else do you hunt?
(64) Why do you hunt for deer? (Meat, trophy, or other?)
    (a) About how often do you hunt for deer?
(65) What does a successful hunt mean to you?
    (a) Would you say that you are typically successful?
(66) How many deer do you take in a typical season?
    (a) What is/are the typical age and sex of the deer you harvest?
(67) How would you describe your ideal deer to hunt?
    (a) How do you feel towards hunting large bucks?
(68) How has your experience of hunting deer changed since you first started?
    (a) What about since you began hunting in Indiana?
    (b) How do you feel about these changes?
(69) Do you hunt mostly on private or public lands?
(70) What has your experience been with accessing private lands?
    (a) Do you find this access easy or difficult? How so?
    (b) How often do you request permission to access private land?
    (c) How do landowners typically respond to your requests?
        (i) Have you ever been denied access or lost permission?
        (ii) What reasons do they give for denying access?
(71) How do you think people in Indiana who don't hunt perceive you as a hunter or hunters and hunting in general?
    (a) Do you think other Indiana residents approve or disapprove of hunting?

Management philosophy--Your views about deer management in Indiana

(72) When I say "deer management" what does that mean to you?
(73) Who should be responsible for managing deer? (if they are not already)
(74) Whom should deer be managed for?

(a) What should be the goal of deer management agencies?

(75) Do you think that deer belong to anyone? Who "owns" deer?

(a) If deer come onto your land or yard, does this change who they belong to? How so?

(b) More generally, should individuals get to say what happens to a deer that comes onto their land? Why?

(76) Should the public be involved in deer management? How so?

(a) What would that involvement look like?

(b) Are you aware of any existing opportunities for the public to be involved in deer management?

(77) We've mentioned the DNR a few times. Have you ever interacted with anyone from the DNR before?

(a) Who do you interact with? Conservation Officers, wildlife biologists, foresters?

(b) Would you tell me more about that interaction? Are they positive/negative?

(78) In general, how well or poorly is the DNR managing deer populations? Why?

(79) I'm new to the state. Could you tell me more about how deer hunting is managed in Indiana?

(a) How are quotas are established? *Who provides input during that process?*

(b) Are there different rules for different people or different parts of the state?

(80) How do you feel about these hunting regulations?

(a) Do they need to be changed? How so?

(b) Are they too relaxed or too strict?

(81) How do you view your role as a hunter in the management of deer populations? Is hunting effective or ineffective?

(a) What about hunting is effective/ineffective for deer management?

(82) Do you know about any programs/initiatives *other than hunting* to manage white tailed deer in Indiana?

(a) What are your views on how effective this is at managing deer populations?

(83) Based on what we've discussed so far, do you see a need for White Tailed Deer to be managed (differently) in Indiana?

(a) If so, what is needed? i.e., do you want to see the number of deer increase or decrease? Do you want to see more protection from deer, such as barriers/fencing near farmland, yards, or roads?

Information on deer management--This is the final section of our conversation today.

(84) If you (were to) have a question or concern about deer, who or where would you go to *first* to find that information?
   (a) *If Yes:* Could you tell me about an experience with this person, organization, or information source? How do you feel about the experience? Was your question or concern answered?
   (b) *If No:* Whom would you talk to about your concern? Family, neighbor, colleague?

(85) How often do you read or hear about deer-related issues in Indiana?
   (a) When was the last time you read/heard information about deer?
   (b) What was the source of your information? Could you tell me more about this source?
   (c) About how often do you interact with/access this source?

(86) How do you feel about the information that is available or communicated about deer?
   (a) Do you find it useful or un-useful? What about the information is useful/un-useful?
   (b) Do you feel like information about deer-related issues is sufficient or insufficient? How so?
   (c) What more is needed if anything from this information?

(87) Could you tell me about your connections with other hunters?
   (a) How do you view the level/sense of community among Indiana hunters?
   (b) Do you share information about your hunting with other hunters? If so, what kind of information do you share?
   (c) Do you discuss where you've hunted deer before, where you access private land, where you are going to hunt this year? Or do you prefer to keep such information private?

(88) Do you talk about your hunting experiences with other people? If so, whom and what do you discuss?

(89) What kind of deer information may be of interest to you?

We're just about done, but I'd like to ask one last question:

(90) Do you have any concerns regarding deer that are not being addressed?

(a) Are you worried about diseases carried by deer? Hitting a deer with your car? Deer eating your crops, landscaping, or garden plants?

(b) *If concerned:* what changes in deer management would you like to see to better address your concerns?

Those are all the questions I have. Is there anything else you would like to share about any of the topics we discussed?

Thank you so much for your time.

Urban/Suburban Resident interview protocol

Interviewer:_____

Pseudonym of Interviewee: _____

Date: _____/_____/_____

Time: _____:_____ AM / PM

Introduction verbiage: I appreciate you taking the time to do an interview with me. Thank you in advance. My name is Taylor Stinchcomb and I am a doctoral student at Purdue University working with Dr. Zhao Ma in the Department of Forestry and Natural Resources. Our research is part of a larger collaboration with the Indiana Department of Natural Resources to improve deer management

A few things about the process:

This interview is entirely voluntary and should take about 60 minutes. Everything you tell me during the interview will be kept strictly confidential. Your name will not be revealed to anyone beyond myself and Dr. Ma. For the purpose of data coding and analysis, it will be really helpful for me to record this conversation. I will not share this recording with anyone outside our research team. You can tell me to stop recording or stop this interview at any time. Do you feel comfortable with recording?

