2021

COMMUNITY-BASED DEER MANAGEMENT: A CASE STUDY IN MISSOULA, MT

Taylor Ingle Mudford

COMMUNITY-BASED DEER MANAGEMENT: A CASE STUDY IN MISSOULA, MT

By

TAYLOR INGLE MUDFORD

Bachelor of Arts, University of Hartford, Hartford, CT, 2017

Thesis

Presented in partial fulfillment of the requirements for the degree of

Master of Science
Resource Conservation, International Conservation and Development

The University of Montana
Missoula, MT

September 2021

Approved by:

Scott Whittenburg, Dean of The Graduate School
Graduate School

Dr. Jennifer Thomsen, Chair
Department of Society and Conservation

Dr. Alexander Metcalf
Department of Society and Conservation

Shawn Johnson
Natural Resource Conflict Resolution Program

Mudford, Taylor, M.S., August 2021 *Resource Conservation*

Community-based deer management: A case study in Missoula, MT

Chairperson: Dr. Jennifer Thomsen

Human development and expansion have led to urban sprawl and fewer, less developed areas suitable for wildlife habitat. Populations of white-tailed deer (*Odocoileus virginianus*) have adapted to urban communities; however, their prevalence can lead to myriad of ecological and social issues, necessitating communities to pursue comprehensive urban deer management strategies. These strategies have increasingly been pursued via community-based deer management (CBDM) and are an example of collaborative natural resource management (CBNRM). Despite the growth in urban white-tail deer populations and the interactions with humans, there are few studies that explore the CBDM and the acceptability of diverse deer management techniques. Mahajan et al.'s (2020) theoretical framework unifies three distinct social theories, (i.e. collective action theory, governance theory, and diffusion of innovation theory), studies how CBNRM emerges in a community, persists over time, and spreads across geographic scales and to other communities. Two components of this framework, the emergence of CBNRM and the diffusion of CBNRM, were used to guide an investigation into the enabling conditions and potential for various CBDM techniques in Missoula, MT. This urban community nestled in the northern Rocky Mountains of the United States has a growing resident population of urban deer and the community has been unable to find a satisfactory resolution regarding how best to manage the wildlife. Through qualitative data collection, this study indicates that there are enabling conditions (e.g. positive working relationships) and constraining conditions (e.g. lack of shared knowledge and vision, poor political leadership) for the emergence of CBDM in Missoula. Additionally, there are multiple attributes of diffusion of innovation theory (e.g. relative advantage, decision-making, geographic settings) that indicate the success of CBDM in Helena, a nearby city in Montana, are influencing the acceptability of different deer management techniques and the potential for successful CBDM in Missoula. These results provide Missoula residents information on how to move toward engaging in CBDM and indicate that diffusion of innovation theory is an effective tool to study and analyze a novel community's potential adoption of CBDM.

Contents

Chapter 1: Introduction

Expansion of human settlements has encroached upon wildlife habitat. In the United States (US), this expansion has led to more species (e.g. deer, elk, geese) being found in urban and suburban areas (Lee & Miller, 2003; Patterson et al., 2003; Raik et al., 2005a). Not only are some of these species being found at higher rates in urban areas, but some, especially deer, have adapted well to surviving in urban areas. In suitable habitat, these urban deer herds are capable of overpopulating due to lessened predation pressures (Patterson et al., 2003; Kilpatrick & Walter, 1997). Overpopulated urban deer populations across the US have caused negative social and biological impacts. Excessive numbers of deer in an urban environment increase the chance of human-wildlife conflict, ranging from deer destroying residents' ornamental vegetation and gardens; vehicle collisions, which can injure or kill motorists; spread of diseases such as Chronic Wasting Disease and Lyme Disease among the densely packed deer population; and encourage large predators, such as mountain lions, to move from more remote areas to denser population centers to hunt the readily available prey (e.g. Kilpatrick & Walter, 1997; Messmer et al., 1997; Conover, 1995; Rondeau & Conrad, 2003; Patterson et al., 2003; Byron, 2014).

Wildlife managers and city officials across the US have struggled to effectively manage urban deer. A significant challenge is attributed to Americans' diverse perceptions of urban deer. These perceptions range from some urban residents enjoying the deer in their neighborhood, while others strongly favor lethally culling urban deer (Kilpatrick & Walter, 1997; Raik et al., 2005b; Lee & Miller, 2003; Friesen, 2017). Because of the controversy fueled by varied stakeholder perceptions of urban deer management, some cities have pursued a collaborative approach to urban deer management. Such a process "involves effort from wildlife agencies, local governments, interest groups, citizens experiencing impacts from wildlife, and other

stakeholders to make decisions about deer management and to implement management actions" (Raik et al., 2005b, p 260) and is often a necessary strategy for reaching wildlife management goals (Raik et al., 2005a). Processes predicated upon this strategy of bringing diverse stakeholders within a community together to cooperatively reach management decisions regarding natural resources (e.g. wildlife, landscapes, etc.) will be referred to as community-based natural resource management (CBNRM).

CBNRM has been pursued in the context of managing urban deer (Raik et al., 2005b, Raik et al., 2005a; Decker et al., 2004). In these contexts, a distinct subtype of CBNRM has emerged in the literature and is referred to as community-based deer management (CBDM) (e.g. Decker et al., 2004; Raik et al., 2005b; Raik et al., 2005a; Siemer et al., 2000). CBDM is largely the same as CBNRM and its specific name merely indicates that natural resource to be managed via a collaborative process is deer. CBDM has succeeded in numerous communities including Helena, MT. In Helena, a long collaborative process involving stakeholder involvement, input, and feedback in conjunction with city managers and representatives from Montana Fish, Wildlife, and Parks (FWP) resulted in a successful program that reduced the urban mule deer population to a more manageable and sustainable level via trapping and killing individual deer (C. Stinson, personal communication, 6/30/20; J. Stults, personal communication, 8/7/20).

A similar collaborative approach following an established CBDM framework could be effective in Missoula, MT, which has grappled with urban white-tailed deer for several years (e.g. Szpaller, 2012; Friesen, 2017). This issue has resulted in several instances of human-wildlife conflict and has remained highly controversial. Many Missoula residents strongly oppose any type of controlled management of urban deer while others wish to see the deer eradicated (Szpaller, 2012; Szpaller, 2014; Friesen, 2017). One specific management approach

could be to lethally cull the deer in consultation with Montana FWP, as Helena did; this idea has been floated before by Missoula city government (Szpaller 2012; Szpaller 2014; Friesen, 2017), but has never progressed into a formal initiative. This technique could additionally serve the Missoula community because 20% of Missoula residents have used the Missoula Food Bank and Community Center (MFB&CC) for groceries in the past year (J. Breidenbach, personal communication, 10/1/20). This management strategy could therefore potentially minimize negative impacts associated with overpopulated urban whitetail deer and provide additional, healthier meat protein (Gramatina et al., 2011; Strazdina et al., 2013; Wiklund et al., 2014; Goguen et al., 2018) for food insecure individuals and families in the city. There are numerous other management techniques that have been used in other communities across the US and should be considered, but the trapping and killing technique could be the most promising option considering its use in Helena is the most geographically proximate successful example of CBDM to Missoula. Given this, there is a clear need for a more intentional collaborative process to address Missoula's urban deer management; however, there is a lack of research that seeks to understand if and how CBDM could meet the needs of the Missoula community.

To better understand the potential for CBDM in Missoula, it is necessary to analyze the enabling conditions that can support the emergence of CBDM and the acceptability of different deer management techniques. Much research has been conducted studying these enabling conditions and their importance; this robust body has been compiled by Mahajan et al. (2020) into one component of a new framework designed to assist in analyzing CBNRM processes. Additionally, the authors included another component to the framework that applies diffusion of innovation theory to CBNRM processes to understand how collaborative processes and innovations spread beyond an initial community (Mahajan et al., 2020, p 7-8). This framework is

new and has only recently been applied to various case studies (Mahajan et al., 2020), thus requiring further testing to better understand its utility. Additionally, the use of diffusion of innovation theory has seldomly been studied or applied to conservation science and practice (Mahajan, et al., 2020; Mascia & Mills, 2017). Finally, it has not yet been applied to CBDM specific contexts. Despite its novelty, the framework has been designed in accordance with the vast existing body of social theory and literature (Mahajan, et al., 2020).

These two components from Mahajan et al.'s (2020) framework will therefore be used to guide this research. First, understanding potential enabling and constraining conditions to CBDM has been shown to be an important indicator for successful CBDM initiatives (Decker et al., 2004; Raik et al., 2004; Raik et al., 2005a). By studying these conditions in this context using this framework, this study clarifies how these conditions are influencing the emergence of CBDM in Missoula. Second, applying diffusion of innovation theory to CBNRM is an emerging field of study in conservation science; it has not been applied to CBDM. Considering that the theory attempts to understand how new innovations or techniques spread across geographic scales and between communities (Mahajan et al., 2020; Mascia & Mills, 2017; Rogers, 2003), and that Missoula is geographically proximate to Helena, where an urban deer management technique was adopted, this theory may be applicable and useful to fully analyzing and understanding the potentiality for CBDM in Missoula. Applying this theoretical framework to a CBDM-specific context, as well as using the diffusion of innovation theory in conservation science, are understudied; this study will therefore have practical results for the Missoula community and will progress toward a more complete understanding for this framework's utility for CBDM and other CBNRM contexts. Thus, this study addresses the following research questions (RQ):

RQ1: What are the enabling and constraining conditions that influence the emergence of CBDM in Missoula, MT?

RQ2: What are the attributes that influence the adoption of different urban deer management techniques in Missoula, MT?

Chapter 2: Literature Review

Urban Deer Management

Deer (whitetail or mule deer, depending on the geographic area) have been successful at adapting to human settlements, which has led to deer overpopulating urban and surrounding areas (Urbanek et al., 2011; Raik et al., 2005b). Overpopulated deer have caused a litany of cascading impacts such as over-browsing of plants, including residents' gardens; increased rates of vehicle-deer collisions; increased rates of aggressive behavior from deer toward people, etc. (e.g. Leopold et al., 1947; Eve & Kellogg, 1977; Klein, 1981; Warren & Krysl, 1983; Conover, 1995). The study of overpopulated deer and their impacts has further developed into study of how best to manage these deer in urban areas.

The issue of overpopulated urban deer has led to a multitude of management strategies that have been adopted by communities across the US. Some communities have pushed to sterilize deer to non-lethally control the population (Raik et al., 2004); while this is quite popular amongst the public, most wildlife and deer managers view sterilization or birth control as the least ideal management strategy due to its ineffectiveness and high cost (Urbanek et al., 2011; Deer Management, n.d.; Meyer et al., 1995). Another non-lethal strategy is to capture and relocate deer (Kuser, 1995), but this is again costly and often illegal in some regions to prevent spread of disease (Urbanek et al., 2011).

Remaining strategies focus on lethally culling deer to control the population. Hunting has become one of the stronger controls on deer populations due to loss of apex predators (Eve & Kellogg, 1977), but allowing public hunts within city limits is often a controversial management strategy to implement because of varied stakeholder perceptions of urban deer (Deblinger et al., 1995; Urbanek et al., 2011; Patterson et al., 2003; Lee & Miller, 2003) and safety concerns

regarding hunting in densely populated towns and cities (Lee & Miller, 2003; Urbanek et al., 2011; Kuser, 1995). One tactic is to allow a special hunting season for qualified hunters or landowners, which has been used in Princeton, NJ and Clarence, NY (Urbanek et al., 2011; Kuser, 1995; Raik et al., 2004). Another is to have law enforcement or other hired professionals shoot deer in specified areas during specified times of year, such as in Cleveland, OH. (Deer Management, n.d.). Finally, deer can be trapped and euthanized, as in Helena, MT (Urbanek et al., 2011; C. Stinson, personal communication, 6/30/20). As communities explore these techniques, it is often done collaboratively with different stakeholders individuals, non-governmental organizations, and governmental organizations- to reach new management decisions.

Community-Based Natural Resource Management

CBNRM is a strategy for managers and agencies that shifts from more traditional top-down management approaches regarding natural resources to bottom-up, context-specific decisions borne from rigorous input and participation by local communities (e.g. Kellert et al., 2000; Gruber, 2010; Armitage, 2005; Fabricius & Collins, 2007). The concept of CBNRM is rather broad, partly because there has yet to be a definition that has been adopted by the conservation field (see Reed et al., 2016). Instead, this broader conceptual understanding has been applied to numerous situations under varying terminology but through similar processes and goals. Other terms that refer to broadly similar management strategies and approaches include but are not limited to collaborative natural resource management (e.g. Kellert et al., 2000; Reed et al., 2013), community-based management (e.g. Zanetell & Knuth, 2004; Mahajan et al., 2020), community-based conservation (e.g. Abdullah et al., 2014), and community-based

natural resource management (e.g. Armitage, 2005; Gruber, 2010). For this paper, CBNRM broadly refers to natural resource management approaches that seek to reach decisions through an inclusive and collaborative process with local communities and institutions such as government agencies and non-governmental organizations.

CBNRM has grown in popularity both in the US and around the world over the past several decades because it is viewed as a more democratic processes that encourages greater public participation (Conley & Moote, 2003; Nie, 2008; Reed, 2008). With its increasing usage, there has been increased scientific inquiry and examination of its effectiveness and key components. While there have been some criticisms of CBNRM, namely concerning its cost, time commitment, and capacity to inadvertently cause greater conflict by allowing some stakeholders to commandeer proceedings (e.g. Coglianese, 1999; National Research Council, 2008; McCloskey, 1996), there have also been numerous studies that have shown that CBNRM can and has succeeded (e.g. Reed et al., 2013; Schuett et al., 2001; Brody, 2003).

Multiple studies examining successful CBNRM processes include case studies focusing on communities that collaboratively reached management decisions regarding urban deer (e.g. Raik et al., 2004; Raik et al., 2005b; Raik et al., 2005a; Lauber, et al., 2005; Decker et al., 2004). These processes will be referred to as community-based deer management (CBDM), which is a subset of CBNRM that applies the same principles to contexts in which urban deer are the natural resource to be managed. Both CBNRM and CBDM literature highlight initiatives emerge and are most successful when multiple enabling conditions exist, thereby increasing the community's capacity to engage in CBNRM (Decker et al., 2004; Raik et al., 2004).

CBNRM Framework

Mahajan et al.'s (2020) theoretical framework was developed to help "diagnose the current status and context of [CBNRM/CBDM] in specific geographies" (Mahajan et al., 2020, p 10). The framework is composed of three components. Component 1 is informed by collective action theory and these enabling conditions and is most helpful in understanding the emergence of community-based conservation (CBC) (note: Mahajan et al. (2020) use the term CBC, whereas this paper will use the term CBNRM henceforth). Component 2, based upon governance theory, is used to understand the persistence of CBNRM governance systems and their ecological and sociological impacts. Finally, Component 3 is used to analyze how CBNRM scales across landscapes and communities via diffusion of innovation theory (Mahajan et al., 2020). Figure 1, provided by Mahajan et al. (2020), shows the interconnectedness of the framework's components.

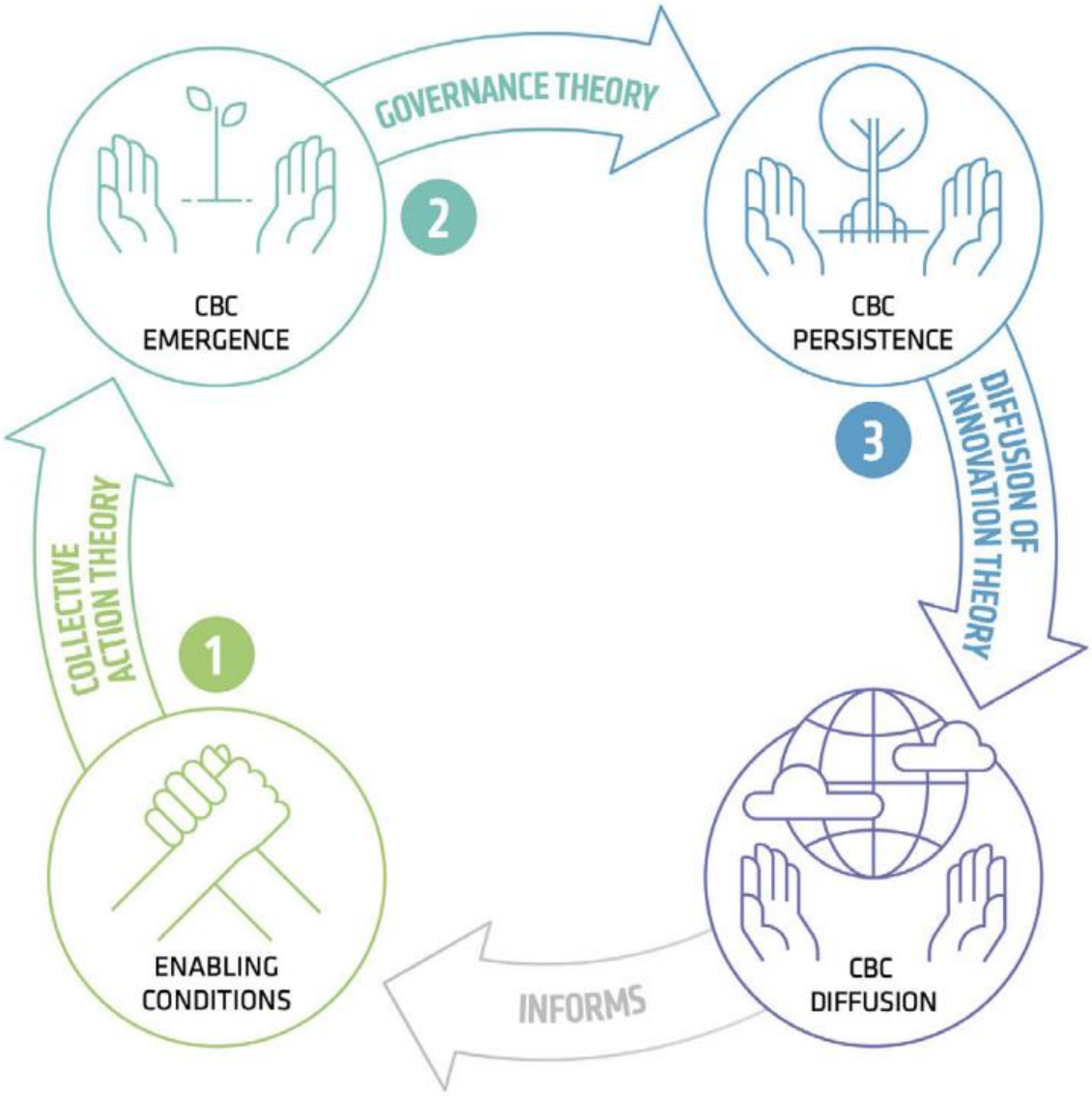

Figure 1: CBNRM framework (Mahajan, et al., 2020). Note: Mahajan et al. (2020) use the term CBC, whereas this paper uses the term CBNRM.