Again, thank you for your willingness to participate in this interview. Do you have any questions before we begin?

Background information

I'd like to start by getting to know a little more about you. Where are you from?

(91) How long have you (or your family) lived in Indiana?
   (a) Where do you live currently? What type of land (farm? forest? sub/urban?)
   (b) How long have you (or your family) owned your current forest property?

(92) What is your educational background?
   (a) Where did you go to school?
   (b) *If attended college:* What did you study?

(93) Where do you work? What do you do for a living?
    (a) How long have you been in your current position?
    (b) What is your role?
(94) How do you usually commute to work? (Personal vehicle, bus, bike?)
(95) What is the approximate distance between your home and work?
    (a) What kind of roads do you travel on? Are they mostly paved or unpaved? Highway or county roads?
(96) Do you drive long distances (over 100 miles) in Indiana or to neighboring states?
    (a) *Provide reference distances*, e.g., the distance from Lafayette to South Bend is ~110 miles, Lafayette to Gary is ~100 miles, Lafayette to Chicago, IL is ~120, Indianapolis to Bloomington is ~50 mi, Bloomington to Evansville is ~120, Indianapolis to Cincinnati or Louisville is ~115 mi,
    (b) Could you tell me the reason(s) for this commute/travel?
(97) How much time do you spend outside in a typical week/day?
    (a) What do you do? Where do you go?
    (b) Do you expect to see wildlife (including deer) while you are _____(*outdoor activity mentioned*)?
    (c) How does seeing wildlife affect your outdoor experience?
(98) Do you or anyone in your household hunt for deer?
    (a) *If No:* How do you feel towards hunting in general?
        (i) Prompt: What are your opinions about hunting deer?
        (ii) What about deer hunting do you dislike/like?
    (b) *If Yes:* Who hunts in your family?
        (i) Why do they hunt? (Meat, trophy, or other?)
        (ii) How often do they hunt for deer?
(99) How important are _____[activities mentioned] to you?
    (a) Which of these are the most important related to deer or deer issues? Which would you most closely identify with?

Your knowledge about White Tailed Deer

(100) Would you tell me what you know about White Tailed Deer populations in Indiana?
    (a) What about in the area where you live?

(101) When was the last time you saw a White Tailed Deer?
    (a) About how often do you see White Tailed Deer? Weekly, monthly, a few times per year?
    (b) How do you feel about seeing deer so often/rarely?

(102) Where do you typically notice the presence of deer?
    (a) Do you sight them or see them live sometimes?
    (b) Do you see road kills sometimes?
    (c) Do you notice tracks or signs of browsing when you walk around your property?
    (d) Do you see tracks or droppings outside your property, in public spaces?

(103) In general, when you see a deer on or approaching your home, how do you react?
    (a) How do you feel when you see them?

(104) Do your interactions with deer affect how you manage or use your property? How so?
    (a) How have these interactions changed since you've lived at your current residence?
    (b) How do you feel about these changes?

(105) *If mostly around their home:* Do you see deer anywhere else other than on your property?
    (a) How/where do you see these deer or deer signs?
    (b) Do you feel differently about these sightings?

(106) ***If commuter:*** You mentioned that you commute to work regularly. When was the last time you saw a deer during your commute?
    (a) Are you concerned about hitting deer on your daily drive?
    (b) Have you ever been in a collision with a deer? If so, when did this happen and where?
        (i) How did this incident affect you?
        (ii) Did it affect how you think about deer or how you react when you see them?

(107) Have you noticed any changes in the deer population where you live? (How many you see at one time? How they behave?)
    (a) Do you feel the number/frequency has gone up or down/been more or less frequent over time in Indiana?
    (b) How do deer populations in Indiana differ from other states where you've lived, worked, and hunted?
    (c) How do you feel about these changes/differences?
(108) Would you tell me about a particularly memorable experience related to deer?
    (a) Can you tell me about another positive/negative (*opposite of above*) experience you remember?
(109) What would you say is your top concern about the deer populations?
(110) Do you have any other concerns about deer populations in Indiana that we haven't mentioned yet?
    (a) Are you worried about diseases they carry? Ticks? Hitting deer on the roads?

Management philosophy--Your views about deer management in Indiana

(111) When I say "deer management" what does that mean to you?
(112) Who should be responsible for managing deer? (if they are not already)
(113) Whom should deer be managed for?
    (a) What should be the goal of deer management agencies?
(114) Do you think that deer belong to anyone? Who "owns" deer?
    (a) If deer come onto your land or yard, does this change who they belong to? How so?
    (b) More generally, should individuals get to say what happens to a deer that comes onto their land? Why?
(115) Should the public be involved in deer management? How so?
    (a) What would that involvement look like?
    (b) Are you aware of any existing opportunities for the public to be involved in deer management?
(116) *If DNR has not been mentioned:* Do you know who (or what agency) is currently responsible for managing white tailed deer in Indiana?

(117) We've mentioned the DNR a few times. Have you ever interacted with anyone from the DNR before?
    (a) Who do you interact with? Conservation Officers, wildlife biologists, foresters?
    (b) Would you tell me more about that interaction? Are they positive/negative?

(118) In general, how well or poorly is the DNR managing deer populations? Why?

(119) What do you know about the information or data that goes into establishing deer quotas or reduction zones each year? *Who provides input during that process?*

(120) We've talked a little about hunting so far. How/in what ways do you interact with hunters?
    (a) Do you have a particularly memorable interaction with hunters or hunting?
    (b) Do hunters request access to your land? If so, how do you respond?
    (c) Could you tell me a little more about your feelings towards hunting on your farm/forestland?

(121) What are your views on the use of hunting (*or similar lethal methods) to* manage deer populations? Is it effective or ineffective?
    (a) What about these methods is good/bad for deer management?
    (b) What challenges do you see to continuing hunting as a management tool?

(122) Do you know about any programs/initiatives *other than hunting* to manage white tailed deer in Indiana?
    (a) What are your views on how effective this is at managing deer populations?

(123) Are you involved with any local organizations or councils? Could you describe your involvement?
    (a) What are your roles or responsibilities as a member?

(124) Do deer come up as a topic of discussion? How often?
    (a) If so, what is the goal (or concern) of your organization/council related to deer populations?
    (b) What approach has your organization/council taken to address these issues?

(125) Is something more needed from deer management agencies to help your organization?
    (a) As an organization/council, what more would you like to see from deer management agencies?

(126) Based on what we've discussed so far, do you see a need for White Tailed Deer to be managed (differently) in Indiana?

(a) If so, what is needed? i.e., do you want to see the number of deer increase or decrease? Do you want to see more protection from deer, such as barriers/fencing near farmland, yards, or roads?

Information on deer management--This is the final section of our conversation today.

(127) If you (were to) have a question or concern about deer, who or where would you go to *first* to find that information?

(a) *If Yes:* Could you tell me about an experience with this person, organization, or information source? How do you feel about the experience? Was your question or concern answered?

(b) *If No:* Whom would you talk to about your concern? Family, neighbour, colleague?

(128) How often do you read or hear about deer-related issues in Indiana?

(a) When was the last time you read/heard information about deer?

(b) What was the source of your information? Could you tell me more about this source?

(c) About how often do you interact with/access this source?

(129) How do you feel about the information that is available or communicated about deer?

(a) Do you find it useful or un-useful? Is it sufficient or insufficient? How so?

(b) What more is needed if anything from this information?

(130) Have you ever interacted with or received information from Purdue Extension services?

(a) How would you evaluate that interaction/information?

(b) Do they provide any information related to deer/deer management?

(131) Do you talk about deer and your experiences with other people? If so, whom and what do you discuss?

(a) Would you say that the views of other residents in your area are similar or different from your own? How so?

(b) Are there any deer-related topics that divide members of your community?

(132) What kind of deer information may be of interest to you?

We're just about done, but I'd like to ask one last question:

(133) Do you have any concerns regarding deer that are not being addressed?

(a) Are you worried about diseases carried by deer? Hitting a deer with your car? Deer eating your crops, landscaping, or garden plants?

(b) *If concerned:* what changes in deer management would you like to see to better address your concerns?

Those are all the questions I have. Is there anything else you would like to share about any of the topics we discussed?

Thank you so much for your time.

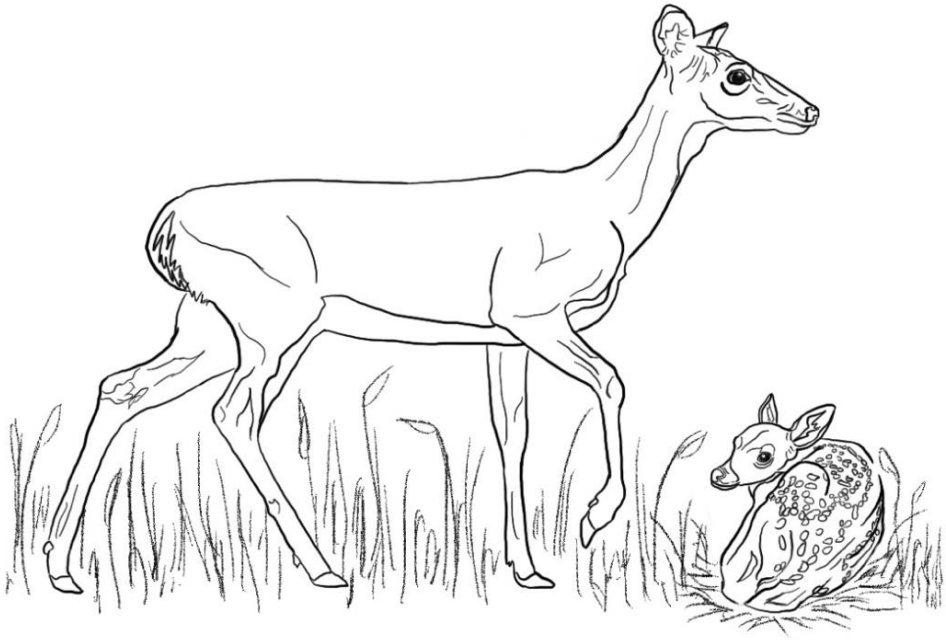
APPENDIX B. SURVEY INSTRUMENT

Perceptions of White-Tailed Deer Study

Background and Instructions

This survey is part of a collaborative research project titled "The Integrated Deer Management Project" conducted by Purdue University and the Indiana Department of Natural Resources. The goal of this survey is to learn how Hoosiers like you interact with white-tailed deer, what you think about deer-related issues, what motivates or prevents you from engaging in deer management, and how your experiences have shaped your views on deer and deer management.