This comprehensive framework guided the research for this study by applying Component 1 (emergence of CBNRM) and Component 3 (diffusion of CBNRM) to investigate the potential utility and feasibility of CBDM in Missoula based on a variety of deer management techniques. Component 2, the persistence of CBNRM governance, will not be fully applied in this study because CBDM has not yet emerged in the community; however, certain attributes

within it are frequently mentioned in other literature, indicating that parts of Component 2 may be important to consider for Missoula. Component 3 will be used as it has been proposed that diffusion of innovation theory can help understand and analyze how conservation innovations and techniques can scale across geographies and communities (Mahajan et al., 2020; Mascia & Mills, 2018); because Helena has adopted an urban deer management technique and implemented a successful CBDM program, Component 3 may assist in understanding how CBDM may diffuse from Helena to Missoula. In the next sections, greater detail is provided about these two components.

Component 1: Emergence of CBNRM

As Mahajan et al. (2020) note, Component 1 is based upon an existing extensive body of literature and research into collective action theory. This body of work has informed analyses and investigation into how and why individuals in communities work together and has been applied to conservation science and CBNRM for decades (e.g. Poteete & Ostrom, 2008; Matta & Alavalapati, 2006; Ratner et al., 2017). Factors that enable individuals and communities to cooperatively work together toward something like CBNRM or, more specifically, CBDM, are known as enabling conditions (Mahajan et al., 2020). These enabling conditions that influence and facilitate collective actions are grouped into two categories, each with several attributes; category 1 specifies attributes of the appropriator (i.e. the resource user) and category 2 specifies attributes of the resource itself (Mahajan et al., 2020; Olson, 1965; Ostrom, 1990).

Category 1: Appropriator

High salience

High salience of the appropriator, or resource user, denotes the extent to which the resource is relevant to the livelihood and well-being of community members (Mahajan et al., 2020). The more individuals in a community view the resource as vital to their everyday lives, the more likely it is that they will cooperate to manage or conserve that resource. In the Missoula context, however, the salience of urban deer was not specifically investigated or expected, as few, if any, members of the community rely upon the deer for their livelihoods and well-being.

Common understanding and purpose (Shared Knowledge and Shared Vision)

This attribute indicates that a mutual understanding among resource users to be managed or conserved is an important enabling condition to the emergence of CBNRM and CBDM. While Mahajan et al. (2020) use original terminology developed by Olson (1965) and Ostrom (1990), this condition is discussed frequently in other CBNRM and CBDM literature using the terminology shared knowledge, which is applied to the current study.

Shared knowledge partly refers to "the consideration, incorporation, and production of traditional and modern ecological knowledge in managing natural resources" (Kellert et al., 2000, p 707). The need for stakeholders to share and learn this ecological knowledge is acknowledged in other studies (Gruber, 2010; Conley & Moote, 2003; McCool & Guthrie, 2001), though another element of shared knowledge regarding understanding and awareness of agency procedures is highlighted by CBDM specific literature.

In CBDM, stakeholders and wildlife managers must have shared knowledge and understanding of deer biology, negative impacts associated with overpopulated deer, issues

stemming from human-deer conflict, varying values among stakeholders, the decision-making process and authority, and relevant regulations (Decker et al., 2004). If stakeholders or managers lack shared knowledge about any of these areas, it may become more difficult to effectively engage in CBDM as there may be disagreement or misunderstanding as to why overpopulated deer are an issue or what the benefits are to managing their population. In CBDM literature, informative communication has been defined as "the process of providing information and increasing awareness of local deer issues" (Raik et al., 2005b, p 265). This type of communication most often occurred more informally between individuals either before or during a CBDM process. Alternatively, wildlife managers may lack information about the perspectives and attitudes of community stakeholders regarding urban deer management; inadequate knowledge of the specific local setting greatly complicates the efficacy of any collaborative effort (Decker et al., 2004). Additionally, strategies to change public opinion and attitudes is notoriously difficult (Heberlein, 2012).

In tandem with shared knowledge, Mahajan et al. (2020) note the importance that resource users "share a common purpose" (p 4). The term common purpose is often called shared vision, which will be used in this research, and has been extensively studied in CBNRM and CBDM literature (e.g. Conley & Moote, 2003; Schuett et al., 2001; Schusler et al., 2003; Raik et al., 2005a). Shared vision is a mutual idea or goal shared by the stakeholders that is sought to be achieved via CBNRM (Gruber, 2010; Conley & Moote, 2003). CBNRM processes have highlighted the necessity for stakeholders to have clear and shared goals (Schuett et al., 2001); this shared vision can be achieved and improved by shared knowledge and social learning (Schuett et al., 2001; Schusler et al., 2003). Articulating a shared vision or common purpose, as it is sometimes called, can be difficult when participating stakeholders have misaligned values,

perspectives, or knowledge (Raik et al., 2005a). In a CBDM context, for example, one stakeholder may believe in the sanctity of all life, another has battled urban deer eating their plants every year, and a third is aware of the importance of maintaining a sustainable population of deer in an ecosystem. Thus, collaborative groups will often dedicate time toward clearly articulating a shared vision (Schuett et al., 2001; Schusler et al., 2003; Fabricius & Collins, 2007). An important distinction to make is that the stakeholders are not required to have a specific and already agreed upon solution to resolve the issue of overpopulated deer; rather, all that is required is that the stakeholders have a common and shared vision that the issue needs to be addressed (Decker et al., 2004; Raik et al., 2005a). Previous studies' emphasis of shared knowledge and shared vision and their impact on CBNRM and CBDM make them critically important enabling conditions to investigate in Missoula.

Low discount rate that individuals attach to future resource flows

This attribute refers to the extent to which appropriators are willing to bear the cost to collaboratively manage a natural resource with the expectation that they benefit from the resource in the long-term (Mahajan et al., 2020). In other words, users who value long-term and future benefits of the resource are more likely to work collaboratively to manage that resource, compared to those who prefer the short-term gain by exploiting the resource (Ostrom, 2000). This attribute will not be specifically investigated in this study because the resource to potentially be managed is urban deer, which is not scarce or in danger of disappearing in Missoula and are not a particularly exploitable resource.

High trust

Trust among users and the ensuing relationships between them are highly important to the emergence and eventual persistence of CBNRM and CBDM. Multiple studies have shown trust's central role in CBNRM (e.g. Metcalf et. al, 2015; Levesque et. al, 2017; Davenport et. al, 2007; Young et. al, 2017). One recent study (Stern & Coleman, 2015) delineated trust as a broad concept into four more specific dimensions to better understand how and why one person trusts another person to perform an action in CBNRM initiatives. These dimensions, dispositional, rational, affinitive, and procedural, have been shown to have varying incentives and barriers to their existence and varying usage in creating and maintaining a successful CBNRM initiative. For example, procedural trust, or a stakeholder participant's trust in the initiative's internal process itself, is stressed as vital because a strong and transparent process or institution guiding CBNRM can help shift participants' levels of trust through relationship building, sharing information, and engendering common understanding (Coleman & Stern, 2018; Blumberg, 1999; Kellert et al., 2000).

Trust between stakeholders directly leads to higher quality working relationships between stakeholders (Schuett et al., 2001; Decker et al., 2004; Gruber, 2010). In CBDM contexts, working relationships can be categorized into formal and informal relationships. Formal relationships would be partnerships between stakeholders and agencies to work toward a common goal, which are key to facilitate effective CBDM (Decker et al., 2004; Raik et al., 2005a; Lauber et al., 2004). For example, a formal partnership between a wildlife agency, local government, and a public advocacy representative to strive toward a deer management plan would greatly encourage effective collaboration. Informal relationships are one-on-one relationships between stakeholders. For example, a deer manager with a wildlife agency having a

personal working relationship with a city councilperson, which may have developed during previous work projects. Like formal relationships, informal relationships are incredibly helpful to CBDM (Decker et al., 2004; Raik et al., 2005a; Lauber et al., 2004). The critical role trust and working relationships play in the emergence of CBDM make these interwound attributes primary enabling conditions to investigate in Missoula.

High autonomy

High autonomy of the user indicates the extent to which the user can self-organize and institute new legislation (Mahajan et al., 2020). Appropriators "with the legal autonomy to make their own rules" (Ostrom, 2000, p 38) will experience less pushback from other authorities, which allows for greater chances of successful emergence of CBNRM. In Missoula, this is not a particularly important enabling condition because the city already has legal authority to make wildlife management decisions for the city with approval from Montana Fish, Wildlife, and Parks (FWP) (Wildlife Removal in Cities Based upon Ordinance or Resolution, 2003).

Prior organization experience and local leadership

Organizational experience refers to individuals within the community having previously cooperated (Mahajan et al., 2020). Local leadership is additionally noted as an enabling condition; the role of local leadership has been extensively studied in CBNRM and CBDM contexts (e.g. Gray, 1985; Reed et al., 2013; Schuett & Selin, 2002; Schuett et al., 2001; Decker et al., 2004; Raik et al., 2005a; Raik et al., 2005b; Lauber, 2010). Leaders, who are instrumental in keeping collaborative processes moving forward, can be formal or informal (Decker et al., 2004). Formal leaders are typically institutional, meaning they emerge from local government or

wildlife agencies and are often effective at motivating change in policy and can foster support from public stakeholders if trust exists between the institutions and the public (Decker et al., 2004; Gray, 1985). Informal leaders emerge from the community and volunteer their time and energy to propelling the collaborative forward. These types of leaders are often influential and well-respected members of the community and particularly successful at forming relationships between various stakeholders (Decker et al., 2004; Gray, 1985).

For leaders to emerge in any given context, the individual needs to possess some level of credibility, which is the perceived "competence, reliability, integrity, and trustworthiness of individuals…and institutions…engaged in collaboration" (Raik et al., 2005a, p 117). In other words, if stakeholders do not trust the institutions involved in CBDM or do not view a potential informal leader as legitimate (e.g. the individual may be well-respected, but some stakeholders may view them as particularly biased and thus unsuitable), it will be difficult for any group or individual to recruit and retain other stakeholders around the cause of managing deer (Gray, 1985; Decker et al., 2004; Lauber, 2010; Reed et al., 2013). The impact leadership has on the emergence of CBDM necessitates its inclusion in the investigation of CBDM in Missoula.

Category 2: Resource

Feasible improvements

The first attribute of the resource is feasible improvements, or the extent to which users perceive their participation in a collaborative to have beneficial and tangible impacts on the resource (Mahajan et al., 2020; Ostrom, 2000). Ostrom (2000) specifically notes that this attribute is more likely to galvanize collaborative action if the resource is damaged, destroyed, or scarce. This is not the case in Missoula, as the resource, urban deer, are present and potentially

overabundant; improvements to the resource in this context are more likely to refer to social improvements via CBDM (i.e. minimizing human-wildlife conflict by removing individuals from the urban deer population) rather than ecological improvements. Framing the attribute in this manner may still emerge as an enabling or constraining condition in the Missoula context.

Indicators for resource condition exist at a low cost

The ability to effectively and cheaply monitor the resource the resource is important to the emergence of CBNRM (Mahajan et al., 2020; Ostrom, 2000). Essentially, the easier and more affordable it is to monitor the condition of the resource to be managed better enables collaboratives to begin. Currently, it is unknown what indicators exist, or if any that exist are effective, in Missoula for monitoring the condition of urban deer. This may emerge as an enabling or constraining condition to CBDM in Missoula.

Predictability of resource dynamics

The more predictable a resource is, the easier it is to manage (Mahajan et al., 2020; Ostrom, 2000). Ostrom (2000), for example, writes that an unpredictable and erratic resource "is always difficult for appropriators…to judge whether changes in the resource stock or flow are due to overharvesting or to random exogenous variables" (p 37). The predictability of urban deer in Missoula is unknown at this time, thus this attribute may emerge as an enabling or constraining condition to CBDM in Missoula from this study.

Spatial extent

Spatial extent serves as an enabling condition when the resource is in a small enough area for users to know its boundaries and micro-environments (Mahajan et al., 2020). For example, a small landscape, such as a city park, would be easier to collaboratively manage for a community than an entire national park, which requires collaboration between multiple national agencies and gateway communities. In the context of CBDM in Missoula, the spatial extent for urban deer, are in city limits, which has clear boundaries; however, the results of this study may indicate otherwise.

Category	Attribute
Appropriator	High salience (high livelihood dependence)
	Common understanding of the resource system, and how actors affect each other and resources
	Low discount rate that individuals attach to future resource flows
	High trust and reciprocity among users
	High autonomy—ability to self-organize
	Prior organization experience and local leadership
Resource	Feasible improvements
	Indicators for resource condition exist at a low cost
	Predictability of resource dynamics
	Spatial extent is sufficiently small for users to know boundaries and internal micro-environments

Table 1: Factors that influence collective action (Mahajan et al., 2020)

Component 2: Persistence of CBNRM governance

Component 2 of the Mahajan et al. (2020) framework seeks to guide analysis and investigations into how CBNRM processes persist over time. Overall, this component is not particularly relevant to the context of CBDM in Missoula because no collaborative process has yet emerged in the city to manage urban deer. However, two principles to CBNRM governance- representation and shared decision-making- have been extensively studied and viewed as enabling conditions to CBNRM and CBDM (e.g. Gruber, 2010; Blumberg, 1999; McCool & Guthrie, 2001). Even though Mahajan et al. (2020) have included these conditions as attributes

of their framework's Component 2, decision-making is a key attribute of Component 3 as well. This demonstrates that "the social processes of [CBNRM] establishment, persistence, and diffusion are interconnected and often nested within each other" (Mahajan et al., 2020, p 8). Thus, it is important to include these conditions in the investigation to CBDM in Missoula.

Representation and shared decision-making

Stakeholder involvement "is the process of engaging affected stakeholders to provide breadth of input for decisions, participation in making decisions, or help in implementing actions" (Decker et al., 2004, p 16). Much research has shown that inclusion from a broad swath of stakeholder groups is critical to a CBNRM or CBDM initiative succeeding (Gruber, 2010; National Research Council, 2008; Blumberg, 1999; Decker et al., 2004). Brody (2003) found that inviting the right stakeholders to participate sufficiently increased the quality of decisions, indicating that while forming a CBNRM initiative, planners should focus on quality of participants (achieving a wide range of interests and perspectives, including industry and business), rather than quantity. High quality representation of stakeholders is often seen as a key variable to study or consider when evaluating whether a CBNRM process succeeded (Conley & Moote, 2003; Smith & McDonough, 2001; McCool & Guthrie, 2001) and has been found to be an indicator of successful CBDM (Decker et al., 2004). Convening a CBNRM process by haphazardly or arbitrarily inviting stakeholders can "marginalise important groups, bias results and jeopardise long-term viability and support for the process" (Reed et al., 2009, p 1933). Deliberate planning from a facilitator or the convening stakeholder regarding who to invite by conducting a stakeholder analysis (a process that essentially identifies who/which groups can affect or are affected by decisions or actions targeted at social or natural phenomenon, such as

how to best manage a watershed) can avoid these potential downfalls (Reed et al., 2009; Decker et al., 2004).

Inviting a wide variety of stakeholders is important, but only truly effective when those stakeholders are allowed some level of control over the outcome of the process. Successful CBNRM initiatives often involve shared decision-making procedures, meaning that all stakeholders have some level of power or influence to affect change (e.g. Gruber, 2010; McCool & Guthrie, 2001; Smith & McDonough, 2001; Conley & Moote, 2003; Kilpatrick & Walter, 1997). When CBNRM succeeds, it tends toward elevating previously less-powerful stakeholders by encouraging greater decentralization of decision-making power, thus allowing stakeholder participants to wield greater influence during meetings and allow them to impact the outcome of the process (Gruber, 2010; Kellert et al., 2000). This trend holds true for CBDM processes too, as they are predicated upon inviting and encouraging participation from public stakeholders and striving toward collaboratively reaching a plan that reflects the needs and desires of the public stakeholders (Raik et al., 2005b; Decker et al., 2004).

Component 3: Diffusion of CBNRM

Component 3 of this framework seeks to guide analysis into the spread or diffusion of CBNRM processes across geographies and between communities (Mahajan et al., 2020). This component is based upon the diffusion of innovation theory, which has been "prominent in the sociological and political science literatures" (Mahajan et al., 2020, p 8) but has seldomly been applied to conservation social science (Mahajan et al., 2020; Mascia & Mills, 2018). Both Mahajan et al. (2020) and Mascia & Mills (2018) note that this theory could be applicable to CBNRM researchers and practitioners, making it of great interest to further test its utility in a larger number of communities and contexts. Specifically in the Missoula context, it may be

especially helpful in investigating how the attributes of Component 3 (outlined below) influence Missoulians' willingness to adopt different CBDM techniques, especially because Helena, the state capital and geographically proximate to Missoula, succeeded in CBDM.

Component 3 is split into three categories (see Table 1 at end of this section) that each focus on one aspect of diffusion of an innovation. Category 1: characteristics of the innovation/practice focuses on various attributes of the specific practice or technique that may be instituted after a community enters a CBNRM process. In the context of urban deer in Missoula, Category 1 includes five commonly used techniques to manage urban deer as discussed prior: trapping and killing; sharpshooters; public hunting; contraceptives; and trap and relocation. Category 2: characteristics of the adopter/community focuses on attributes of the community and potential adopters of the practice that influences their acceptance of the new practice. Finally, Category 3: context/enabling environment focuses on broader, community level attributes that influence the community's adoption of a new conservation practice.

Category 1: Innovation/CBNRM practices

Category 1 has six attributes, each of which relates to a specific characteristic of a potential practice, innovation, or technique a community can adopt to manage a natural resource. For the remainder of this paper, technique is used to refer to the urban deer management practices that could emerge in Missoula. The first attribute is relative advantage, or the extent to which the technique is perceived as superior to the status quo (Mahajan et al., 2020). Additionally, the relative advantage of a new technique can accelerate its adoption by the community (Mascia & Mills, 2018). Missoulians' perceptions of the relative advantage of any of the urban deer management techniques will be important to understand when investigating the

potential for CBDM in the city; if residents do not believe there is an advantage to adapting current management techniques, there is little chance the community will begin or succeed in CBDM.

Another attribute is the flexibility of the technique, or the extent to which adopters can tweak and adjust the technique to fit their needs, can influence the perceived compatibility of the technique; the more compatible a technique is perceived to be to adopters' beliefs and values, the more likely the technique is to be accepted (Mahajan et al., 2020; Mascia & Mills, 2018). The observability of the technique is also an important attribute, as the extent to which the technique and its results are communicable to others can influence adoption (Mahajan et al., 2020; Mascia & Mills, 2018). Adopters can observe the technique and its results by communicating with other communities that have already instituted the technique (i.e. Missoulians are aware of Helena's technique via news articles, e.g. Szpaller, 2012; Szpaller, 2014). Alternatively, the trialability of the technique, or the feasibility for the adopters to experiment the technique themselves on a limited basis, can help communicate the results of the technique to others (Mahajan et al., 2020; Mascia & Mills, 2018). Finally, adopters can be influenced by the complexity of the technique; the more the technique is perceived as difficult to understand or use, the less likely it is that adopters will view the technique as advantageous, worth experimenting with, or adopting (Mahajan et al., 2020; Mascia & Mills, 2018).

Each of these six attributes are interconnected and can influence one another as well as the adopters' perception of the technique. It is currently unknown which of these attributes are most influential in Missoulians' perceptions of urban deer management techniques, which therefore requires Category 1's inclusion in this study.