Even if you have had little-to-no experience with deer, we would still like to learn about your general thoughts and opinions. If a question does not apply to you, you will be instructed to skip ahead. Please answer all questions in a way that accurately reflects your own personal opinions, feelings, and experiences. **Your responses will remain confidential and your identity will not be disclosed.**



For the purpose of this survey, please consider the following throughout the survey:

- **"Deer"** refers specifically to wild white-tailed deer (*Odocoileus virginianus*)
- **"Management"** refers broadly to any efforts or actions to control deer behaviors or population sizes, or to minimize deer-related risks and impacts to people. This can occur on private properties or public lands, and by individuals, groups, or state agencies.
- **"Primary residence"** refers to where you reside for most of your time in Indiana. If you own or rent multiple properties, **"primary property"** refers to the property you manage the most for deer or other purposes. For some homeowners or landowners, their primary residence and primary property will be the same; in other situations, these will be two different properties.

SECTION 1: YOU AND YOUR CONCERNS ABOUT DEER

This section asks some introductory questions to learn more about you and your concerns.

1. About how long have you lived **in Indiana**? (*Round to the nearest year)*
_____ years, OR ☐ Less than one year

2. About how long have you lived **at your primary residence**? (*Round to the nearest year)*
_____ years, OR ☐ Less than one year

3a. How would you **identify yourself**? *(Check all that apply)*

☐ Farmer or grower ☐ Woodland owner ☐ Urban or suburban resident
☐ Rancher or livestock producer ☐ Deer hunter ☐ Rural resident

3b. What is your **primary identity**? *(Check one that you identify with the most)*

☐ Farmer or grower ☐ Woodland owner ☐ Urban or suburban resident
☐ Rancher or livestock producer ☐ Deer hunter ☐ Rural resident

4. If you identify as a deer hunter, **how many years** have you been **hunting deer in Indiana**? (*Round to the nearest year)*
_____ years, OR ☐ Not applicable

5. If you identify as a deer hunter, **where** do you hunt for deer **in Indiana**? *(Check all that apply)*

☐ My own land ☐ Family land ☐ A close friend's land
☐ Other private land ☐ Public land

6. Do you **own or rent** your **primary residence**? ☐ Own ☐ Rent

7. What land type **best** describes your **primary residence**? *(Check only one)*

☐ Farmland (mostly) ☐ Mixed farm & woodland ☐ Rural, not farmland nor woodland
☐ Woodland (mostly) ☐ Urban or suburban

8. Approximately how many acres is your **primary residence**? _____ acres

9. How many **total properties** do you own or rent in Indiana? _____ property/properties
(If 1, please skip to Question 15, next page. If greater than 1, please answer Questions 10-14 below.)

For questions 10-14, please think about **one property that you manage the most** in Indiana. We will refer to this as your **primary property** for the rest of the survey.

10. Is this **primary property** separate from your primary residence?

☐ Yes ☐ No

11. Do you own or rent this **primary property**? ☐ Own ☐ Rent

12. What land type **best** describes this **primary property**? *(Check only one)*

☐ Farmland (mostly) ☐ Mixed farm & woodland ☐ Rural, not farmland nor woodland
☐ Woodland (mostly) ☐ Urban or suburban

13. Approximately how many acres is your **primary property**? _____ acres

14. What is the zip code of your **primary property**? _____ *(zip code)*

15. How important to you are the following **characteristics** of your **primary residence or property?**

	Not at all Important				**Very Important**
Proximity to nature	1	2	3	4	5
Wildlife viewing opportunities	1	2	3	4	5
Property aesthetics	1	2	3	4	5
Hunting opportunities	1	2	3	4	5
Crop, garden, or timber yields	1	2	3	4	5
Potential to grow hardwood trees	1	2	3	4	5
Proximity to a town or city	1	2	3	4	5
Being secluded	1	2	3	4	5
Being part of a close-knit community	1	2	3	4	5

16. Please indicate whether or not you… (*Check <u>one</u> box for each row*)

	Yes	**No**
Hunted for deer in the 2020/2021 season?	☐	☐
Commute regularly on rural roads / highways between your home / town and your workplace?	☐	☐
Had timber harvested from 25% or more of your wooded property within the last 15 years?	☐	☐
Are a hobby gardener?	☐	☐
Are a member of a hunting-based conservation organization? *(e.g., Indiana Deer Hunters Association, Backcountry Hunters & Anglers, National Wild Turkey Federation, Ducks Unlimited)*	☐	☐
Are a member of a non-hunting conservation organization? *(e.g., Indiana Forest & Woodland Owners Association, Audubon Society, Defenders of Wildlife)*	☐	☐
Are a member of an animal welfare organization? *(e.g., Humane Society, American Society for the Prevention of Cruelty to Animals (ASPCA), Animal Legal Defense Fund)*	☐	☐

17. How concerned are you about the following issues related to deer? *(circle <u>one</u> number for each row)*

	Not at all Concerned				**Very Concerned**
Vehicle collisions with deer	1	2	3	4	5
Disease transmission related to deer	1	2	3	4	5
Current deer population sizes	1	2	3	4	5
Deer hunting opportunities	1	2	3	4	5
Deer damage to crops, gardens, or landscaping	1	2	3	4	5
Deer damage to forests	1	2	3	4	5
Deer welfare	1	2	3	4	5
Managing deer in urban areas	1	2	3	4	5

SECTION 2: YOUR EXPERIENCES WITH DEER IN INDIANA

18. How would you describe the **current deer population size**? *(Circle <u>one</u> number for each row)*

	Very Low	Low	About Right	High	Very High	Not Sure
Where you live?	1	2	3	4	5	6
Around your primary property? *(if separate from primary residence)*	1	2	3	4	5	6
In Indiana?	1	2	3	4	5	6

19. **About how often** do you see deer **where you live**? (*Circle the number closest to your experience*)

Every day	More than weekly	Once a week	More than monthly	Once a month	More than yearly	Yearly or less
1	2	3	4	5	6	7

20. *If you own or rent <u>one</u> property, skip to Question 21. If you own or rent multiple properties, please think about your primary property.* **About how often** do you see deer **on your primary property**?

Every day	More than weekly	Once a week	More than monthly	Once a month	More than yearly	Yearly or less
1	2	3	4	5	6	7

21. **In general**, do you think of deer as: *(Circle <u>one</u> number for each row)*

	Very	Slightly	Neither	Slightly	Very	
Bad	1	2	3	4	5	**Good**
Dangerous	1	2	3	4	5	**Harmless**
Detrimental	1	2	3	4	5	**Beneficial**
Nuisance	1	2	3	4	5	**Asset**

22. Which of the following experiences have you **personally had in Indiana**? (*Check all that apply*)
I have…

- ☐ Driven or been a passenger in a vehicle that had to swerve or brake to avoid hitting a deer
- ☐ Driven or been a passenger in a vehicle that hit a deer
- ☐ Had deer damage crops, trees, shrubs, or gardens on my property
- ☐ Encountered a deer while walking, running, or biking in my local area
- ☐ Seen one or more deer in a state park or natural area
- ☐ Seen a fawn (baby deer) on or near my property
- ☐ Caught hunters trespassing on my property
- ☐ Seen signs of hunters trespassing on my property
- ☐ Been diagnosed with Lyme disease
- ☐ Known a friend or family member with Lyme disease
- ☐ Found ticks on myself or a family member
- ☐ Found ticks on my pet(s)
- ☐ Harvested deer to feed myself and my family
- ☐ Harvested a buck (male deer) for its antler size at least once

23. Do you allow deer hunters on your property?

☐ Yes *(please answer Q24)* ☐ I don't own private land suitable for hunting *(skip to Q25)*

☐ No *(skip to Q25)* ☐ Local ordinances don't allow hunting on my property *(skip to Q25)*

24. Whom do you allow to hunt on your property? *(Check all that apply)*

☐ Myself ☐ Acquaintances from my work or community ☐ Close Friends

☐ Family members ☐ Others who have requested access

25. Please indicate whether you **have taken** or **plan to take** **the following actions** related to deer. *(Check all that apply for each row)* ***The Indiana DNR (Department of Natural Resources) is the agency in charge of wildlife and habitat management in Indiana.*

	I have in the past	I intend to in the future	Neither or not applicable
Fence part or all of my property to keep deer out	☐	☐	☐
Use sprays or scents to keep deer away from certain plants or crops	☐	☐	☐
Use wraps or cages to protect certain plants or crops from deer	☐	☐	☐
Call or email someone at the Indiana DNR** about my deer concerns	☐	☐	☐
Change what I plant on my property	☐	☐	☐
Change the number of hunters I allow on my property	☐	☐	☐
Plant crops or other plants specifically to attract deer	☐	☐	☐
Take photographs of deer in my backyard or on my property	☐	☐	☐
Set up game cameras to monitor deer in my area	☐	☐	☐
Participate in a public meeting or forum about deer	☐	☐	☐
Apply for a special permit to kill a 'problem' deer	☐	☐	☐
Start hunting deer myself on my property	☐	☐	☐
Give up on trying to manage deer on my property	☐	☐	☐
Do nothing to manage deer on my property	☐	☐	☐

26. To what extent do you agree with the following statements about **managing deer on your primary residence or property?**

	Strongly Disagree				Strongly Agree
Using methods to minimize deer damage will **save me money in the long run**	1	2	3	4	5
Using methods to minimize deer damage will **improve yields for my crops, timber, or garden**	1	2	3	4	5
Existing methods to minimize deer damage are **too expensive for me**	1	2	3	4	5
I have the time to manage deer or deer damage on my property	1	2	3	4	5

	Strongly Disagree				Strongly Agree
I have the technical skills and knowledge to control deer on my property	1	2	3	4	5
Deer populations are **too large to be controlled**	1	2	3	4	5
No matter what I try, deer keep coming back and damaging my property	1	2	3	4	5
I don't know what else I can do to control deer populations and damage	1	2	3	4	5

27. Which of the following people you know **manage for deer using non-hunting approaches** on their property? *(Check all that apply)*

☐ My friends or family members ☐ Leaders of my community or organizations

☐ Other residents in my area ☐ I don't know anyone who manages for deer

28. Which of the following people you know **hunt deer or allow deer hunting** on their property? *(Check all that apply)*

☐ My friends or family members ☐ Leaders of my community or organizations

☐ Other residents in my area ☐ I don't know anyone who hunts or allows hunting

29. How much would the following people you know **disapprove or approve of you managing for deer** using **non-hunting approaches** on your property?