Category 2: Adopter/Community

Category 2 includes attributes that describe aspects of the adopting community. The first are social-economic "characteristics that influence adopter's ability to learn or implement a new practice" (Mahajan et al., 2020, p 9). Collaborative processes are expensive and time-consuming endeavors (e.g. Coglianese, 1999; National Research Council, 2008; McCloskey, 1996), which can potentially exclude some stakeholders from the process due to their economic or social status. Alternatively, it may disincentivize some stakeholders from learning or participating in the implementation of a new technique because of economic or social limitations, such as insufficient time to participate in public meetings due to work commitments or required traveling distances to public meetings (e.g. Smith & McDonough, 2001; Reed, 2008).

The next attribute is the personality of the adopter(s), as personality traits "influence an adopter's willingness to learn and implement new practices" (Mahajan et al., 2020, p 9). One of the key traits highlighted by Mahajan et al. (2020) beneath the personality attribute is risk orientation. Willingness to accept risk has been documented in trust literature as an influencer of an individual's propensity to trust others (e.g. Stern & Coleman, 2015; Coleman & Stern, 2018). Given the important function that trust has in CBNRM and CBDM, it is thus important to consider these personality characteristics when analyzing the potential diffusion of CBNRM processes.

The third attribute of Category 2 is knowledge, or "the degree to which the adopter is familiar with the innovation and innovation consequences" (Mahajan et al., 2020, p 9). The more difficult it is to understand the technique, the harder it is for an adopter to be able to implement it or support its adoption. For example, in CBDM, galvanizing support for a city-wide effort to give contraceptives to deer to prevent reproduction may be too technical for an average resident

to fully understand the process needed to give out the contraceptives and the results of supplying the contraceptives. While this lack of knowledge of the innovation's implementation and outcome can be addressed during the collaborative process (Reed, 2008), it can prevent that process from beginning if enough members of the community do not understand the innovation and therefore refuse to entertain the thought of implementing it.

Fourth is organizational innovativeness, "the degree to which the adopter is relatively open to adopting new ideas and practices" (Mahajan et al., 2020, p 9). If a group is open to new ideas or techniques, it will be more likely or more willing to adopt a new conservation innovation. In the Missoula context, this is tentatively already the case. For example, an employee with Missoula Food Bank and Community Center (MFB&CC) has indicated their personal and their organization's interest to explore new urban deer management techniques (personal communication, J. Breidenbach, 5/7/20). Additionally, FWP has already worked with Helena and approved the city's community-built urban deer management plan (Kuglin, 2020; personal communication, J. Stults, 8/7/20), indicating that the agency would be open to working with Missoula on instituting a community-built management plan in the city.

The final attribute for Category 2 is decision making, which Mahajan et al. (2020) specifically define as "arrangements [that] specify the rights of individuals or groups to make choices regarding other aspects of conservation intervention design and management" (p 9). This attribute is identical to the second principle of Component 2 outlined prior and is another example of the interconnectedness and "nested" nature of these components (Mahajan, et al., 2020, p 8). Decision making arrangements that allow all stakeholders to share responsibility and have an impact on the outcome are important to both the persistence and diffusion of CBNRM and CBDM.

Category 3: Context/Enabling environment

The final category of Component 3 examines four attributes of the context and enabling environment in which the potential innovation may be adopted. In this study, the context is the city of Missoula. The first attribute is geographical settings, which includes both "physical features of the landscape" and "spatial proximities to other adopters" (Mahajan et al., 2020, p 10). This attribute will be particularly important to study because of Missoula's proximity to Helena, which has adopted CBDM and specifically the trap and kill technique. Helena's adoption may positively influence Missoula to adopt a similar technique, but this cannot be assumed.

Next, culture, "shared behaviors and ideas" (Mahajan et al., 2020, p 10), is quite similar to shared knowledge and shared vision, discussed above. Essentially, the more cohesive a community is, the more likely it is that CBNRM will emerge (Mahajan et al., 2020), either within the community with little outside influence or by diffusion (i.e. influence from other adopters/communities). In Missoula, which is mostly demographically homogenous (United States Census, 2019a), there are reported vast differences in opinion regarding deer. While there has been fairly widespread acknowledgement of urban deer causing issues in the city (Neighborhood Councils' Priorities, see Appendix), minimal progress has been made toward addressing the issue (Szpaller, 2012; Szpaller, 2014; Friesen, 2017). This is largely due to widespread controversy concerning the urban deer. Despite eight of the 20 Neighborhood Councils in Missoula identifying urban deer as priority issues, there are significant numbers of residents who intensely oppose any discussion or moves to manage the deer (Szpaller 2012; Szpaller, 2014). This may indicate not just a lack of shared vision among the community, but lack of "shared behaviors and ideas" (Mahajan et al., 2020, p 10).

Third are the political conditions, or "character of political systems, along with the regulations and norms inherent in the legal systems" (Mahajan et al., 2020, p 10); additional studies have highlighted the necessity of examining political conditions or political acceptability in CBNRM contexts (Conley & Moote, 2003; McCool & Guthrie, 2001). Political conditions will be especially important to examine in Missoula because government institutions and nongovernmental organizations have hesitated in outwardly pursuing CBDM caused by the perceived controversy (J. Breidenbach, personal communication, 5/7/20). Additionally, urban deer management plans need to be formed with the approval and participation of wildlife management agencies (C. Stinson, personal communication, 6/30/20; Decker et al., 2004). Any CBDM plan in Missoula must be in accordance with FWP, and FWP must be willing to participate and be flexible in adapting to management desires of the city.

The final attribute of Category 3 is global uniformity, which is defined as "diffusion is affected by the extent to which the adopter's context influences and is influences by globally circulating ideas, norms, and practices related to the innovation" (Mahajan et al., 2020, p 10). This attribute, despite its inclusion in the framework, may not be particularly relevant to Missoula because of the city's unique characteristics. For example, Montana has one of the lowest population densities in the US (United States Census, 2019b) and Missoula is a small urban area located proximately to rural areas and open wilderness. Missoula and Montana are isolated from other parts of the US, let alone the global community, which may impact the relevance of global uniformity in this study.

Category	Attribute	Definition
Innovation/CBNRM practices (Category 1)	Relative advantage	The expected net benefits of adopting an innovation compared to status quo
	Compatibility	The degree to which the technique is perceived as consistent with existing values, existing actions, past experiences, and needs of potential adopters
	Complexity	The degree to which the technique is perceived as difficult to understand and use
	Trialability	The degree to which the technique may be experimented with on a limited basis.
	Observability	The degree to which the technique and the results of that technique are visible (observable or communicated) to others
	Flexibility	The ability to transform the technique to something that aligns with the adopter's desires and constraints
Adopter/Community (Category 2)	Social-economics	Social-economic characteristics that influence adopter's ability to learn or implement a new technique (economic well-being, education, social status)
	Personality	Personality traits that influence an adopter's willingness to learn and implement new techniques, such as risk orientation and competitiveness
	Knowledge	The degree to which the adopter is familiar with the innovation and innovation consequences
	Organizational innovativeness	The degree to which the adopter is relatively open to adopting new ideas and techniques compared to others in the social system
	Decision-making	Decision-making arrangements specify the rights of individuals or groups to make choices regarding other aspects of conservation intervention design and management
Context/enabling environment (Category 3)	Geographical settings	Physical features of the landscape/seascape, as well as spatial proximities to other adopters, markets, etc. that affect adoption by influencing the applicability of the innovation
	Culture	Shared behaviors and ideas— Belief systems, traditionalism, and socialization of adopters— That influences adoption of innovations
	Political conditions	Character of political systems, along with the regulations and norms inherent in the legal systems that influence the potential adopters' behaviors
	Global uniformity	Diffusion is affected by the extent to which the adopter's context influences and is influenced by globally circulating ideas, norms, and techniques related to the innovation

Table 2- Characteristics of innovation, adapter, and context that influences adoption of CBNRM (adapted from Mahajan et al., 2020)

Chapter 3: Methodology

Study Area

These enabling conditions and attributes for the emergence and diffusion of CBDM were examined in Missoula, MT. Located in the southwestern region of Montana, Missoula is the second largest city in the state with an estimated population of 75,500 (United States Census, 2019a). The city and its residence are divided into 20 neighborhoods and six wards (see appendix, Figure 1).

Each ward in the city elects two members to the City Council, which is the legislative authority in Missoula (City of Missoula Charter). Each neighborhood possesses a neighborhood council (NC), though these members are volunteers rather than elected officials. The 20 NCs serve to advise the City Council and the Mayor of Missoula on neighborhood specific issues. Additionally, one representative from each NC forms the Community Council for the purpose of sharing information across neighborhoods and make recommendations to the City Council and Mayor about city-wide issues (City of Missoula Charter).

The city is also located in Region 2, an administrative region for FWP. The agency has monitored populations of whitetail deer in the state for several years, but only maps distribution of the deer according to the agency's administrative divisions. Region 2 has an estimated whitetail deer population of 31,539 (Montana Fish, Wildlife, & Parks, 2020). However, the population of urban whitetail deer in Missoula is currently unknown (L. Bradley, personal communication, 10/19/20). There were plans between the city, FWP, and the University of Montana to study and estimate population densities of whitetail deer in Missoula (Bragg, 2020), but this plan was thwarted by the COVID-19 pandemic (L. Bradley, personal communication, 10/19/20).

Methodological approach

A social constructivist worldview and context-specific necessities informed the approach of this research proposal. Creswell (2009) defined social constructivists as researchers who "hold assumptions that individuals seek understanding of the world in which they live and work. Individuals develop subjective meanings of their experiences...These meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas" (p. 8). Essentially, research based upon this worldview relies upon the participants' view of the situation being studied (Creswell, 2009), which is generally best achieved by interviewing participants. Additionally, when investigating stakeholder perceptions and attitudes, interviews are one of the best tools to collect necessary data (McKinney, 2015). Thus, semi-structured open-ended interviews were used to collect data from the key stakeholders (see Table 2 below) to evaluate the enabling factors for CBDM and the participants' perceptions of CBDM. These methods were approved by the University of Montana's Institutional Review Board (IRB proposal #177-20).

Study Population and Sample

For this research study, the population was defined as individuals, non-governmental organizations, and government agencies that are involved or impacted in some capacity with urban white-tailed deer in Missoula. Table 3 identifies and describes the stakeholder groups and their relation to urban deer.

A mixture of chain-referral and purposive sampling method was applied. Purposive sampling method is effective when the targeted population is easily identified (Babbie, 2012); in this case, the interviews targeted key stakeholder groups which were already known. Most of

these groups had clearly identified individuals who needed to be interviewed. In instances in which there was not a clear individual to contact and interview, chain-referral was used instead. An employee with Missoula Food Bank and Community Center (MFB&CC) was a key informant for this study and was adept at identifying other individuals to interview. Other interviewees were asked to identify other individuals to interview when purposive sampling and referrals from the MFB&CC informant are inadequate.

Stakeholder Group	**Targeted individuals and total interviews**	**Relation to urban deer**
Neighborhood Councils	Members from the 8 NCs that have identified urban deer as a priority issue. Requests/invitations to participate will be extended to each NC (9 interviews)	8 of the 20 NCs have identified urban deer as priority issues to resolve. Because multiple NCs can overlap in one ward, each of which votes for 2 city council members, it was important to understand the NCs positions on CBDM (i.e. if a group of NCs are adamantly opposed to CBDM, it can stall any progress as the corresponding City Council member may in turn oppose CBDM)
City Council	Councilpersons from Wards 1, 4, 5, 6, whose constituents' NCs have identified urban deer as priority issues (2 interviews)	The City Council is responsible for passing any legislation and must approve budgets drafted by the mayor (City of Missoula Charter). The City Council is also advised by the NCs and Community Council. City Council approval and participation is required for CBDM to proceed
MT Fish, Wildlife, & Parks (FWP)	Wildlife biologists. Initial contact was asked to refer other FWP employees to interview via chain-referral (2 interviews)	FWP is the state agency tasked with managing wildlife. Its participation and approval are required for the city to move forward and implement a city-wide management plan borne from CBDM (C. Stinson, personal communication, 6/30/20)
MFB&CC	Management staff. Initial contact was asked to refer other potential interviewees in the community (2 interviews)	MFB&CC participation may not be required for CBDM if lethal culling is denied, but to explore the feasibility of introducing lethal culling they had to be included in analysis
Agricultural Center	Teacher. Initial contact was asked to refer other potential interviewees (1 interview)	Part of the Missoula Public School district and a potential partner in establishing CBDM based around lethal deer management. It has been posited (J. Breidenbach, personal communication, 5/7/20) that the Ag center could provide processing services for harvested venison.
Wildlife Conservation	Defenders of Wildlife Rockies and Plains Representative and	Wildlife advocacy groups may strongly oppose and slow or prevent CBDM from moving forward.

Organizations and Advocates	other self-identified advocates (1 interview)	
Missoula Police Department (MPD)	Police officer (1 interview)	Multiple interviewees referenced police officers as individuals who could or should kill deer if lethal management in Missoula was pursued. An interview was scheduled with an officer with MPD in response to these references.

Table 3: List and description of key stakeholders (sample frame)

Instrumentation

This study relied upon in-depth semi-structured interviews for data collection. Thus, an interview guide was used to facilitate the data collection with the stakeholders. Interviews were recorded via an audio recording device or, if the participant did not wish to be recorded, detailed notes. The interview guide below (Table 4) was informed by literature (Decker et al., 2004; Raik et al., 2005b; Raik et al., 2005a; Raik et al., 2004; McKinney, 2015; Mahajan et al., 2020) on CBNRM and CBDM.

Question/Section	Follow-Up Questions or Probes	Rationale
Section 1	Introduction	
Greeting and introduction.	N/A	N/A
Can you tell me about your experiences with urban deer in your neighborhood/city/community?	Have your experiences with the deer changed over time? If so, how, why? Can you share with me a little more about why you really like/dislike deer?	This question aimed to frame the conversation around urban deer and probe changing experiences/impacts of urban deer. Also attempted to allow the participant to expand and be comfortable sharing true feelings about deer (i.e. whether they really love or hate them).
Section 2	Shared Knowledge & Vision	
Several neighborhood councils have indicated that urban deer is a priority issue in need of addressing for them. What are your thoughts on their perception of urban deer?	Do you agree with them that urban deer need to be managed? Why/why not?	This question attempted to elucidate the participant's perception of the issue. This clarified the understanding of the issue possessed by each stakeholder, which is important to know for future collaboration efforts and when assessing stakeholders

		(McKinney, 2015; Decker et al., 2004).
Cities across the US have adopted various deer management strategies. I'd like to give just a quick overview of some and hear your reaction/thoughts to these strategies.	*I explained some management strategies, broadly categorized as lethal, non-lethal, and no management*	This targeted participant's understanding and knowledge about urban deer management strategies and dug into their perspective about if/how urban deer management should be pursued in Missoula (shared vision).
To you, what does the ideal urban deer management strategy in Missoula look like?	What are some reasons why you chose a management program like this? How do you think decisions regarding implementing this strategy should be made? Are there any factors (specific management techniques, how it is decided, who does the work, etc.) that would allow you to support a different management strategy?	
Section 3	Trust & Relationships; Representation	
Who do you think are the key stakeholders or groups that should be involved in deer management for Missoula?	Can you describe your relationship with these other stakeholders? What are your thoughts on these stakeholders' ability to effectively participate or work together toward CBDM? Would you be willing to work with these stakeholders toward CBDM? Why/why not?	This question and its follow-ups attempted to allow the participant, in their own words, to describe their current and past working relationships with other stakeholders, which has been shown to be an important enabling condition for CBDM (e.g. Decker et al., 2004; Raik et al., 2005b; Raik et al., 2005a).
Section 4	Local Leadership & Credibility	
Who do you think are the key leaders for deer management in Missoula?	a. Why did you choose these individuals/groups/organizations as the key leaders? b. Do you trust these leaders? Why/why not? c. Do you feel that these leaders represent your values? Why/why not? d. Do you think these leaders would be effective at leading/guiding a collaborative process? Why/why not?	This question attempted to identify stakeholder-perceived leaders in this context (later analysis revealed whether these leaders were informal or formal). Follow-up questions a-d attempted to understand various qualities of the leader, all of which build into the leader's credibility (as perceived by the participant).
Section 5	Social & Political Acceptability	

In your opinion, can CBDM work in/meet the needs of Missoula? Why/why not?	a. *If yes*: What do you think is needed for Missoula to begin moving forward with CBDM? b. *If yes*: What, if any, are some roadblocks or barriers you anticipate that would make CBDM difficult (e.g. no political will, lack of trust, etc.)?	The community needs to be willing to enter a collaborative process for it to work (social acceptability). This question and its follow-ups dug into each stakeholder's perception of CBDM (i.e. will it meet their needs). Political acceptability was touched upon in the second follow-up.
Section 6	Conclusion	
1. Thank you for your time and speaking with me. Do you have any other thoughts or comments that you would like to add?	a. Do you have any questions for me?	
2. Could you provide me any information for other people you think I should speak to?	a. None.	Sampling for this proposal relied partly upon chain-referral.
3. Would you like a copy of my final report, or some variation of it, after I complete my study?	a. If not a copy of the report, how would you like to be informed of my study's findings?	

Table 4: Interview guide

Data Analysis

Interviews were conducted via Zoom or by phone. All interviewees who participated through Zoom consented to being recorded via Zoom's built-in record meeting feature. The two interviewees who were unable to participate through Zoom instead participated by phone call. During these interviews, detailed notes were typed during the conversation. Audio files and notes from each interview were saved to the researcher's personal laptop and cloud storage. Recorded interviews were transcribed using the audio transcription feature in Microsoft Word Online and Trint. These transcripts, plus the notes from non-recorded interviews, were uploaded to the qualitative data analysis software NVivo.

The transcripts and notes were coded and memoed within NVivo to parse through the data. Codes, or classification of specific pieces of each transcript, were organized primarily by

the three components and subsequent attributes of the framework (Mahajan et al., 2020), the five specific management techniques, and overall perceptions of urban deer. Memos were used to help keep the data and analyses coherent and organized as well as identify new codes that emerged. Memos were also created during the analysis stage to track thoughts and ideas pertaining to deeper meaning behind the data. Dr. Thomsen and other graduate students in her lab assisted in analyzing certain interviews to assist my work as well as supply intercoder reliability. Such reliability boosted the validity of the study's conclusions, as the analysis of the data was generally uniform among the group of individual researchers.

Chapter 5: Results

In total, 18 interviews were conducted with 23 individuals. Two Neighborhood Council groups participated in a group of five and a group of two. The following sections present the results from the interviews, beginning with interviewees' perceptions of urban deer. Next, the targeted and emergent attributes of Component 1 from the framework adapted from Mahajan et al. (2020) are discussed, followed by Component 3. The final section covers interviewees' attitudes toward the overall feasibility of CBDM in Missoula.

Perceptions of urban deer

Interviewees discussed their attitudes toward deer within Missoula and overwhelmingly, interviewees spoke positively of deer. Several of the interviewees focused specifically on the beauty of living near and with wildlife, expressed succinctly by one participant: "We live in Montana, this is one of the beautiful things about it. We're in the heart of the wilderness" (#4). When the interview progressed toward more specific questions about deer behavior and impacts within the city, some interviewees began to discuss frustration and concerns about the impacts of deer. These discussions focused on several aspects: 1) deer overgrazing and damaging private gardens and vegetation; 2) residents who illegally feed deer and attract them to residential areas; 3) injured deer without any clear services to help or euthanize them; and 4) mountain lion encroachment.