	Greatly Disapprove				Greatly Approve
My friends or family members	1	2	3	4	5
Other residents in my area	1	2	3	4	5
Leaders of my community or organizations	1	2	3	4	5

30. How much would the following people you know **disapprove or approve of you hunting deer yourself?**

	Greatly Disapprove				Greatly Approve
My friends or family members	1	2	3	4	5
Other residents in my area	1	2	3	4	5
Leaders of my community or organizations	1	2	3	4	5

31. How much would the following people you know **disapprove or approve of you allowing deer hunting** on your property? *If you don't own private land suitable for hunting or if local ordinances don't allow hunting on your property, skip to Q32 on the next page.*

	Greatly Disapprove				Greatly Approve
My friends or family members	1	2	3	4	5
Other residents in my area	1	2	3	4	5
Leaders of my community or organizations	1	2	3	4	5

SECTION 3: YOUR OPINION ABOUT DEER MANAGEMENT IN INDIANA

32. To what extent do you agree with the following statements about **deer hunting**?

	Strongly Disagree				**Strongly Agree**
Hunting is the most effective way to control deer populations	1	2	3	4	5
Hunters will harvest enough deer to control population numbers	1	2	3	4	5
Most hunters are responsible and safe with their weapons	1	2	3	4	5
Hunting is a humane way to control deer populations	1	2	3	4	5
Hunting presents a safety risk to myself or others	1	2	3	4	5
Hunting is an important part of Indiana's culture	1	2	3	4	5

For the next questions, please refer to the following **definitions of deer management actions**:

- **Licensed hunting:** permits are allocated to licensed hunters each year during the designated deer hunting season. Hunters must obtain permission from landowners to hunt on private lands.
- **Culling:** a coordinated effort to hunt many deer at once and reduce population numbers, usually within a designated area like a public park.
- **Urban Deer Reduction Zones:** zones within urban areas where additional licensed deer hunting is permitted. It usually involves increasing the number of permits to hunt does (female deer) in the areas.
- **Community Hunting Access Programs**: partnerships that provide local communities with monetary and technical assistance to develop their own deer hunting programs and recruit hunters.
- **Contraception**: administering birth control to deer to reduce their fertility. This has been attempted in other states, but **it is not currently legal in Indiana.**
- **Trap & relocate:** trained professionals trap one or more deer and transfer them to another area in the state. **This has not been done in Indiana**.
- **Provide advice or information:** authorities provide information to local communities or landowners about how to control deer-related impacts on their property and minimize risks to personal health or safety.
- **Do nothing / no management:** authorities take no further action to monitor or control deer populations.

33. How **ineffective or effective** do you consider the following **existing actions to manage deer in Indiana**?

	Very Ineffective				**Very Effective**
Licensed hunting	1	2	3	4	5
Culling deer in specific areas	1	2	3	4	5
Urban Deer Reduction Zones	1	2	3	4	5
Community Hunting Access Programs	1	2	3	4	5
Providing advice or information about deer	1	2	3	4	5
Doing nothing / no management	1	2	3	4	5

34. To manage deer populations **in your local area**, how **unacceptable or acceptable** do you consider the following **potential actions**?

	Very Unacceptable				**Very Acceptable**
Increasing **licensed hunting** in my area	1	2	3	4	5
Culling deer populations in my area	1	2	3	4	5
Creating a **Community Hunting Access Program** for my area	1	2	3	4	5
Using **contraception** to control deer fertility in my area	1	2	3	4	5
Trapping & relocating deer from my area to another in Indiana	1	2	3	4	5
Providing advice or information about deer to residents in my area	1	2	3	4	5
Doing nothing / no management in my area	1	2	3	4	5

35. How **undesirable or desirable** do you consider the following **potential outcomes** of deer management?

	Very Undesirable				**Very Desirable**
Decreased damage to vegetation on personal property	1	2	3	4	5
Decreased damage to vegetation in forests, parks, and natural areas	1	2	3	4	5
Lower rates of human disease related to deer (e.g., Lyme disease)	1	2	3	4	5
Increased licensed hunting opportunities	1	2	3	4	5
Fewer deer suffering from starvation or disease	1	2	3	4	5
Fewer deer-vehicle collisions	1	2	3	4	5
Increased public participation in deer management	1	2	3	4	5
Decreased deer population sizes	1	2	3	4	5

36. In your opinion, if the following actions **were to occur in your area**, what is the **likelihood** that they would lead to **desirable outcomes**?

Desirable outcomes from ____ would be …	**Highly Unlikely**				**Highly Likely**
Increasing **licensed hunting** in my area	1	2	3	4	5
Culling deer populations in my area	1	2	3	4	5
Creating a **Community Hunting Access Program** for my area	1	2	3	4	5
Using **contraception** to control deer fertility in my area	1	2	3	4	5
Trapping & relocating deer from my area to another in Indiana	1	2	3	4	5
Providing advice or information about deer to residents in my area	1	2	3	4	5
Doing nothing / no management in my area	1	2	3	4	5

The following questions refer to the Indiana DNR (Department of Natural Resources), the agency in charge of managing wildlife and habitat in Indiana.

37. On a scale of 1 to 10, how **poorly or well** do you think the Indiana DNR is managing deer populations in Indiana? *(1 = Very Poorly; 10 = Very Well)*

Very Poorly									**Very Well**
1	2	3	4	5	6	7	8	9	10

38. How much to you **distrust or trust** the Indiana DNR to do the following?

	Distrust				**Trust**
Employ people with the scientific expertise necessary to manage deer in Indiana	1	2	3	4	5
Employ people who know what needs to be done to manage deer in Indiana	1	2	3	4	5
Listen to the public	1	2	3	4	5
Treat all members of the public equally	1	2	3	4	5
Communicate unbiased information to the public	1	2	3	4	5
Shares similar values as me for deer management	1	2	3	4	5
Consider the opinions and needs of people like me when making deer management decisions	1	2	3	4	5

39. How **trustworthy** do you consider the following **sources of deer management information** in Indiana?

	Very Untrustworthy				**Very Trustworthy**
Indiana DNR website or newsletters	1	2	3	4	5
District Conservation Officers	1	2	3	4	5
District Wildlife Biologists	1	2	3	4	5
District Foresters	1	2	3	4	5
Private forestry & wildlife consultants	1	2	3	4	5
Private agricultural organizations *(e.g., Indiana Farm Bureau, Cattlemen's Association)*	1	2	3	4	5
My organization meetings or newsletters	1	2	3	4	5
Podcasts	1	2	3	4	5
YouTube videos	1	2	3	4	5
Hunting magazines or publications	1	2	3	4	5
My friends and family	1	2	3	4	5
Other landowners in my area	1	2	3	4	5
Purdue Extension services	1	2	3	4	5
University research publications	1	2	3	4	5
Federal agencies *(e.g., U.S. Department of Agriculture, U.S. Fish & Wildlife Service)*	1	2	3	4	5

SECTION 4: DEER SCENARIOS

PLEASE READ BEFORE ANSWERING QUESTIONS IN THIS SECTION

In this section, we will present **four hypothetical scenarios involving deer**. For each scenario, please **think about how you would feel in the situation** and **rate the acceptability of management actions** that might be used to address the situation.

Possible management actions include:

- **Lethal control**. Authorities hire hunters or increase deer hunting in the area to decrease the deer population or eliminate a specific deer.
- **Nonlethal control**. Without killing any deer, authorities take action to minimize deer-related impacts to humans or local environments. This could include relocating deer, protecting property with fencing or deterrents, or preventing deer from crossing roadways.
- **Advise & monitor**. Authorities take no immediate action but monitor the situation and provide information to the public about how to protect themselves and their families, pets, or properties. This could include posting warning signs. As the situation develops, however, authorities might need to take further action.
- **Do nothing / no management**. Authorities take no action to monitor or control deer populations.

Scenario 1: While walking on your property or in your neighborhood, **an adult deer** appears and stops on the path in front of you, **then begins eating the nearest plants**.

40. Would you say that this scenario would be a positive, negative, or neutral experience for you?

Very Negative				Very Positive
1	2	3	4	5

41. In this scenario, to what extent would you feel the following? *(For **each row**, circle the number that best represents your response)*

	Strongly	Slightly	Neither	Slightly	Strongly	
Nervous	1	2	3	4	5	**Calm**
Unexcited	1	2	3	4	5	**Excited**
Upset	1	2	3	4	5	**Pleased**
Tense	1	2	3	4	5	**Relaxed**
Scared	1	2	3	4	5	**Not scared**
Sad	1	2	3	4	5	**Joyful**
Alert	1	2	3	4	5	**Not alert**

42. Under this scenario, how **unacceptable or acceptable** would it be to use the following management actions?

	Very Unacceptable				Very Acceptable
Lethal control	1	2	3	4	5
Nonlethal control	1	2	3	4	5
Advise & monitor	1	2	3	4	5
Do nothing / no management	1	2	3	4	5

Scenario 2: While walking on your property or in your neighborhood, **a large buck (male deer)** appears and stops on the path in front of you, **then looks your way.**

43. Would you say that this scenario would be a positive, negative, or neutral experience for you?

Very Negative				Very Positive
1	2	3	4	5

44. In this scenario, to what extent would you feel the following? *(For **each row**, circle the number that best represents your response)*

	Strongly	Slightly	Neither	Slightly	Strongly	
Nervous	1	2	3	4	5	**Calm**
Unexcited	1	2	3	4	5	**Excited**
Upset	1	2	3	4	5	**Pleased**
Tense	1	2	3	4	5	**Relaxed**
Scared	1	2	3	4	5	**Not scared**
Sad	1	2	3	4	5	**Joyful**
Alert	1	2	3	4	5	**Not alert**

45. Under this scenario, how **unacceptable or acceptable** would it be to use the following management actions?

	Very Unacceptable				Very Acceptable
Lethal control	1	2	3	4	5
Nonlethal control	1	2	3	4	5
Advise & monitor	1	2	3	4	5
Do nothing / no management	1	2	3	4	5

Scenario 3: While walking on your property or in your neighborhood, **a fawn (baby deer)** appears and stops on the path in front of you, **then looks your way**.