Deer's impact on vegetation emerged in 78% of interviews (N=14). This aspect was predominately expressed by members of Neighborhood Councils, one of whom noted "it becomes difficult as a homeowner, as a gardener, as somebody who wants to grow vegetables in it…I've had to adapt a lot and I still got plenty of frustrations because the threat grows" (#7).

Current FWP employees both reported hearing these concerns from Missoula residents; “I would say most of what I hear from are people that have concerns about too many deer eating their ornamental shrubs, their gardens” (#2) and “Some of it [early career with FWP] was mitigating issues with deer conflicts and gardens” (#15). There were occasional references to deer impacting conservation of native plants in the city, but this was only mentioned by FWP employees and City Council members. There were also multiple interviewees from various Neighborhood Councils that acknowledged some of the impact deer have on personal vegetation but were more accepting of it. One noted, “Even if they graze our shrubbery, even if they get in the yard and feed on the bird feeders or whatever, it’s not an issue for me. I just feel we’re here sharing this space” (#10).

Illegal feeding emerged in 44% (N=8) of interviews and occurred most frequently when interviewing Neighborhood Council members. Interviewees expressed negative attitudes toward illegal feeding because it is perceived that feeding the deer only exacerbates the issue of deer coming close to residential areas and increases the chances of predators coming into the city. For example, one member said “…we also had an incident where someone took it upon themselves one winter to bring in alfalfa to feed the deer…that cause[d] more accidents because then the deer[were] making a beeline to where the…alfalfa was dropped and they got hit by cars…” (#6). Another interviewee mentioned “…if you would stop feeding deer, you wouldn’t get the mountain lion that they don’t want to be that close to us” (#18). An employee with FWP also recognized the pervasiveness of illegal feeding, “and obviously we have illegal feeding going on. You know, people feed the deer, which is not a good thing, but it happens quite a bit” (#2).

Injuries to deer emerged in 44% (N=8) of interviews and was expressed as highly negative. This view was emphasized by Neighborhood Council members, one of whom reported

seeing a deer "dragging its hoof and the lower- it broke at the ankle…A few weeks later, I saw it walking on its foot, and the hoof was still attached by a tendon" (#11), while another recalled "that last year you did hear a fawn screaming from a dog attack. So that wasn't fun" (#16). These attitudes expressed by interviewees were closely tied to a sense of responsibility to treat the deer humanely and ethically; this sentiment of wildlife ethics emerged in 7 of the 8 (88%) interviews that also discussed injured deer. An example of this cross-over came from one Neighborhood Council member, "there has to be some way [to manage deer] instead of letting these deer drag around their legs all summer" (#6). It was common for interviewees to express frustration and concern regarding the City of Missoula's lack of clear management for injured deer. Several of the interviewees reported seeing the same injured deer for weeks with no knowledge or ability to help the deer or have it euthanized. Police officers from the Missoula Police Department primarily handle on-site euthanasia, but they and FWP will generally only respond to injured deer when "three limbs are damaged" (#6), according to one Neighborhood Council member. Still, anecdotal evidence from a city police officer stated, "the department probably fields a couple of calls a day about injured deer needing to be put down" (#17). In all, interviewees were mostly united when discussing injured deer, with the majority expressing dissatisfaction with the status quo of how injured deer are managed and emotional distress at witnessing injured and maimed deer.

Mountain lion encroachment was discussed in 56% (N=10) of interviews, including individuals from six of the seven stakeholder groups. The consensus was that mountain lions were entering city limits more frequently because of the high number of urban deer. This was summarized by an FWP employee:

> "when you've got a concentration of deer in an urban area it'll draw in predators, so we see, you know, in these areas we will see in the wintertime primarily, but not

> exclusively, increase[d] mountain lion activity and so with that comes concerns with human safety, comes concerns, you know, for people's pets" (#2).

Several Neighborhood Council members expressed safety concerns about mountain lions near and sometimes in the city, with one member recalling:

> "a friend of mine, someone who I worked with for a long time and who, together with her husband, lived on XXX, in their backyard a deer was killed by a mountain lion and [left there by the lion] and I have photos of that. I mean, that's right in the city" (#7).

Another Neighborhood Council member recounted a more recent event as well:

> "just this past week there was some mountain lion sightings up XXX. My daughter, who's eight, she walks from our house up a gully to her friend's house on XXX. So we stopped- put the kibosh on that for a while. Not saying that's the deer was the reason for that, but they have a kill up there" (#6).

The animal rights advocate expressed frustration at the concerns regarding mountain lions encroaching on city limits, saying:

> "we've had a couple- there's a mountain lion right now on the Rattlesnake neighborhood that people are like, oh my God, there's a mountain lion, kill it. And it's like, well, if you would stop feeding deer, you wouldn't get the mountain lion…they don't want to be that close to us, but they will follow their prey" (#18).

Overall, interviewees agreed that mountain lions have been and continue to be active on the outskirts of Missoula because of the concentration of urban deer. However, interviewees had varied perceptions of how severe of an issue this is. Only some Neighborhood Council members expressed pressing safety concerns regarding mountain lions, while the majority of interviewees merely reported that the predators do roam the outskirts of the city.

Component 1: Emergence of CBDM

The enabling conditions that feed into the emergence of CBDM were frequently discussed by interviewees and were mostly negative (i.e. constraining). However, these references focused on conditions and attributes described in Category 1 of the component, which focuses on attributes of the appropriator of the resource. Attributes of Category 2, attributes of the resource itself, did not emerge. Additionally, the way in which these conditions were discussed led to grouping these references into two distinct categories: *shared knowledge and shared vision* and *interpersonal relations and perceptions*. Of these categories, *shared knowledge and shared vision* was the most discussed condition, but this is relative; overall, all these two groups were heavily discussed in all interviews.

Shared knowledge and shared vision

Many interviewees focused on the lack of scientific data about urban deer in Missoula, which in turn impacted numerous interviewees' willingness to support new urban deer management techniques. The sentiment about this lack of knowledge about urban deer was discussed in 56% (N=10) of interviews. Specifically, Missoula stakeholders lack 1) data on deer population; 2) data on how to determine an appropriate population in the city. Regarding the first point, several interviewees pointed out that there is limited scientific data on the population of deer in Missoula. One Neighborhood Council member said:

> "I don't know if anybody even has a sense of how many deer we're talking about. How many deer are there here…when [people say] there's just an overabundance of deer, is it really an overabundance of deer? What's that based on?" (#10).

A City Council member agreed that obtaining this data is vital, saying:

> "one of the things is just trying to get a sense of the change in population both, both, you know, what's the population look like today, and to the extent that we can understand how it has changed over time, you know, what is that. Knowing that we're probably pretty limited and it's more anecdotal kind of going back" (#14).

Individuals from other stakeholder groups also pointed out the lack of scientific data about the deer population. An MFB&CC employee said, "I don't know what exists already in terms of population studies, but I want to make sure we had accurate populations studies" (#3). Similarly, an FWP employee said, "you need to know how many deer you have" (#2). This employee also highlighted the difficulty in even determining the population:

> "[a University of Montana class] were experimenting with some new methods, using trail cameras to [estimate urban deer population], and weren't sure that that would even be a reliable way to estimate urban deer population. So it- it's been used, you know, in wild situations, but urban deer, you know, live at different concentrations and have different patterns and stuff, so they didn't even know that that necessarily would be the right technique. So a barrier would be figuring out what is the best technique to even estimate the deer population" (#2).

Beyond a lack of data regarding the population of deer in Missoula, several interviewees also pointed out the lack of data and knowledge on how to determine the number of deer that should be in town. An employee at the Agricultural Center mentioned that the number of deer in town should be based on biological capacity, whereas an FWP employee and a City Council member both indicated it could instead be based on human tolerance. The FWP employee said, "there's no right answer for what's the right number here to have in town, so, it's figuring out what that it" (#2) and the City Council member said:

> "I don't think that we have a good understanding of the problem or problems or- and included in that sort of the human tolerance for wildlife, as a, um, I don't believe- I would be inclined to then- to not believe it is a static one size fits all for the entire city in all neighborhoods" (#14).

This lack of scientific data contributed to split perceptions among the interviewees of whether deer management was an issue and how it should be addressed. Many interviewees indicated a desire to change urban deer management in Missoula based upon their and their neighbors' anecdotal experiences. For example, an MFB&CC employee said, "I think that many people that I have talked to and myself included feel like urban deer management is an issue that needs to be addressed" (#1) and a Neighborhood Council member said, "there's other people that feel the same way as I do. They're frustrated with seeing these injured deer limping around" (#16). A City Council member mentioned that "deer are consistently a priority among constituents" (#14).

Conversely, many interviewees expressed that they did not view urban deer management as an issue that needs to be addressed. One Neighborhood Council member said, "I'm not convinced yet we're at the necessary phase [to start lethal management]" (#10) and another said, "I don't think our urban deer problem is as big as people try to make it out" and "I think there's a lot bigger problems and lot more problems that need to be addressed than urban deer" (#12). Another interviewee said that while their organization would likely be willing to participate in a collaborative process regarding urban deer management, they did not "personally see the need for a change" (#17). Other interviewees who were personally in favor of addressing urban deer management recognized that their beliefs were not widely held. For example, a Neighborhood Council member said, "there was skepticism [during a meeting] about whether this is really a problem" (#9). Another Neighborhood Council member recalled a community meeting in which neighbors expressed:

> "opinions that ranged from oh the poor babies are getting shot to kill them all, right? And everything in between…In fact, people sitting next door to one [another]- didn't see anybody come to blows- but there were opposite opinions in the same room, very close together" (#6).

An FWP employee also highlighted the difficulty when trying to address a potential problem when large groups of people do not have a shared vision:

> "So you have, you know, that's always been the challenge with this issue is that for every- everybody that hates them, you've got just as many people that love them, and so it makes it hard to strike the right balance with that for sure" (#2).

A City Council member pointed out the divisions between people that even shared concerns about deer, saying, "How do you deal with [lack of shared vision and split opinions]? Because even the people that are concerned with that, they all have different ideas on how to best deal with it" (#13).

The animal rights advocate offered a unique viewpoint of framing the issue with deer as a human problem that needs to be addressed:

> "humans may feel that deer are the problem, but humans are in fact the problem. So any solution is going to be based on human behavior, not mitigating deer damage by killing deer. That's never going to be the solution" (#18).

While this sentiment was shared by only one interviewee, it illuminates the complex perceptions of urban deer management.

Interpersonal perceptions and relationships

Interviewees focused overwhelmingly on their perceptions of other stakeholders' ability to lead or participate in some type of CBDM process, combining several attributes laid out in Component 1 of Mahajan et al.'s (2020) framework, including high trust and local leadership. Additionally, specific enabling conditions discussed in CBDM literature, like working-relationships (e.g. Decker et al., 2004; Raik et al., 2005a; Raik et al., 2005b), were categorized

into this umbrella attribute. These references are thus categorized beneath the broadly encompassing attribute, *interpersonal perceptions and relationships*. This better represents the results of these data, which was coded into three sub-attributes: 1) *leadership*; 2) *working relationships*; 3) *credibility*.

Leadership

Leadership was discussed at length by 89% (N=16) of interviewees. These discussions revolved around the interviewee's perceptions and attitudes toward potential leaders of a collaborative process to address urban deer management. Most of the discussions that centered on leadership were neutrally stated. Individuals from Neighborhoods Councils, FWP, MFB&CC, and an animal rights advocate agreed that the City Council had to provide leadership on this issue. For example, an MFB&CC employee said, "Maybe leadership from, you know, within the city government that can help bring everybody together for these discussions…" (#1); similarly, an animal rights advocate said, "the City Council is like the soul of our of our place" (#18). Interviewees emphasized that City Council had to be the key convener, driver, and leader of any type of urban deer management discussion. Interestingly, neither City Council member indicated that leadership on the issue had to originate with City Council; one councilmember repeatedly indicated that FWP should provide the key leadership role:

> "Well, I certainly think Fish, Wildlife, and Parks I think needs to be the top leader…with Fish, Wildlife, and Parks at the helm they can kind of be the quarterback with all those different other groups and get that information to the table and kind of get that going" (#13).

This sentiment was strongly rebutted by both FWP employees. One employee stated, "I would think it [leadership] would come from the city. You know, from the City Council…" (#2).

The other employee said, “the city is the jurisdiction of the city” and “this is a city issue. You guys [City Council] have to get organized and come up with a plan” (#15).

Several interviewees indicated specific individuals who they felt would be strong and effective leaders, either of the entire collaborative process or a singular stakeholder group. Two individuals that were repeatedly singled out were City Council President and FWP wildlife biologist. An employee with MFB&CC had previously worked with FWP on elk management on private land and identified the wildlife biologist as a potential leader “because I’ve worked with XXX on management of a public resource, a wildlife public resource” (#1). Another FWP employee also identified FWP’s wildlife biologist as a leader or representative in a collaborative process, “[key leaders to be involved are] your local FWP biologist, like XXX” (#15). The City Council President was also repeatedly mentioned, mostly by Neighborhood Council members. These members were often skeptical that City Council would do anything but did note that the President had shown a willingness to advance the urban deer question. One Neighborhood Council member said, “I’m not yet convinced that [City Council will act], but I am encouraged by XXX’s willingness to lead” (#7). Another highlighted the President’s initiative, saying:

> “[XXX] said that there was concern about the deer in the [neighborhoods] and that he wanted to put together a committee and maybe sort of explore some opportunities or questions or issues” (#9).

In addition to perceptions of which specific individuals could or should lead CBDM in Missoula, several interviewees commented more broadly on their perception of City Council providing formal leadership. These interviewees indicated that the controversial nature of urban deer management has prevented city government from acting. These references were closely related to perceptions that City Council had avoided leadership regarding deer management due to fear of political blowback. For example, a Neighborhood Council member said, “Do you

wanna get reelected? Do you think you're gonna be an advocate? [laughter] Yeah, ok, just see myself running on such a ticket: kill the deer, kill the deer" and:

> "I think City Council will never make a decision because they're scared of the public. And this is such a hot issue that they really don't want to get involved. They let XXX establish this just hoping that it will kind of blow away because they don't want to have to take his stand on it" (#6).

Another Neighborhood Council member echoed this sentiment, saying, "I think our government leaders are afraid of dealing with it" and:

> "I think unless our government leaders are willing to step up and help there's no point even talking about solving this. I know how the law is written. I know that if the city government is not willing to help take ownership of this, and at least even study it, that it will go nowhere" (#7).

This Neighborhood Council member also mentioned that "Fish, Wildlife, and Parks is understandably reluctant to get involved in something until they have confidence that our mayor and…city government are willing to hear the people on this" (#7). This hesitancy to trust that City Council can or will do anything was also touched upon by an FWP employee, who noted:

> "So far it's [city-led decision-making process] always gone to stage one, kick started to stage one. Basically, they've gotten a motorcycle started about 30 times, but then nobody ever hits the throttle and moves forward, mostly because it's a can of worms" (#15).

Overall, the negative references to leadership and political will were directed at City Council and city government broadly. Members of Neighborhood Councils most harshly viewed City Council and expressed a lack of faith or trust in the legislative body to lead effectively or willingly. One Neighborhood Council member sardonically mentioned:

> "I think if you could convince them they could get votes from being positively involved in this, they should get involved in a hurry. The older I get, the more I realize is that politicians are very interested in staying in office, more so than doing

anything really productive. So to me, if they find it to be a benefit to them, I think they would get involved" (#16).

Working relationships

A key attribute in CBDM literature (e.g. Decker et al., 2004; Raik et al., 2005a; Raik et al., 2005b) is the existence of working relationships between stakeholders. Discussions of working relationships emerged in 89% (N=16) of interviews and was placed subordinate to this attribute, as the interviewees framed these relationships as borne from personal experiences with other individuals and groups.

Many of the references made to working relationships were framed positively by interviewees. Most of these statements were aimed at FWP, with individuals from Neighborhood Councils and the MFB&CC all communicating positive past experiences with FWP and indicating willingness to work with the agency regarding urban deer management. An MFB&CC employee who had previously worked with FWP employees on elk management said, "My experience in working with Fish, Wildlife, and Parks is that they were very communitive" (#1) and a Neighborhood Council member reflected on FWP's responsiveness, "anytime we've had to call FWP [about deer] in this neighborhood, they always respond right away…when somebody [has] called them and said there's an injured deer, they show up" (#6).

In contrast to FWP, interviewees expressed a lack or weak working relationship with City Council or city government. One Neighborhood Council member said, "I've gotten the runaround from City Council about this urban deer census…it's frustrating working with City Council" (#6). Another, who had been working to secure grant funding to study deer in their neighborhood, felt that a city employee "was representing the mayor's interests…I think she was running interference [to derail study of deer] for the mayor" (#7). Overall, though, these views

were not widespread across interviews and most interviewees highlighted positive working relationships and experiences with FWP.

Credibility

Credibility, or the individual's perception of another's ability to engage or work together (Raik et al., 2005a.) emerged the least frequently of the three sub-attributes of personality. Credibility was discussed in only 28% (N=5) of interviews but encompassed members of five of the seven stakeholder groups. Most of the references to credibility focused again on FWP, with several interviewees expressing trust and belief that FWP was knowledgeable and the local expert in wildlife management. For example, an MFB&CC employee said:

> "I think the most important piece is that, we do need to implement some sort of urban deer management plan and working with partners who know what they're doing so Fish, Wildlife, and Parks…" (#1).

Similarly, a City Council member said, "I think that deferring to them [FWP] and their expertise, they know the head count…I think we have to defer to the experts, not the politicians" (#13). A police officer further noted: "I would say we have a state agency [that] was established with wildlife management at the state level and they seem to me to be highly capable and able to perform in that arena" (#17). This sentiment was also succinctly put by a Neighborhood Council member, "they have credibility. They have knowledgeable people" (#9).

Component 3: Diffusion of CBDM

Category 1: Characteristics of the innovation

When investigating the feasibility of a collaborative effort to diffuse from one community to another and emerge, attributes of the conservation innovation or technique must be analyzed.

These attributes are 1) *relative advantage*; *2) compatibility*; 3) *complexity*; 4) *flexibility*; 5) *observability*; 6) *trialability*. Together, these six attributes influence the technique being adopted by a community (Mahajan et al., 2020).

For this study, the techniques discussed with participants were the most commonly referenced urban deer management techniques in the literature. This includes two non-lethal techniques- trap and relocate, contraceptive/sterilization- and three lethal techniques- trap and kill, professional sharpshooters, public hunting. Interviewees viewed and discussed the trap and kill technique most positively compared to any other technique. Broadly, *relative advantage* of the techniques was the most referenced attribute of Component 1 and the *trialability* of the techniques the least referenced attribute. Below, results of each specific attribute are discussed.

Relative Advantage

Relative advantage, which is the expected net benefit of a new management technique compared to the status quo (Mahajan et al., 2020), was overwhelmingly the most discussed attribute (83%, N=15) of Component 1.

Interviewees questioned most often, and almost exclusively with a negative and skeptical attitude, toward the relative advantage of contraceptives. This negative sentiment was expressed by individuals from five (Neighborhood Councils; City Council; FWP; Missoula Police Department; MFB&CC) of the seven stakeholder groups. Interviewees questioned both the efficacy and the cost of contraceptives, with a Neighborhood Council member remarking "I have never heard of an example where it worked" (#9) and one FWP employee stressing "it's so expensive" (#15). This wildlife biologist expanded further, saying ""So many people are like, well, why don't we just give the deer birth control? And it's like, well, that's one of those

Disneyland sort of cartoon caricatures of what it's like to be a wildlife biologist, you know?" (#15)" and:

> "I mean, oh my God, you know, they'll have to hire a lot of city people going around and inoculating these deer with, you know, dart guns or they're going to have to be paying FWP a heck of a lot of money to hire college interns to do it. It's- it's so expensive, so time consuming that it's, in my opinion, unrealistic" (#15).

The relative advantage of trapping and killing was the second most discussed technique. One of the interviewees, a City Council member, questioned "…what's the efficacy? What's the cost?" (#14), though still expressed a willingness to consider the technique. The other two interviewees, one an FWP employee and the other an employee with the MFB&CC, both expressed much more positive sentiments toward the trapping and killing technique's relative advantage, with one employee saying, "I think it's been shown to work in Helena, which I know provides some evidence that it certainly could help here" (#2). Multiple interviewees also highlighted that trapping and killing could provide additional meat protein to the local food bank. For example, a City Council member said, "I think that Helena method where they trap and euthanize and then send the meat to the food bank is a great model, personally" (#13). A Neighborhood Council member, who was hesitant about any lethal management, also mentioned:

> "in terms of euthanizing or sharpshooting, if the meat could be taken to the process[or] and taken to food banks…then that would be more palatable, I guess. To know that the meat was at least being used to feed people who have food insecurity" (#5).

Interviewees discussed the relative advantage of trapping and relocating and almost exclusively with negative sentiments. An FWP employee outright called it "an impossible sort of thing to do" (#15) and a City Council member stated, "the trapping and relocating one…that would probably be the one I'd be the most skeptical about" (#14). Multiple Neighborhood

Council members also questioned if this technique would just cause problems for other communities, let alone even work in Missoula. One member said, "…does that [trapping and relocating] really solve the problem? Or have you just moved it to somebody else's neighborhood?" (#6). Another member posited that this technique does nothing to prevent future conflict with urban deer or fix the underlying cause of urban deer coming into the city:

> "Let's say that the city of Missoula decides that they have an urban deer problem, and they're going to trap these deer and they're gonna haul them 100 miles out of town. They're going to haul them up to Lincoln, Montana and turn them loose. And that's what that's, uh, thus alleviate the so-called urban deer problem here in the city. So now we don't have any or we have very few. In about four or five years, they've propagated, guess what? That's the same old deal because they're not giving... people will start planting flowers and shrubs and stuff that they really think they'll like and next thing you know, there's going to be a deer coming in and start eating them" (#12).

Further, a City Council member stated, "the trapping and relocating one…that would probably be the one I'd be the most skeptical about" (#14).

The relative advantage of public hunting had more nuance in perspective across interviewees than the other techniques. One Neighborhood Council member was supportive of public hunting within Missoula and noted, "I think it would be the least expensive" (#6), though this was a minority opinion across all interviews. A police officer, for example, said, "I don't think it would be feasible in city limits mostly because of the recovery rates with deer and bowhunters" (#15). Another Neighborhood Council member and an FWP employee were somewhat positive and supportive of public hunting but discussed it as a tool to use on the periphery of Missoula and not in the city itself. The FWP employee said that approach is "kind of the foundation of a lot of, you know, of our management practices" (#2) and the Neighborhood Council member said, "there are hillsides on the edge of town where hunting could be allowed" (#7).

Interviewees spent the least amount of time discussing the relative advantage of sharpshooters. A City Council member and an employee with MFB&CC both stressed that it would need to be cost efficient and effective. The councilmember remained neutral toward sharpshooting, "I think they're [public hunting and sharpshooting] certainly on the table. Again, I'm just going to keep reiterating cost and efficacy" (#14). The MFB&CC employee was much more positive toward sharpshooters but did note that "You're paying. You are paying professional…I don't think taxes are all bad, but I want to be efficient as a taxpayer also, right?" (#3).

Some interviewees also spoke of the relative advantage of any technique to lower the population of urban deer to prevent the spread of Chronic Wasting Disease (CWD). For example, a City Council member noted, "I, like I think most people in Montana, I've certainly watched it's spread if you will, and have had some conversations with state officials about that. So that's another thing that has heightened my interest in [urban deer management]" and "with chronic wasting disease, you know, we should be talking about this and figuring out, figuring out an approach [to urban deer management]" (#14). An FWP employee also brought up CWD when discussing ecological impacts of high densities of urban deer:

> "we're very aware of [and] concerned about the potential for CWD in this population, because it'd be very , you know, difficult. I mean, you can't get rid of CWD once you have it, right. And so, [it would] be an issue for sure. So that's one- that's definitely on our radar…we're looking for, we test symptomatic animals" (#2).

A Neighborhood Council member also asked, "I think eventually it [CWD] is going to find its way to our urban deer and do we…is it better to reduce the population before that happens?" (#6).

Overall, the relative advantage of the various techniques was the most salient attribute for the interviewees. While each technique's relative advantage was discussed, the interviewees focused most heavily on contraceptives and were almost overwhelmingly negative. Trapping and killing was the second most discussed technique and was much more positively discussed but was discussed in fewer interviews. Compared to these two techniques, the relative advantage of trapping and relocating, public hunting, and sharpshooters were much less discussed.

Compatibility

Compatibility refers to "the degree to which the practice is perceived as consistent with existing values, existing actions, past experiences, and needs of potential adopters" (Mahajan et al., 2020, p 9). The compatibility attribute emerged in 55% (N=10) of interviews and was generally related by interviewees to the practices' impact on public safety and ethical concerns.

Interviewees found sharpshooting methods incompatible, though one interviewee from the MFB&CC expressed that "It [sharpshooting] just feels better to me than the idea of luring deer and trapping them and then euthanizing them, but I don't know" (#3). Interviewees indicated that this technique was incompatible because of safety concerns, with one Neighborhood Council member mentioning that "It just that just seems like there's the potential for some sort of accident to occur" (#10). A police officer summed up their perception of the sharpshooting technique with:

> "…if you [a police officer] cannot walk up to that deer and shoot that deer from a matter of inches away, you have no business shooting that deer in the city…to maintain the fundamental tenants of firearm safety, the circumstances in the city have to be so rare or I guess so specific, that it's very difficult to engineer those consistently" (#17).

There was also a sentiment that Missoula residents would simply never support a sharpshooting technique, with one interviewee adding, "…optics of some, some professional sharpshooting wearing shooting glasses and camo, taking Bambi out who was eating your carrots was just bad optics for Missoula" (#3). This view was only mentioned minimally compared to concerns about public safety.

Like the sharpshooting technique, most interviewees negatively viewed the compatibility of public hunting, which stemmed from concerns to public safety and the perception that Missoula residents would find it incompatible with their values. Some Neighborhood Council members felt comfortable and were supportive of public hunts, but it was consistently viewed negatively by City Council members, FWP employees, and the police. One City Council member responded to the possibility of the public hunting technique with, "We cannot have people shooting guns…in any neighborhood in the city" (#13).

Interviewees generally viewed contraceptives as incompatible. An interviewee from the MFBCC expressed general discomfort at the idea of using contraceptives, saying "that feels, feels weird" (#3) and an FWP biologist said, "You're mucking around with Mother Nature instead of playing the music with your fingertips, you're getting down inside and causing trouble and wreaking havoc in an unnatural way. There may be unforeseen repercussions" (#15). A City Council member also expressed this concern, "I don't necessarily think that we should be going out sterilizing wild animals by any stretch" (#13). The animal rights advocate viewed contraceptives as the most acceptable and compatible technique, but their support was limited: "if I had to pick one [technique to adopt], it would probably be the sterilization or birth control" (#18). Similarly, a Neighborhood Council member said, "…I personally would prefer the birth control as opposed to shooting them" (#11).

Generally, interviewees associated trapping and killing deer as compatible for Missoula. The driving factors that drive this perception is the fact that a program based on trapping and killing deer was successfully developed and used in Helena, MT, that this technique can provide venison to the MFBCC, and that it was safer than other techniques. An MFB&CC employee noted, "I know that's what they do in Helena, it's seems safer and…maybe a little bit more foolproof for ensuring that- a clean kill" (#1). Similarly, the FWP employee said, "through the kind that- the trapping and euthanization program, they [police officers] can kind of do it more out of the sight of the public and safely and keep the numbers down there too" (#2). One Neighborhood Council member knew of the Helena management plan and said, "that seems probably the most reasonable way to deal with it" (#10) and an FWP employee specifically mentioned that "meat goes to the food bank so it's not wasted. You know, it goes back to the community" (#2). One Neighborhood Council member said that "…the Helena method…the bolt, the dispatching of the deer is pretty humane…I could see that" (#16), while the police officer noted that "From the mechanical standpoint of trapping and bolt-gunning deer, you're going to have fewer issues raised from the public from a safety perspective than you would with the sharpshooter model" (#17).

There were two interviewees who disagreed with the compatibility of trapping and killing. An animal rights advocate insisted that "for me, it's that's not putting the animals first. And, you know, we have to put them first. We've killed enough of them" (#18); similarly, one Neighborhood Council member viewed trapping deer was inhumane. These perceptions, however, were in the minority.

There were few references made to the compatibility of trapping and relocating. One Neighborhood Council member stated, "the issue of trapping and relocating I think in in many

settings the deer don't- don't get established. I mean, they oftentimes- it's not as humane as it sounds" (#7).

Complexity

The complexity attribute, or the degree to which adopters view the potential technique as difficult to use or understand (Mahajan et al., 2020), was referenced relatively infrequently in 44% (N=8) of the interviews. Contraceptives was viewed as the most complex technique especially for the logistics and understanding the efficacy. An FWP employee said that "logistically would be really challenging to- to try to do contraception kind of work on deer here" (#2) and an MFBCC employee questioned "Is it actually efficient? Is how do we know that we are sterilizing different deer and tracking that" (#3).

Two interviewees also indicated that trapping and killing was complex, though it was in reference to how to transport the deer carcasses and how to process the meat. One Neighborhood Council member noted that "the meat would have to be processed at a licensed facility, you can't just do it in your backyard" (#9). Overall, interviewees did not discuss complexity of techniques except when it came to contraceptives.

Flexibility

Flexibility, the technique's ability to be adapted to fit the needs and desires of the adopters (Mahajan et al., 2020), was also infrequently referenced (47%, N=7) and almost exclusively in relation to lethal techniques. Some interviewees expressed their support for lethal techniques hinged on the ability to modify or tightly regulate the technique. For example, one Neighborhood Council member said, "I'm not opposed to it [lethal management] completely, I

just want to see it applied judiciously and only when necessary" (#10). More commonly, interviewees highlighted that they would prefer to see some type of lethal technique locally deployed rather than city-wide. This sentiment was expressed by members of three Neighborhood Councils, "And there might be some sort of compromise if you're not having any problem with deer in your area, then we don't locate the culling in that area or something like that" (#7). Similarly, one City Council member expressed, "given the nature of the issue, it would be really wise to do something in a neighborhood or area that…was generally, you know, very strongly in support" (#14). Additionally, an FWP employee said:

> "I actually think that'll have to be done with an approach of, there's too many deer in the Rattlesnake Valley…maybe have someone and, you know, harvest the deer in a in a humane, smart, common sense type way and then deliver the meat to them" (#15).

Overall, however, flexibility was infrequently discussed by interviewees and, when mentioned, focused exclusively on lethal techniques.

Observability

The observability attribute is the degree to which the technique and its results are observable or communicable to others (Mahajan et al., 2020). Observability was discussed in 33% (N=6) of the interviews and half of the references focused on the technique's ability to be tracked and monitored. This sentiment was expressed exclusively by Neighborhood Council members, with one mentioning, "…my ideal is…getting the data, thinning the herd, and then figuring out if it worked" (#9). Some interviewees also hoped to learn from and model a potential Missoula method after other communities that had adopted various urban deer management techniques. One Neighborhood Council member stated, "I would…look at, um, the

communities that did choose the different options and how successful they were, whether it was successful in reducing the numbers as well as winning the support of the population" and "I don't know what the other communities did to move towards taking action, but if we could learn from the communities…" (#6).

There were two final references to the observability of techniques that focused on public perception. Specifically, there was a negative sentiment toward Missoula's citizens willingness to adopt a sharpshooting method because the optics of "some professional sharpshooter wearing shooting glasses and camo taking Bambi out who was eating your carrots" (#3) were bad. The positive sentiment was in reference to trapping and killing deer and ensuring the meat was donated to the local food bank, will the interviewee noting "That helps, I think, with a lot of public perception too" (#2). Overall, interviewees focused on the ability to track and monitor techniques after implementation.

Trialability

Trialability, the final attribute within Component 1, is defined as "the degree to which the practice may be experimented with on a limited basis" (Mahajan et al., 2020, p 9). This was the least referenced attribute within Component 1 with only two references from 11% (N=2) of interviews. A Neighborhood Council member posited:

> "if a person had a plan where you were to take out 10% of them... I'm- I think he would learn from that experience, how expensive it is to do that to take out the, the easiest 10% the 1st 10%. And then to see how the others behaved as a reaction to that" (#7).

This was not in reference to any specific management technique, however. Similarly, a City Council member thought of employing a pilot program:

> "I could certainly imagine a pilot program or two or more, matched to very specific locales within the city where we tried some things, and maybe it's trying, you know, a- one technique, a different technique, a combination of techniques" (#14).

There were no other mentions of a technique's trialability across any other interviews and this attribute was the least salient in this study.

Category 2: Adopter/Community

Category 2 focuses on attributes of the community that will or could adopt a new technique, practice, or innovation to collaboratively conserve a natural resource. The theoretical framework proposed by Mahajan et al. (2020) contains five attributes to Category 2, 1) *decision-making*; 2) *knowledge*; 3) *organizational innovativeness*; 4) *personality;* 5) *socio-economics*. Broadly, *decision-making* was the most discussed attribute among interviewees and *socio-economics* the least.

Decision-making and representation

Beneath Category 2, Mahajan et al. (2020) define decision-making as arrangements that "specify the rights of individuals or groups to make choices regarding other aspects of conservation intervention design and management" (p 10). This is very similar to the definition of the seventh principle of Component 2, which states "resource users can organize and make decisions that are respected" (Mahajan et al., 2020, p 7). This attribute was discussed at length in 89% (N=16) of interviews, during which interviewees articulated their views on a decision-making process regarding urban deer management. Broadly, individuals from all stakeholder groups agreed that any process should include public comment and input and be a collaborative approach that focuses on inclusive bottom-up decisions rather than managerial top-down

decisions. For example, numerous Neighborhood Council members said that some type of community input was necessary: “I think an open forum for people to have a chance to discuss” (#16); “public input is always a good thing to have, so you get buy-in to what decisions are made” (#5); “I just want it to be where our government leaders, together with the citizens agree and use science to solve it and adapt as the evidence grows” (#7). Several interviewees also stressed the importance of approaching any decision collaboratively; both City Council members stressed this, with one saying, “I think that these decisions have to be approved by the Neighborhood Council[s], the City Council, [FWP], the state government, county government…” (#13) and the other councilmember adding:

> “I guess what jumps to mind for me is a collaboration…it’s hard for me to envision something more sort of top down that simultaneously honors whatever the results are from the human dimensions element” (#14).

An FWP employee also supported a collaborative approach to decision-making, saying “you got to have a bunch of people at the table, they can sit down and work together…they compromise so that you can come up with a management solution” (#15).

However, despite there being broad consensus that a collaborative solution was the best way to approach decision-making, there were lingering questions and disagreements about how to reach a decision. Several interviewees said that they would accept whatever the majority of Missoula decides upon, but no interviewees had a clear vision of how to determine a majority decision. For example, one Neighborhood Council member spoke of a potential need to “put it up for vote” but then soon added, “Oh my God, I’m ending up with thinking that the whole city’s gotta vote on it. Oh Lord. Never mind” (#5). Another Neighborhood Council member also questioned if eventually relying on a city vote would work, asking, “if there’s a real problem here and have 20% of people vote on it, is that really true representation of the whole city?”, but

also mentioned "if it's good for the people, it's good for the citizens, and the majority of the citizens, then I'm all for it" (#12). Overall, interviewees seemed to think entering a collaborative decision-making process was good but were unsure how to make a final definitive decision.

While discussing decision-making, additional focus was spent on inclusivity and representation, which is specified in the framework from Mahajan et al. (2020) as the third principle of Component 2 (p 6). In this study, it emerged more as concept closely connected and related to decision-making. 94% (N=17) of interviewees spoke of who or which groups should be included in a collaborative decision-making process. References to inclusivity ran the gamut from "anyone that has an interest in deer in Missoula in the city limits" (#2) to naming just specific organizations. Broadly, FWP, City Council, and Neighborhood Councils were mentioned by each interviewee as key groups to include. Several interviewees highlighted including hunters and antihunters; the police officer mentioned people should "engage with…sportsmen's groups" (#17) and an FWP employee mentioned inviting "antihunter and hunter" (#15) groups to participate. Both MFB&CC employees indicated a desire to be directly involved, with one stating "Missoula Food Bank could benefit from [harvested] meat" and the other "anti-hunger groups [should be involved] …groups like the food bank" (#3). Numerous interviewees also mentioned that police officers would need to be included and the police officer interviewed agreed, saying:

> "I think we [Missoula Police Department] welcome a seat at the table…we do very much welcome the opportunity to sit down and engage with decision makers during that kind of initial process to determine what is our path forward, what are our likely outcomes, what are our what are unforeseen, the possible outcomes, because we do have unique and specific insight into a lot of these different areas that by nature, what we do is confined largely to us" (#17).

Only two interviews mentioned the inclusion of Indigenous people and groups in Missoula. One MFB&CC employee stressed the importance of including Indigenous stakeholders:

> "I think the last group that I would mention would be Indigenous populations, right? When you look at local native populations that have relied on deer and bison and so on. As part of their livelihood, you know, engaging those populations in these conversations, they- they are the original population management experts and, um, just making sure that they were at the table for these kind of conversations, I think would be really important" (#3).

The animal rights advocate also stressed the need to include Indigenous stakeholders, saying:

> "I would want Indigenous people [to participate]…all the different people who live in Missoula should be represented, but especially the Indigenous community, because they've always had a wisdom that we don't have about wildlife" (#18).

Lastly, the animal rights advocate was also the only interviewee to say that the deer are stakeholders in the conversation, "so who speaks for them is extremely important" (#18).

Knowledge

The knowledge attribute is "the degree to which the adopter is familiar with the innovation and innovation consequences" (Mahajan et al., 2020, p 9). Several interviewees referenced a lack of knowledge about the specific techniques and was closely related to the *complexity* attribute beneath Category 1. The majority of references to knowledge, however, focused on the lack of scientific data about urban deer in Missoula, which was more related to *shared knowledge and shared vision* in Component 1.

Organizational innovativeness

The organizational innovativeness attribute is "the degree to which the adopter is relatively open to adopting new ideas and practices compared to others in the social system" (Mahajan et al., 2020, p 9). This attribute emerged only in 28% (N=5) of interviews. Generally, FWP employees said that the agency was willing and able to work with Missoula to assist in formulating an urban deer management plan, with one of the FWP employees saying, "Yes, yes. And we've offered [to assist] several times" (#15).

Most of the references to organizational influence came from the interview with the police officer, who expressed hesitancy toward the idea of having police officers serve as the laborers tasked with killing deer. The police officer mentioned, "I don't find much about the mission of municipal police departments that dovetails well with trapping and euthanizing deer" (#17). More specifically, they said:

> "I think you have to be you have to think about the fact that we hire people because we believe they're going to be good police officers performing the vital job functions of a police officer. And so does that mean that [they] are good mental health case workers? Does it mean that [they are] social workers? Does it mean that they're good people to give advice about parenting? Does it mean that they're good wildlife managers? You see where I'm going with this? ... And I don't- I'm reluctant to take on or advocate for taking on more and disparate duties into an organization that's already working really hard to provide a high level of service, doing the basic functions expected of a municipal police organization" (#17).

Personality

The personality attribute, defined as "traits that influence an adopter's willingness to learn and implement new practices" (Mahajan et al., 2020, p 9), did not emerge in any of the interviews. Aspects of interpersonal relationships and perspectives were heavily discussed, but these discussions were far more related to Component 1 and the enabling conditions that

influence the emergence of CBDM. Aspects of intrapersonal characteristics that constitute this attribute were not referenced.

Socio-economics

Socio-economics, the "social-economic characteristics that influence adopter's ability to learn or implement a new practice" (Mahajan et al., 2020, p 9), did not emerge in any of the interviews.

Category 3: Context/enabling environment

Component 3 refers to the context or enabling environment in which the potential conservation practice, technique, or innovation is to occur within the adopting community (Mahajan et al., 2020). There are four attributes beneath Component 3: 1) *political conditions*; 2) *culture*; 3) *geographical settings*; 4) *global uniformity*. The most discussed attribute among interviewees was *political conditions* and the least discussed was *global uniformity*.

Political Conditions

Political conditions are the "character of political systems" and "the regulations and norms inherent in the legal systems that influence the potential adopters' behaviors" (Mahajan et al., 2020, p 10). This attribute emerged frequently across 78% (N=14) of interviews. References to political conditions mostly focused on the political will of elected officials. Multiple interviewees from five of the seven stakeholder groups touched on some aspect of political will impacting the adoption or pursuit of some form of CBDM. For example, several interviewees noted that a collaborative urban deer management plan would require time and money, which could be difficult to justify for Missoula's city government. A City Council member said:

> "we've got a whole set of competing priorities. And they compete to various degrees and extents and we're allocating resources to those, so it's not just cost efficacy, it's costs and it's costs relative- a dollar we spend on this is a dollar we don't spend on doing something else important for the community" (#14).

Similarly, the police officer acknowledged that "the city's got a lot of different problems" (#17) and an FWP employee noted, "…for a city that has so many issues, right? I mean [laughter], you're talking about people are managing the full breadth of everything, you know, within the city, and deer management is just one piece of that" (#2).

The final references to political conditions were focused on existing laws and regulations that could impact the adoption of certain lethal techniques. This was summed up by the police officer:

> "we [Montana] actually have a state law that prohibits the hunting of deer specifically inside city limits…for whatever reason, it specifically talks about deer. I don't know the origins of the law. So you have a legal hurdle to overcome with that" (#17).

Essentially, laws at the state level and regulations at the city level provide significant barriers to acceptance of lethal management predicated on public hunting or sharpshooters.

Culture

Culture, as defined by Mahajan et al. (2020), is "shared behaviors and ideas…that influences adoption of innovations" (p 10). This attribute was discussed in 67% (N=12) of interviews across six of the seven stakeholder groups. Most references focused on the diversity of opinions and political leanings within Missoula and how this amalgam could impact the adoption or palatability of certain techniques. For example, an MFB&CC employee noted that "there are lots of different people in Missoula from, you know, vegans all the way to people who

are heavy hunting families" (#1) and an FWP employee recalled some Missoula residents who "want [him] to come up and clean the deer shit off their lawn…they're quite, some of them are quite anal, very wealthy, for the most part, very conservative" (#15). Broadly, interviewees agreed with this assessment.

Stemming from this smorgasbord of social and political backgrounds yielding a complex cultural backdrop, multiple interviewees perceived that any type of urban deer management technique would spawn intense pushback from one group or another. For example, one Neighborhood Council member said:

> "I think whatever…is decided to do, you are going to have protestors out galore when they find out that somebody is going to be hunting in this area or they're going to put out something to drug the female deer" (#6).

While interviewees seemed to expect severe pushback from some segment of the population regardless of the technique pursued, there appeared to be a consensus that public hunting and sharpshooters would be the most culturally unacceptable for Missoulians. A Neighborhood Council member indicated this sentiment, saying, "I can't imagine that even a decent percentage of folks would wanna have people running right, even trained people, running around with a shotgun in the neighborhood" (#9), while an FWP employee said, "the whole concept of sharpshooters and baiting and stuff like that just won't fly" (#15). A City Council member also reiterated this stance, remarking that "discharging of any firearms in city limits, and or, say archery techniques or something, will be a fun conversation to have in the community, and I'd put fun in big air quotes" (#14).

Geographical settings

Geographical settings, the "physical features…as well as spatial proximities to other adopters…that affect adoption by influencing the applicability of the innovation" (Mahajan et al., 2020, p 10), emerged in several interviews. Most references to geographical settings related to Missoula's proximity to Helena, MT, which is the state capital and location of a well-publicized and successful urban deer management program based upon the trapping and killing technique. When Helena's method was mentioned by interviewees, it was generally referred to as a reason why trapping and killing could work in Missoula. For example, an FWP employee noted that "we've [FWP] had really good success with that program in Helena" (#2).

Additionally, an FWP employee also pointed out a key reason why so many deer congregate in Missoula:

> "The heavy winters, too, when we do have heavy, heavy snow, that's when Mother Nature's ancient memory kicks in. There are certain magic spots in these valleys where during these heavy snow years, for thousands and thousands and thousands and thousands and thousands of years, our elk and deer have gone to those sites because they're just perfect aspect to that kind of thing where it's a good place to go in a heavy winter. Sadly, that's where a lot of our subdivisions have occurred" (#15).

This employee also highlighted:

> "By placing these homesites, the subdivision on top of that sort of habitat and then with the heavily watering of lawns, manicured hedges, exotic vegetation that's lovely, gardens, you know, we've created an oasis in essence they have enhanced the wildlife habitat to a supreme urban habitat, human influenced habitat…" (#15).

Essentially, Missoula's expanding housing developments have displaced deer from their natural habitat to an artificial, but abundant, residential habitat leading to the growing calls for new urban deer management strategies among Neighborhood Councils within these areas.

Global uniformity

Global uniformity, defined as "diffusion is affected by the extent to which the adopter's context influences and is influenced by globally circulating ideas, norms, and practices related to the innovation" (Mahajan et al., 2020), did not emerge in any of the interviews.

Emergent themes

Two themes emerged from the interviews that were not included in the framework. First was an emergent urban deer management technique that some interviewees posited as the best solution. Second was an overall perception of CBDM and its feasibility in Missoula.

Emergent technique (education)

Several interviewees spoke of using educational programming or initiatives to mitigate deer impacts and human-deer conflict. Education as a management technique has not been discussed in the CBDM literature, but interviewees from multiple stakeholder groups framed it as a potential technique to try before resorting to a non-lethal or lethal technique. This position was most commonly expressed by individuals who did not personally see a need for a new urban deer management technique. For example, a Neighborhood Council member said, "I would say to me the best way to mitigate deer issues is to educate the public about deer issues and what you can do to mitigate them causing disturbances" (#10). This view of placing the responsibility on humans to change or modify their behavior in response to deer disturbances was also expressed by the police officer and the animal rights activist. The police officer said:

> "I do see the need for the public education to continue and probably intensify. Wildlife comes into town for a reason and very frequently is because we make an artificially beneficial environment for wildlife and then we frequently act as though

> wildlife are doing something wrong or unnatural or confusing, when in fact it's kind of the opposite, at least from my perspective" (#17).

Similarly, the animal rights advocate expressed frustration at other Missoulians framing urban deer as a deer problem and not a human problem, saying:

> "if anything, it's [human-deer conflict] gotten worse because we have more people and more out of staters moving. I mean, I didn't grow up here, but so I'm one of them, but out of staters moving in and not understanding the rules of wildlife and how we behave in wildlife zones" (#18).

The advocate also said, "if we put all this time money and thought and care into educating and helping humans be more willing or able to coexist, these problems would not exist" (#18). A Neighborhood Council member agreed with this sentiment, saying that people should recognize what kind of neighborhood they move into and adjust accordingly (#8).

Another Neighborhood Council member agreed that education should be used to curtail illegal feeding of deer:

> "I would like to expand a little bit on what XXX and XXX said about the conflict with neighbors who think it's ok to feed the urban wildlife and that's something I think education should take place in" (#6).

However, this same Neighborhood Council member indicated that education should be used not just to mitigate deer impacts but to galvanize city-wide support for urban deer management: "I think it would take a community education program for people who may think that the deer are not an issue" (#6).

Overall perception of CBDM and its feasibility

After discussing perceptions of urban deer and urban deer management techniques and aspects of each component, interviewees were asked if they thought some type of CBDM

process occurring in Missoula. Overall, interviewees spoke very positively of the potential for a CBDM process to work in Missoula. For example, an MFB&CC employee said, “I think it’s worth trying, because it seems like people want something” (#1). Both City Council members interviewed agreed, with one saying “I think it can, I hope it can. I’ll say that” (#13) and the other “Yea, I think, I think absolutely. Yeah. I’m an optimist” (#14). And FWP employee also expressed a strong positive sentiment, saying, “Yeah, I really do” (#15). A Neighborhood Council member said, “Yeah, I’m hopeful, yes” (#7) and the police officer said:

> “I think Missoula is capable of really many great things if you have a lot of people here who are highly motivated and highly engaged and willing to invest a lot of personal time and energy in things that they deem to be important. We can see examples of that all over the place. So I don't think that this would be different if they had that same core group of support of people who want to make it a priority and are willing to put the time in for sure” (#17).

Only one interviewee, a Neighborhood Council member, directly expressed a lack of belief that a CBDM process could work in Missoula:

> “No. Just I, there’s too many- I hate to say it out loud, but there I feel like there’s too many diverse interests. There’s too many very strong opinions on either side. There’s as many opinions as there are deer inside the city limits and just given, watching our City Council and seeing how things progressed and also in the process trying to build a park in our neighborhood and seeing how that has progressed or regressed, it doesn’t give me a ton of hope and- I’m sorry to ruin everyone’s Friday, but that’s my point” (#6).

Interestingly, while this interviewee was the only interviewee to state that they did not believe CBDM would work, their specific reasoning was commonly expressed by other interviewees when thinking of barriers that could inhibit a CBDM process in Missoula. Even interviewees that believed CBDM would work in Missoula admitted that this lack of shared vision and diverse groups would make it difficult for a CBDM process to succeed. For example, the police officer said, “I think we both know that regardless of what the strategy is proposed,

you're going to have significant pushback from one group or another. It doesn't matter which strategy, there will be detractors" (#17). A City Council member agreed, saying, "I think just the special interest groups not agreeing on it would be the fastest way to slow it down. There could be lawsuits thrown, there could be all kinds of different things" (#13).

A second commonly mentioned barrier to CBDM was the cost of the process. A City Council member highlighted this as a key barrier, saying:

> "funding in the face of competing demands. Funding challenges because…I mean, there's so many things going on at the state legislature about what cities can and can't do about the kind of funding that we receive" (#14).

A Neighborhood Council member also acknowledged this barrier:

> "it will take money because, you know, just communicating with people and holding meetings and providing data that's been vetted, you know, to present to people all that will take time and money to be able to put together a proposal and obviously the methods of whatever, the contraception or so forth, all of that's going to be costly, so. So definitely need to be some money involved as well as communication" (#5).

A final point about CBDM raised by an FWP employee was the impact an attention-grabbing event could have on the city, either as the impetus to galvanize widespread support for urban deer management or the catalyst for adamant opposition. For example, the employee said that a headline-grabbing incident like "someone dying because a deer ran its leg down the mouth and into the stomach when it leaped over the top of them [the person] and broke their neck" (#15) would drive people to want a change in Missoula's urban deer management approach. Conversely, an incident could also push Missoulians to fiercely oppose CBDM or new management techniques. For example:

> "some idiot shooting a deer on the edge of town and having the deer run [through town], dragging its guts and having it on TV, you know, going on the YouTube. That never helps to have these deer walking around town with a fucking arrow

sticking out of its skull between two eyes. Those kinds of things can really put a damper on everything" (#15).

Chapter 6: Discussion

The purpose of this research was to investigate 1) enabling and constraining conditions influencing the emergence of CBDM in Missoula, MT; 2) attributes influencing the adoption of CBDM and potential management techniques in Missoula, MT. The results of this study indicate there are two weak conditions and one strong condition from Component 1 that are influencing the emergence of CBDM in Missoula. Component 1's weak and constraining conditions are 1) lack of shared knowledge and shared vision and 2) poor political leadership; Component 1's strong and enabling condition is positive working relationships. The results further indicate that there are two strong positively influencing attributes and one negatively influencing attribute of Component 3 that are influencing the diffusion of CBDM in Missoula. The positively influencing attributes are 1) relative advantage and 2) decision-making and representation; the negatively influencing attribute is political conditions. Despite the varying levels of conditions for CBDM, there was an overwhelming interest and willingness amongst the interviewed stakeholders to engage in CBDM. The existence of these positive influences indicates that should the constraining conditions be addressed, CBDM could be an effective tool for Missoula to collaboratively manage its urban deer population. This study additionally shows that the framework provided by Mahajan et al. (2020) is an effective guiding framework to investigate complex CBDM contexts in a novel community and thus gauge the feasibility for CBDM to work for that community.

Component 1: Conditions for Emergence of CBDM

Two emergent categories for Component 1 were (1) *shared knowledge and shared vision* and (2) *interpersonal relations and perceptions*. These categories were heavily discussed by

interviewees. The first category, *shared knowledge and shared vision*, was overall discussed as a constraining condition to CBDM emergence in Missoula. The second category, *interpersonal relations and perceptions*, was quite nuanced. An attribute of this category, *leadership*, was negatively discussed to indicate it is another strong constraining condition. However, another attribute of this category, *working relationships*, was positively discussed, indicating it is an enabling condition to the emergence of CBDM in Missoula.

Shared knowledge and shared vision

Much research has shown the importance and necessity of shared knowledge amongst stakeholders entering a collaborative process to manage a natural resource (e.g. Gruber, 2010; Conley & Moote, 2003; McCool & Guthrie, 2001; Decker et al., 2004). Shared knowledge about the ecology and biology of deer is of particular importance to the success of CBDM; thus, the lack of scientific data shared among stakeholders can further complicate the process (Decker et al., 2004). In this study, many interviewees, especially those who did not agree that urban deer are a current or significant issue, highlighted that there is a lack of scientific data estimating how many deer are in Missoula and where they are concentrated. This data was referred to as essential by FWP biologists for the successful implementation of a new technique; several other interviewees perceived it as necessary to gain broad public support. For other interviewees, their full support for a new urban deer management technique, or their agreement that urban deer require different management, hinged on the existence and trust of scientific data about Missoula's urban deer population.

Resolving the first part of this constraining condition could involve a scientific study to estimate the urban deer population in Missoula, which was meant to occur in the winter of 2020

(Bragg, 2020). This study, which was cancelled because of the COVID-19 pandemic (personal communication, L. Bradley, 10/19/20), could help the city and FWP determine an appropriate and effective technique. There was widespread support among several interviewees, including City Council members, Neighborhood Council members, and FWP employees, to reorganize this scientific study in partnership with the University of Montana. While there are not yet any definitive plans to relaunch this study, it is promising that the stakeholders are eager to work together to better understand the issue. Positive working relationships between stakeholders has been noted as an important enabling condition for CBDM (e.g. Decker et al., 2004; Raik et al., 2005a; Lauber et al., 2004), so a cooperative process between stakeholders to gain and disseminate scientific data would be a highly beneficial process to rectify the lack of knowledge while also fostering working relationships and trust between one another (e.g. Coleman & Stern, 2018; Blumberg, 1999; Kellert et al., 2000). A collaborative approach between multiple stakeholder groups to gaining scientific data would not only help Missoula, but other communities interested in pursuing CBDM.

The second part of the lack of knowledge related to a belief among some interviewees that collecting scientific data about the urban deer population would galvanize public support and convince hesitant residents to adopt a CBDM technique. However, education and communicating scientific data is seldomly effective at generating a unified view among stakeholders or enacting behavior change in a group of people (Heberlein, 2012). This indicates that it may be unlikely, or potentially impossible, for a scientific study to estimate the urban deer population in Missoula to have any impact on the shared vision of stakeholders in Missoula. Instead, it may be helpful to instead collect data on other variables, such as the cost of current deer impacts (e.g. car collisions, vegetation damage) or a city-wide public survey. The first

option, which has been done in other communities (e.g. Conover, 1995; Rondeau & Conrad, 2003), may be more effective at swaying public opinion in Missoula, especially because interviewees were highly focused on the relative advantage (i.e. cost effectiveness) of new urban deer management techniques. The second option, which has also been used in other communities (e.g. Conover, 1995; Kuser, 1995; Kilpatrick & Walter, 1997), could help the city determine how salient urban deer management is to the broader community. For example, if a public survey indicated a strong lack of shared vision, which is included in this study's findings, it would indicate that Missoula is simply not ready to adopt CBDM. Later surveys may indicate a reversal of this lack of shared vision; repeated surveys were described in Kuser's (1995) article and influenced the community's decision to adopt a new urban deer management strategy.

Related to the lack of scientific data in this study was a distinct lack of shared vision among the interviewees for urban deer management. While shared vision is not an explicit attribute of Component 1 in Mahajan et al.'s (2020) framework, they do highlight it as an important condition to the emergence of CBNRM (p 4); the necessity for stakeholders to have a mutual goal or vision for the outcome of a collaborative process has additionally been extensively documented (e.g. Gruber, 2010; Conley & Moote, 2003; Schuett et al., 2001; Schusler et al., 2003; Porter, 1995). The difficulty in progressing through a CBDM process while lacking a shared vision is highlighted in CBDM-specific literature as well (e.g. Raik et al., 2005a; Decker et al., 2004). For example, one study analyzed CBDM in twelve communities across multiple states in the US and found that a lack of shared vision between stakeholders in one community inhibited effective collaboration (Raik et al., 2005a). A practitioners' guide that synthesized research and case studies of CBDM further articulated that if a community lacks a shared vision and disagrees that urban deer are a problem, then there is little that can be done to

move the community toward a resolution via CBDM (Decker et al., 2005). Thus, the lack of shared vision in this context makes it a constraining condition for CBDM in Missoula.

This constraining condition became evident when interviewees expressed differing viewpoints regarding the impact of urban deer in Missoula. While an overwhelming majority of interviewees expressed very strong positive attitudes toward deer in general, many interviewees expressed frustrations about deer's impacts on local and personal vegetation, traffic collisions, and emotional distress at seeing injured deer and called for new management in Missoula. Yet many other interviewees did not view the current impacts posed by urban deer as problematic or severe enough to warrant the introduction of a new management technique. Essentially, some of the interviewees agreed that urban deer were an issue that can and should be addressed via some type of CBDM process, while other interviewees argued that the deer do not pose significant issues and do not need to be managed any differently. An inability to have a shared vision or goal between stakeholders makes entering, let alone succeeding, in a collaborative process extremely difficult. The presence of this constraining condition further stresses the importance of conducting stakeholder assessments within communities prior to beginning any collaborative process to determine if a shared vision exists. Such assessments have been previously noted as useful tools prior to beginning a collaborative process (Decker et al., 2004).

Interpersonal relations and perceptions

Local leadership

Local leadership is listed in Component 1 of the framework guiding this research as an important enabling condition to CBNRM (Mahajan et al., 2020). While the individual who fills the leadership role can vary between communities (Raik et al., 2004; Decker et al., 2004),

political leadership in Missoula is necessary because of the city's jurisdiction and responsibility to pass an urban deer management plan. Additional research reinforces the importance of such positive political, or formal, leadership to a CBDM process (e.g. Decker et al., 2004; Raik et al., 2004). Political leadership can legitimization to the process (Raik et al., 2004) or "foster stakeholder trust and support" (Decker et al., 2004, p 14). The importance of trust in leaders within CBNRM or CBDM has also been extensively researched (e.g. Stern & Coleman, 2015; Decker et al., 2004; Gruber, 2010; Raik et al., 2005a; Metcalf et. al, 2015).

Interviewees for this study spoke at length about local leadership and particularly focused on the current state of political leadership. These discussions indicated that political leadership in Missoula is poor. Overall, interviewees, especially members of Neighborhood Councils, attributed the lack of local leadership on the issue of deer management to the perception that City Council members want to avoid making any decisions on a controversial issue, which could cost them votes or elections. Multiple interviewees expressed skepticism or outright distrust that the City Council could or would do anything about urban deer management because of the controversy surrounding it. For many, this attitude was reinforced by prior experiences with the City Council regarding urban deer, during which they felt unheard, ignored, or superficially placated. Altogether, there is a clear lack of political leadership in Missoula and is thus a constraining condition preventing CBDM from emerging in Missoula. The prevalence of this attribute in this study further confirms its importance to CBDM and the necessity to consider the role of formal leaders when analyzing other communities seeking CBDM.

Working relationships

CBDM literature has consistently noted the importance of working relationships enabling communities to engage in CBDM processes (e.g. e.g. Decker et al., 2004; Raik et al., 2005a; Raik et al., 2005b). Mahajan et al. (2020) additionally include a similar term, frequent interactions, as a requisite to Component 1's attribute *high trust*. In this study, interviewees spoke very highly of FWP and their prior interactions with the agency. Members of City Council, MFB&CC, and Neighborhood Councils commented on their positive previous interactions with FWP influencing their willingness and desire to work with and learn from FWP during a potential future CBDM process. The way interviewees framed their perception and attitude toward FWP indicate that there may be significant affinitive trust between the community and the agency. This dimension of trust is typically formed by prior shared experiences and relationships between groups and has been shown to be an important form of trust in CBNRM (Stern & Coleman, 2015). This bodes well for Missoula should CBDM begin in the city, especially because FWP will need to approve any urban deer management plan proposed by the city. Stakeholders trusting FWP, wanting to work with the agency, and wanting to listen to their advice and expertise on wildlife management is an enabling condition to CBDM in Missoula. Further, this indicates the need to assess and understand how stakeholders interact and work together when investigating CBDM in other communities.

Below, Table 5 lists the attributes of each category of Component 1 with information on each attributes' relevance to CBDM adoption in Missoula and other communities.

Category	Attribute	Relevance to Missoula and CBDM
Appropriator	High salience (high livelihood dependence)	Not relevant
	Common understanding of the resource system, and how actors affect each other and resources	Highly relevant

	Low discount rate that individuals attach to future resource flows	Not relevant
	High trust and reciprocity among users	Closely related in this study to leadership and working relationships (categorized under *interpersonal perceptions and relations*)
	High autonomy—ability to self-organize	Not relevant
	Prior organization experience and local leadership	Closely related in this study to high trust and working relationships (categorized under *interpersonal perceptions and relations*)
Resource	Feasible improvements	Not relevant. Unknown how influential this attribute is to CBDM emergence in other communities.
	Indicators for resource condition exist at a low cost	
	Predictability of resource dynamics	
	Spatial extent is sufficiently small for users to know boundaries and internal micro-environments	

Table 5: Factors that influence collective action and their relevance in Missoula

Component 3: Diffusion of CBDM and Different Management Techniques

Similar to Component 1, Component 3 had a mix of positively and negatively influencing attributes impacting the diffusion of CBDM in Missoula. The categories and subordinate attributes of Component 3 seek to understand the extent to which a community is willing or able to adopt a new conservation technique from another early adopter, as informed by diffusion of innovation theory. In this study, the attributes most heavily influencing the interviewees' willingness or ability to adopt a new urban deer management technique were relative advantage (Category 1), decision-making/representation (Category 2), and political conditions (Category 3).

Relative advantage (Category 1)

Relative advantage was the most referenced attribute of Category 1 (Innovation/CBNRM practices) and generally spoken of positively by interviewees. Most of these positive references focused on the trapping and killing technique. While it is far too premature for Missoulians to begin advocating for this technique, considering that the city is not yet ready to engage in CBDM, the fact that two attributes beneath Category 1 were so positively framed in relation to a specific technique that has been discussed in CBDM literature (e.g. Krausman, et al., 2014; Lauber et al., 2004; Messmer et al., 1997; Decker et al., 2004) implies Missoula could adopt the trap and kill technique in the future.

Mahajan et al. (2020) defined relative advantage as "the expected net benefits of adopting an innovation compared to status quo" (p 9). Interviewees discussed at length their concerns over the cost and efficacy of any potential urban deer management technique. This concern outweighed considerations about any technique's *compatibility*, *complexity*, *observability*, *trialability*, or *flexibility*. Essentially, the priority of most interviewees was that if CBDM emerged and proceeded in Missoula, a technique that is not exorbitantly expensive and is effective at managing the deer must be chosen and implemented.

With this guiding thought process, most of the interviewees perceived trapping and killing as the most advantageous. There were some that preferred non-lethal techniques, but these individuals were in the minority; most interviewees perceived both trapping and removal and contraceptives to be too expensive and too ineffective. Additionally, some interviewees preferred other lethal techniques, but these views were also not widely held. The relative advantage of trapping and killing emerged among the interviewees as the most positively viewed technique due to its perceived low costs and ability to address the perceived problem of too many

deer in the city. For some, this technique was additionally advantageous because it could provide venison to the MFB&CC. Relative advantage as discussed most by interviewees which bodes well for the prospects of any potential future CBDM in Missoula, as CBDM is used as a tool to change or adjust the management status quo (Decker et al., 2004). Overall, this study shows that relative advantage of a new technique is highly important in Missoula and will need to be considered when analyzing other communities interested in engaging in CBDM.

Decision-making and representation (Category 2)

Engaging stakeholders in the decision-making process of any collaborative and striving to include a diversity of stakeholder groups is critical to a CBNRM or CBDM initiative succeeding (e.g. Gruber, 2010; National Research Council, 2008; Blumberg, 1999; Decker et al., 2004; Conley & Moote, 2003; Smith & McDonough, 2001; McCool & Guthrie, 2001). Mahajan et al.'s (2020) framework includes decision-making and representation as part of the persistence of CBNRM. In this study, these attributes were instead framed as influences on the diffusion or adoption of CBDM in Missoula (Category 2, Adopter/Community). While CBDM does not yet exist in Missoula, the emphasis on this attribute highlights the importance for CBDM to succeed.

Interviewees talked extensively of the critical need for public input and participation in any CBDM initiative in Missoula. There was an overwhelming consensus among interviewees that urban deer management be approached collaboratively and focus on bottom-up community decisions rather than top-down managerial decisions. Exactly who should be included and participate in these collaborative meetings varied depending on the interviewee. While City Council, FWP, and Neighborhood Councils were consistently named as important stakeholder groups to include, some said anyone who has an interest in deer should be included. Meanwhile,

others suggested including other local organizations; a few interviewees strongly insisted Indigenous groups needed to participate; and one interviewee argued that the deer themselves needed to be represented.

The uncertainty about who should be included also extended about how exactly to reach any decision. An extensive body of literature has explored the necessity of shared decision-making and representation (e.g. Gruber, 2010; Blumberg, 1999; McCool & Guthrie, 2001; Kellert et al., 2000; Reed et al., 2009; Decker et al., 2004). Multiple interviewees stressed that any decision needed to have majority-support, but few articulated how to reach that decision. Some questioned if the matter should be put to a city-wide vote, but even those who suggested this tactic mentioned that reaching decisions this way could be problematic. Further, determining exactly who participates and how decisions are made may pose some problems in the development of a process for CBDM. This study further stresses the important influence of representation and inclusion in the decision-making process and how this may be particularly important for CBDM.

Political conditions (Category 3)

Political conditions was the most referenced attribute of Category 3 (Context/Enabling environment). This attribute reflects the consensus view that CBNRM and CBDM processes are most likely to emerge, spread, and succeed when the political conditions of the community are positive (e.g. McCool & Guthrie, 2001; Conley & Moote, 2003; Gruber, 2010; Mahajan et al., 2020). Aspects of political conditions include political will and existing regulations and laws, indicating that collaboratives are more likely to succeed when there is political backing and adherence to local law.

The adherence to local law aspect of political conditions was positive overall. In Montana, cities have jurisdiction to manage wildlife within city-limits provided FWP approves the management plan (Wildlife Removal in Cities Based upon Ordinance or Resolution, 2003). This allows the city to pursue CBDM should it decide to do so. For some specific techniques, this aspect was negative. The police officer and both City Council members indicated that there were city-wide restrictions on the use of firearms, which would complicate if not outright prevent the adoption of the sharpshooter or public hunting techniques. The negative influence of adherence to local law regarding the other techniques was not mentioned.

The political will aspect of political conditions was negative overall. This was partly related to political leadership of Component 1, but also influenced by competing priorities for the City Council. The police officer, a FWP biologist, and one City Council member each mentioned that the City Council must deal with every issue facing the city and to put money into one program or initiative is money taken away from another program or initiative. Currently, the data indicates that because there is a lack of scientific data to clearly define the problem (i.e. how many deer are there and is it above biological carrying capacity) and a lack of shared vision among residents, the City Council is reluctant to prioritize urban deer management above other pressing needs. This was exemplified by one of the City Council members who frequently clarified their need to carefully choose their words as they explained their perception of urban deer. At this time, the issue is controversial in Missoula and there is no unified idea shared among stakeholders about if there are too many deer and if they are a problem. This makes it challenging for the City Council to commit to addressing urban deer in the city, which indicates that political conditions in Missoula are negative. The fact that political conditions were so

complex and impactful in Missoula indicate that this is an important attribute to consider and analyze in other communities working toward CBDM.

Table 6, below, lists the attributes of each category of Component 3 with information on each attributes' relevance to CBDM adoption in Missoula and other communities.

Category	Attribute	Relevance to Missoula and CBDM in other communities
Innovation/CBNRM practices (Category 1)	Relative advantage	Highly relevant/influential to CBDM adoption in Missoula, in part because multiple techniques are available to discuss or implement. Likely to be highly relevant and influential in other communities that have not yet adopted CBDM and have multiple techniques to choose from.
	Compatibility	Somewhat relevant in Missoula, but in specific reference to certain techniques (i.e. contraceptives, sharpshooters). May influence adoption of CBDM in other communities if there are not multiple techniques available for adoption.
	Complexity	Not relevant/influential in Missoula. May influence adoption of CBDM in other communities if there are not multiple techniques available for adoption.
	Trialability	Not relevant/influential in Missoula. May influence adoption of CBDM in other communities if there are not multiple techniques available for adoption.
	Observability	Not relevant/influential in Missoula. May influence adoption of CBDM in other communities if there are not multiple techniques available for adoption.
	Flexibility	Not relevant/influential in Missoula. May influence adoption of CBDM in other communities if there are not multiple techniques available for adoption.
Adopter/Community (Category 2)	Social-economics	Not relevant/influential in Missoula. Unknown how influential this attribute is to CBDM adoption in other communities.
	Personality	Not relevant/influential in Missoula. Unknown how influential this attribute is to CBDM adoption in other communities.
	Knowledge	Strongly related to complexity attribute of Category 1. May influence adoption of CBDM in other communities if there are not multiple techniques available for adoption.
	Organizational innovativeness	Not relevant/influential in Missoula. Unknown how influential this attribute is to CBDM adoption in other communities.
	Decision-making	Highly relevant and influential in Missoula and strongly related to principles of Component 2 (governance theory). Likely to be highly relevant and influential in CBDM adoption in other communities.
Context/enabling environment	Geographical settings	Influential in Missoula because of the city's proximity to Helena. Indicates that proximity to other early adopters of

(Category 3)		CBDM and some techniques influences other community's willingness to adopt new practices.
	Culture	Not highly relevant/influential in Missoula. Unknown how influential this attribute is to CBDM adoption in other communities.
	Political conditions	Highly relevant and influential in Missoula. Likely to be highly relevant and influential in CBDM adoption in other communities.
	Global uniformity	Not relevant/influential in Missoula. Unknown how influential this attribute is to CBDM adoption in other communities.

Table 6- Relevance of characteristics of innovation, adapter, and context that influences adoption of CBNRM to CBDM in Missoula

High potential for CBDM

The final prominent enabling condition in Missoula, existing outside the Mahajan et al. (2020) framework, was an overwhelming view amongst interviewees that CBDM could work in Missoula and, by extension, a broad willingness to participate in it should it begin in the city. This emerged despite many interviewees acknowledging the difficulty in pursuing CBDM and the existence of some of the constraining conditions. This general attitude toward collaborative processes, such as CBDM, does not exist in the Mahajan et al. (2020) framework. This study, however, demonstrates how understanding interviewees' general attitude toward CBDM is important to fully understanding enabling conditions and the feasibility of CBDM in a novel community. In this context, the support for CBDM despite the constraining conditions bodes well for the community should those constraining conditions be improved; when that occurs, it is very likely that the city will be able to enter and succeed in CBDM. Gauging general perceptions of a collaborative process when analyzing enabling conditions to CBDM may be required in future research.

A guiding framework for CBDM

CBNRM is an inherently complex and time-consuming endeavor (e.g. Coglianese, 1999; National Research Council, 2008; McCloskey, 1996); yet is being increasingly pursued by communities across North America and the world (Conley & Moote, 2003; Nie, 2008; Reed, 2008; Gruber, 2010; Mahajan et al., 2020). It is thus extremely important to conduct some type of stakeholder or situation assessment to help gauge if the community is ready, willing, or able to enter a CBNRM process before beginning the process (Decker et al., 2004; McKinney, 2012; McKinney, 2015). This research has shown that the framework provided by Mahajan et al. (2020), which helps unify decades of previous research into a single guiding framework, is an effective tool when investigating the potential emergence and diffusion of CBDM, a specific type of CBNRM, and should therefore guide research and assessments of other communities hoping to employ CBDM. Despite this utility, however, the results of this study indicate that some attributes did not emerge as relevant in this context and may require further research to determine their applicability to CBDM.

Non-emergent attributes of Component 1

The non-emergence of *high salience* was expected, however, as it refers to the degree to which individuals rely upon the resource for their livelihoods (Mahajan et al., 2020); in communities seeking CBDM, this will almost never be the case unless reframed for hunting for subsistence purposes. *High autonomy* was non-relevant in this context because of current legislation in Montana that allows cities to draft management plans for game animals within city limits (Wildlife Removal in Cities Based upon Ordinance or Resolution, 2003). In other communities, this attribute may be more relevant, but further research is needed. *Low discount*

rate similarly did not emerge in this study, but this is believed to have been caused more by a lack of shared vision among the stakeholders. Interviewees spoke less of the cost-benefits of managing the deer and more of if the deer were even an issue that needed management. Perhaps if the community has a shared vision, *low discount rate* would emerge as a relevant attribute.

None of the four attributes of Category 2, characteristics and attributes of the resource itself, emerged in this study. One, *spatial extent*, was not expected to emerge because the geographic boundaries and confines for the management of the resource (i.e. deer) are well-understood. This may not be the case in other, more expansive communities aiming to implement CBDM, so further research is necessary to understand this attribute's relevance to CBDM. The other attributes, *feasible improvements*, *indicators for resource condition*, and *predictability of resource dynamics* appear to have not emerged due to the lack of shared vision and shared knowledge. For example, interviewees seemed to gloss over or not mention how likely it was to improve the resource, how to monitor its condition through management, and the resource's predictability because many believed the deer do not pose a problem at this time or they lacked the data to understand existing dynamics (e.g. deer population, movement, etc.); if there was a unified goal or shared knowledge among the stakeholders to manage the deer, there likely would have been greater discussion about how likely it is that management can improve the condition of the deer, or how to monitor the population and management impacts, or how the deer adapt to changes in management or environmental conditions.

Non-emergent attributes of Component 3

At least one attribute from each category either never emerged in the data or were referenced extremely infrequently. For Category 1, the *trialability* attribute was referenced just

twice across all interviews. This indicates that "the degree to which the practice may be experimented with on a limited basis" (Mahajan et al., 2020, p 9) was unimportant in this context, but this may have been influenced by the fact that Missoula has not yet begun a CBDM process. Additional research into communities in later stages of CBDM may be needed to determine the true applicability and utility of trialability as an attribute of Component 1.

Social-economics, an attribute of Category 2, did not emerge in the data. This attribute, which is the "social-economic characteristics that influence adopter's ability to learn or implement a new practice" (Mahajan et al., 2020, p 9), was clearly unimportant in this specific context. This may have been influenced by the stakeholders who were selected and participated in this study, as they generally were of the same socio-economic status. Future research into CBDM and CBNRM may better indicate the importance of this attribute if the community and stakeholders studied are more diverse. *Personality*, "traits that influence an adopter's willingness to learn and implement new practices" (Mahajan et al., 2020, p 9) similarly did not emerge in the data. It is possible that the questions asked did not adequately target aspects of intrapersonal characteristics, such as propensity for accepting risk; alternatively, it is possible that interviewees would have spoken more candidly about their specific reservations of adopting a new technique if there was a more generally accepted belief throughout the community that urban deer are an issue to be addressed. Future research will be needed to better understand this attribute's influence in the diffusion of CBDM.

Finally, the *global uniformity* attribute of Category 3, defined as "diffusion is affected by the extent to which the adopter's context influences and is influenced by globally circulating ideas, norms, and practices related to the innovation" (Mahajan et al., 2020, p 10), did not emerge in the data. Like the other two attributes, its absence from the data indicates that it was

unimportant and irrelevant to the Missoula context in this study. However, it is not clear if this irrelevance is inherent to the attribute, or if it only irrelevant to this specific context. For example, Montana has a low population density compared to other regions of the US (United States Census, 2019b); Missoula is therefore a unique urban area because of its relatively small population and proximity to rural areas and open wilderness. These two factors may have influenced global uniformity's irrelevance, as Missoula and Montana are isolated from other parts of the US, let alone the global community. Future research into CBDM or CBNRM in larger communities more intricately connected to broader and more distant areas may better reveal the importance and utility of global uniformity as an attribute of Component 3.

Chapter 7: Conclusion

This study found that despite several influencing attributes encouraging the diffusion of CBDM to Missoula, MT, its emergence is heavily hindered by several conditions. More broadly, this study found that the framework provided by Mahajan et al. (2020) is highly effective at investigating conditions and attributes that influence the emergence and diffusion of CBDM. The following recommendations can provide a pathway for supporting the key components for CBDM. Finally, limitations to this study, needs for future research, and practical and theoretical implications from this study are discussed.

Recommendations

Further data collection is necessary

Interviewees commonly spoke of scientific and credible data as necessary for their support of any type of urban deer management plan; others spoke of their belief that scientific data would foster shared vision in the city (e.g. scientific data of the deer population would convince others that deer were a problem). There thus appears to be a need to collect some type of data, but which data is collected may not have the desired results. For example, the city could work with the University of Montana and FWP to organize a population study of urban deer within city limits. Understanding the population, distribution, and movement of urban deer will inform sound management strategies and may convince some residents to support CBDM. However, population data alone may be insufficient in fostering shared vision among the community. A different type of data collection may be superior in fostering this shared vision, as some of the interviewees desired. An economic impact assessment, which could investigate the cost incurred by the city and residents because of deer impacts (i.e. car collisions, vegetation

damage, etc.), may be superior in generating shared vision. This type of data would likely be more effective because of the strong emphasis placed by the interviewees on the relative advantage of the various urban deer management techniques. The interviewees, especially the City Council members, were highly focused on implementing a potential technique that was as cheap as possible and effective. This may indicate that residents city-wide may be more willing to adopt CBDM and one of the techniques if data indicates that it is cheaper for the city to manage the deer rather than maintain the status quo.

In all likelihood, both types of data collection will be necessary. The population data is needed by FWP and the City Council to properly design and implement any type of urban deer management plan in the future. This data may sway the opinion of some residents, but it will be unlikely to be the final piece that enables the emergence of CBDM in Missoula. Rather, an economic impact assessment, which could quantify the cost of the status quo and compare it to the implementation of various techniques, would be far more effective in generating shared vision. These two types of studies, if pursued by the community, would work well to foster shared knowledge, generate shared vision, and improve political conditions.

Adopting a management model like Helena may garner the most support

All stakeholders commented on the five management techniques. Among these techniques, many interviewees favored trapping and killing deer as their first choice or as an acceptable alternative to their preferred technique. This positive sentiment toward this technique most prominently emerged in three attributes beneath Component 3: *relative advantage* and *compatibility* attributes of Category 1 and *geographic settings* of Category 3 (Mahajan et al., 2020). Broadly, there were three specific, recurring reasons that drove interviewees to positively

view trapping and killing. First, interviewees that were in favor of this technique noted that it seemed to be safer and more effective than the other techniques. Numerous interviewees were skeptical at the thought of sharpshooters or residents hunting deer through the city and were much more comfortable with controlled killings. Second, several interviewees viewed trapping and killing as a way to provide venison to MFB&CC. Interviewees who were hesitant about any type of lethal management expressed a willingness to support it if venison could be harvested and donated to food banks. Finally, several interviewees referenced Helena's success with a similar management plan as a reason to explore its implementation in Missoula.

The acceptability and success of this technique by Helena residents may influence the acceptability in Missoula and make it a potential option for the city; however, this study also notes the unique context and culture within Missoula. Having a general idea of which technique to use or may be most effective for the city could help propel a potential future CBDM process forward when stakeholders begin discussing management options. Specific details about how it would work would likely differ from Helena's plan. For example, police officers in Helena provide the labor for trapping and killing the deer but based on the interview with the police officer, this may not be acceptable or appropriate in Missoula. Additionally, Missoula may choose to implement this strategy only in very localized areas of the city to target denser populations of deer rather than adopt the technique city-wide; a more localized approach may be more palatable for residents who do not agree urban deer are an issue but are willing to accept lethal management in neighborhoods where deer are more abundant. would be decided during the process and would need to be adapted to the context and community. No single plan will ever perfectly translate from one community to another; rather, aspects of a plan from one community

can be taken and adopted by another and then molded to fit the specific needs and desires of the new community.

Dissemination of data is critical

Beneath Component 3, the *knowledge* and *complexity* attributes of Category 2 and Category 1, respectively, were tightly linked. Essentially, techniques that were deemed complex by participants, specifically contraceptives, were referred as difficult to use, understand, learn, or gauge efficacy. Most interviewees indicated that they had no real way of understanding the utility of contraceptives unless they had had prior experience in the technique's use in another setting. FWP biologists were the only interviewees who had a true grasp of the technique's use. This implies that the agency may need to be more proactive in disseminating and communicating data to residents and laypeople whenever a CBDM process begins in the city to ensure that all participants fully understand the pros and cons of any management technique. Ensuring shared knowledge amongst all stakeholders and participants in the process is critical to the success of any collaborative and it is incumbent upon larger, more powerful organizations such as FWP and City Council to pass along data necessary for decision-making.

Diagnosing collaboration

The recommendations above were determined because of the effectiveness of applying the Mahajan et al. (2020) framework to the Missoula context. Some interviewees and residents have highlighted their desire for some form of CBDM in Missoula (see Results; Szpaller, 2014), but this in-depth study of enabling and constraining conditions influencing the emergence of CBDM indicate that the community is not at the stage necessary for CBDM to emerge and

succeed. This knowledge is helpful in preventing the City Council and other stakeholder groups from embarking on a long, complex, and costly collaborative process that is built upon a shaky foundation (e.g. lack of shared knowledge and vision, poor political conditions). Therefore, applying the components of this framework to other communities interested in engaging in CBDM or a broader CBNRM process would help in clarifying the capacity for the community to succeed in the process.

In communities such as Missoula, where some residents have indicated some type of natural resource management issue, applying Component 1 to a stakeholder assessment would allow the community to understand the current state of factors that influence the emergence and success of collaboration; knowing this prior to initiating such a process would save time, effort, money, and relationships that would be burdened, lost, or strained by a poorly supported initiative. Similarly, Component 3 when applied to a stakeholder assessment illuminates the attributes influencing a novel community's adoption of a new technique or conservation practice. This approach will be especially applicable to communities that, like Missoula, are geographically proximate to other early adopters of the potential technique or practice. Information gleaned from a stakeholder assessment informed by Component 3 could serve to assist the community in quickly finding a specific technique or practice, potentially speeding along the collaborative process, and assisting in scaling conservation practices across scales and communities, thereby furthering the pursuit of global conservation.

However, an additional attribute that will need to be considered when diagnosing collaboration regarding wildlife management in other communities will be overall values and ethics toward the wildlife species. Personal ethics and values of urban deer was commonly discussed by the interviewees in this study and influenced some interviewees' willingness to

adopt certain techniques (e.g. an interviewee was unwilling to support trap and kill because lethal management violated their personal ethics and values). Understanding the wildlife ethics and values of both individuals within a community and the community at large is important when managing wildlife is the goal, as these beliefs influence individuals' and a community's response to any wildlife management decision (Leong et al., 2006). Emphasis on assessing and understanding these ethics and values, which in part formulate human dimensions of wildlife management (Leong et al., 2006; Warren, 2011), is found in urban deer management literature (e.g. Raik et al., 2005a; Leong & Decker, 2005; Raik et al., 2004; Decker et al., 2004) and broader wildlife management literature (e.g. Manfredo et al., 2019; Dickman, 2010; Purdy & Decker, 1989; Manfredo, 1989). Thus, when applying this framework to investigations and analyses of wildlife management within a community, future researchers and practitioners will need to acknowledge and focus on the existence and impact of wildlife ethics and values.

Limitations

There were some limitations to this research. First, it would have been beneficial to speak to more individuals from some stakeholder groups, such as animal rights advocates and the Agricultural Center. However, the researcher was unable to find and schedule willing individuals for interviews aside from the ones that did participate. Second, two interviewees pointed out that Indigenous groups should be a stakeholder group, but the researcher was similarly unable to find and schedule interviews for willing individuals that would fit into this stakeholder group. Third, the presence of the COVID-19 pandemic prevented in-person data collection, forcing the researcher to rely upon phone and video calls for data collection. This may have impacted data collection, as some potential interviewees could not or did not want to participate remotely.

Fourth, Missoula is a unique area, the borders of which directly buttress wild and open spaces. Cities of similar geographic character are generally less common in the US, especially on the East Coast where urban areas are more highly developed and are often closely surrounded by suburban areas. These characteristics may make it difficult to generalize this study's findings to all other communities seeking to institute CBDM. Finally, the participants in this study were generally of the same socio-economic class (e.g. upper-management professionals, prominent city politicians, or retirees). This fact may have masked the true importance of the attribute *socio-economics*.

Future research

This study shows that this framework is an effective tool to assist in the investigation and diagnosis of conditions that influence the emergence and diffusion of CBDM to determine the feasibility of CBDM in a novel community. Future research should include similar studies in other communities in the US to confirm the applicability of this framework to CBDM research. Additionally, these future studies are also needed to determine the relevance of the attributes of Component 1 and Component 3 that did not emerge in the data of this study. Aside from applying this framework to just CBDM contexts, it will also need to be further applied to broader CBNRM contexts to understand both the framework's utility as a conservation social science tool and to understand which attributes emerge as most salient depending upon the specific resource to be collaboratively managed.

Implications

Practical

The context of CBDM in Missoula is complex and intricate. Still, this study provides some practical implications for the community by diagnosing the extent to which Missoula is ready to adopt a new urban deer management technique and subsequently facilitate the emergence of CBDM in the city. Based on the results, CBDM is feasible in Missoula; some techniques, specifically trap and kill, have diffused to Missoula from Helena and are influencing several interviewees and stakeholders to want to adopt the practice. However, while the diffusion of the technique has begun, CBDM is not yet quite ready to emerge in Missoula because of the existence of some constraining conditions. It is possible to address these constraints, which would increase the likelihood that CBDM would emerge in Missoula. Whether such a process results in a trap and kill management plan or something else entirely will be determined in the future. But a hopeful path forward does exist for the community to contend with a question that has caused much stress and frustration to numerous residents.

Theoretical

The complexity of Missoula's situation would have been difficult to unravel, analyze, and diagnose without the guidance provided by the framework from Mahajan et al. (2020). Using this framework to guide this study has some theoretical implications. First, the three components of this framework were noted as being tightly "interconnected and often nested within each another" (Mahajan et al., 2020, p 8). This study confirms this. Principles of Component 2, specifically representation, emerged more aligned with attributes of Component 3 than as a distinct principle. This occurred even though CBDM has not yet emerged in the city. Attributes

of Component 3, grouped into different categories, were tightly intertwined as interviewees referenced *knowledge* and *complexity* often simultaneously. Researchers that use this framework to guide future research will likely discover a similar nested nature of these components; this does not imply weakness or insufficiency of the framework but rather reinforces the inherent complexity of collaborative natural resource management.

Second, applying these components to communities can diagnose CBNRM or CBDM initiatives. For example, conducting a stakeholder assessment informed by Component 1 can diagnose if a community is ready to engage in a collaborative process. Understanding attributes that enable CBNRM's emergence and their current state in a community would allow that community to make a sound decision; if there are too many constraining conditions, the community can avoid pushing forward and force the emergence of CBNRM, which would almost certainly fail. Similarly, applying Component 3 to a stakeholder assessment can help determine the extent to which a community is willing to adopt a new conservation practice or technique. Knowing these influencing attributes would potentially allow the community to more quickly and seamlessly adopt a new technique that suits their community-specific needs. Lastly, analyzing an existing CBNRM process in a community via Component 2 would allow the diagnosis of the strength and potential persistence of the process. If certain principles of governance theory are found to be weak in this examination, the community could respond accordingly to maximize the likelihood that CBNRM persists over time.

Finally, the social theory behind Component 3 of the framework, diffusion of innovation, has seldomly been studied or applied to conservation social science. This study is among the early investigations into this theory's utility in understanding and analyzing CBDM and, per the results, appears highly effective. Other researchers have recently applied this theory to broader

CBNRM (e.g. Mango et al., 2017; Mascia & Mills, 2018; Harper et al., 2018; Eanes et al., 2019), but it is a new frontier for the conservation social science field. This theory represents a new lens through which researchers can study CBDM and CBNRM processes and continue to drive forward the ever-growing body of conservation social science knowledge. Given that conservation issues will continue to arise in increasing severity and frequency due to rapid social-ecological change, new tools to understand how and why collaborative processes within a community can be adopted will be instrumental in the future.

Chapter 8: Appendix

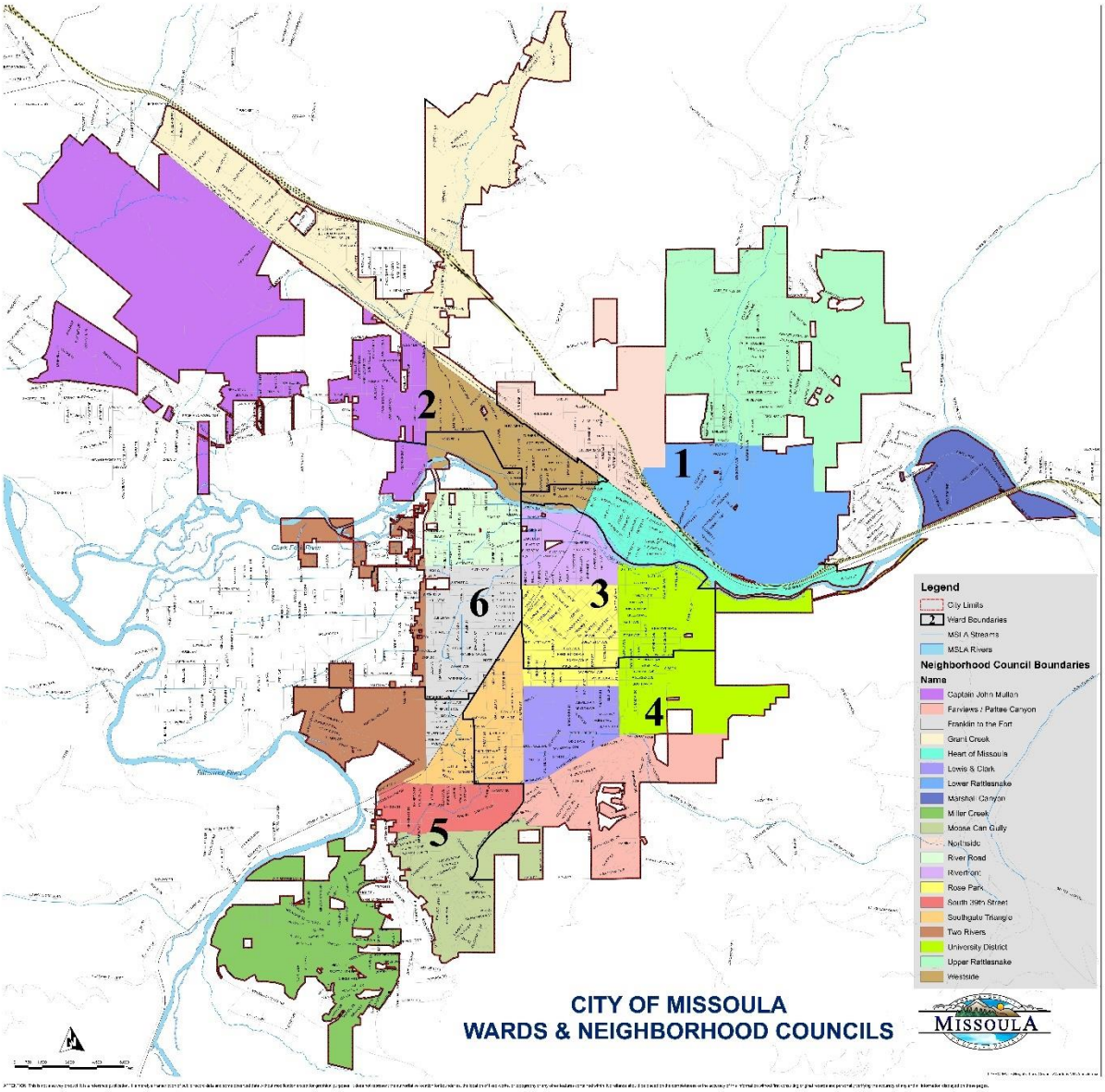

Figure 1: Map of Missoula wards & neighborhood councils. Source: http://www.ci.missoula.mt.us/287/University-District.

Figure 2: Neighborhood Councils' priorities. Urban deer and urban wildlife priorities are highlighted in the light purple boxes. Retrieved from http://ci.missoula.mt.us/298/Neighborhoods.

Chapter 9: Literature Cited

Abdullah, K., Said, A. M., & Omar, D. (2014). Community-based Conservation in Managing Mangrove Rehabilitation in Perak and Selangor. *Procedia - Social and Behavioral Sciences*, *153*, 121–131.

Armitage, D. (2005). Adaptive capacity and community-based natural resource management. *Environmental Management*, *35*(6), 703–715.

Babbie, E. (2012). *The Practice of Social Research.* Belmont, CA: Wadsworth Publishing.

Blumberg, L. (1999). Preserving the public trust. Forum Appl. Res. Public Policy 14(2):89–93.

Bragg, D. (2020, Feb. 19). *Missoula to count urban deer*. KPAX. https://www.kpax.com/news/local-news/missoula-county/missoula-to-count-urban-deer

Brody, S. D. (2003). Measuring the Effects of Stakeholder Ecosystem Management. *Journal of Planning Education and Research*, *22*, 407–419.

Byron, E. (2014, May 17). Helena gets approval to cull 70 deer in 2014. *Missoulian*. https://missoulian.com/news/state-and-regional/helena-gets-approval-to-cull-70-deer-in-2014/article_592085d6-6436-11e3-8472-0019bb2963f4.html

City of Missoula. (1997, January 1). *City of Missoula Charter*. http://www.ci.missoula.mt.us/DocumentCenter/View/21525/Missoulas-City-Charter?bidId=

City of Missoula. (n.d.). *Wards & Neighborhood Councils* [map of Missoula wards and NCs]. Retrieved October 14, 2020, from http://www.ci.missoula.mt.us/287/University-District

City of Missoula. (n.d.). *City-wide Neighborhood Priorities* [chart of priorities]. Retrieved October 14, 2020, from http://ci.missoula.mt.us/298/Neighborhoods

Cleveland Metroparks. (n.d.). *Deer Management*. https://www.clevelandmetroparks.com/about/conservation/natural-resources/current-issues/deer-management

Coglianese, C. (1999). The Limits of Consensus: The Environmental Protection System in Transition: Toward a More Desirable Future. *Environment*, *41*(3), 28–33.

Coleman, K., & Stern, M. J. (2018). Boundary spanners as trust ambassadors in collaborative natural resource management. *Journal of Environmental Planning and Management*, *61*(2), 291–308.

Conley, A., & Moote, M. A. (2003). Evaluating collaborative natural resource management. *Society and Natural Resources*, *16*(5), 371–386.

Conover, M. (1995). What is the urban deer problem and where did it come from?. In J.B. McAninch (Ed.), *Urban deer: A Manageable Resource?* (pp. 11-18). Proc. of the 1993 Symposium of the North Central Section, The Wildlife Society.

Creswell, J. W. (2009). *Research