46. Would you say that this scenario would be a positive, negative, or neutral experience for you?

Very Negative				Very Positive
1	2	3	4	5

47. In this scenario, to what extent would you feel the following? *(For **each row**, circle the number that best represents your response)*

	Strongly	Slightly	Neither	Slightly	Strongly	
Nervous	1	2	3	4	5	**Calm**
Unexcited	1	2	3	4	5	**Excited**
Upset	1	2	3	4	5	**Pleased**
Tense	1	2	3	4	5	**Relaxed**
Scared	1	2	3	4	5	**Not scared**
Sad	1	2	3	4	5	**Joyful**
Alert	1	2	3	4	5	**Not alert**

48. Under this scenario, how **unacceptable or acceptable** would it be to use the following management actions?

	Very Unacceptable				Very Acceptable
Lethal control	1	2	3	4	5
Nonlethal control	1	2	3	4	5
Advise & monitor	1	2	3	4	5
Do nothing / no management	1	2	3	4	5

Scenario 4: While walking on your property or in your neighborhood, **an adult deer** appears and stops on the path in front of you, **looking diseased.**

49. Would you say that this scenario would be a positive, negative, or neutral experience for you?

Very Negative				Very Positive
1	2	3	4	5

50. In this scenario to what extent would you feel the following? *(For **each row**, circle the number that best represents your response)*

	Strongly	Slightly	Neither	Slightly	Strongly	
Nervous	1	2	3	4	5	**Calm**
Unexcited	1	2	3	4	5	**Excited**
Upset	1	2	3	4	5	**Pleased**
Tense	1	2	3	4	5	**Relaxed**
Scared	1	2	3	4	5	**Not scared**
Sad	1	2	3	4	5	**Joyful**
Alert	1	2	3	4	5	**Not alert**

51. Under this scenario, how **unacceptable or acceptable** would it be to use the following management actions?

	Very Unacceptable				Very Acceptable
Lethal control	1	2	3	4	5
Nonlethal control	1	2	3	4	5
Advise & monitor	1	2	3	4	5
Do nothing / no management	1	2	3	4	5

SECTION 5: YOUR OPINION ABOUT WILDLIFE IN GENERAL

52. To what extent do you **disagree or agree** with the following statements about **wildlife in general**? *(Please circle <u>one</u> number for each row)*

	Strongly Disagree				Strongly Agree
Humans should manage wildlife populations so that humans benefit	1	2	3	4	5
Animals should have rights similar to the rights of humans	1	2	3	4	5
We should strive for a world where there is an abundance of wildlife for hunting and fishing	1	2	3	4	5
I view all living things as part of one big family	1	2	3	4	5
Hunting does not respect the lives of animals	1	2	3	4	5
I feel a strong emotional bond with animals	1	2	3	4	5
The needs of humans should take priority over wildlife protection	1	2	3	4	5
I care about animals as much as I do about people	1	2	3	4	5
Wildlife are on earth primarily for people to use	1	2	3	4	5
Hunting wildlife is a positive and humane activity	1	2	3	4	5
We should strive for a world where humans and wildlife can live side by side without fear	1	2	3	4	5
I value the sense of companionship I receive from animals	1	2	3	4	5
Wildlife are like my family and I want to protect them	1	2	3	4	5
People who want to hunt should be provided the opportunity to do so	1	2	3	4	5

SECTION 6: DEMOGRAPHIC INFORMATION

This is the final section of the survey. We will ask you a few more questions about yourself.

53. In which year were your born? _____

54. With what gender do you identify?

☐ Man ☐ Woman ☐ Non-binary ☐ Prefer not to answer

55. On a scale of political ideology, individuals can be arranged from strongly liberal to strongly conservative. Which of the following **best describes your views**?

Strongly Liberal	Liberal	Slightly Liberal	Middle of the Road	Slightly Conservative	Conservative	Strongly Conservative
☐	☐	☐	☐	☐	☐	☐

56. How would you classify your **primary residence**? (*Please select the closest match*)

☐ Single-family detached house

☐ Single-family attached house (e.g., townhome, garden home, or other residence attached to or on the property of another home)

☐ Apartment or condominium

☐ Mobile home, trailer home, or other prefabricated home

☐ Individual room within another residence

57. What is the **highest level of education** that you have completed?

☐ Less than a high school diploma ☐ High school diploma or GED ☐ Associates degree or trade school

☐ Some college ☐ 4-year college degree ☐ Graduate degree

58. What is your approximate **annual household income**, before taxes?

☐ Less than $25,000 ☐ $25,000 to $49,999 ☐ $50,000 to $99,999

☐ $100,000 to $149,999 ☐ $150,000 to $199,999 ☐ $200,000 or more

59. Do you consider yourself …? *(Select all that apply)*

☐ White or Caucasian

☐ Black or African American

☐ Spanish, Hispanic, or LatinX

☐ Asian or Asian American

☐ Native American or Alaska Native

☐ Native Hawaiian or Pacific Islander

☐ Other

Thank you for completing this survey!
If you have any additional comments on deer or deer management in Indiana, please include them in the space below: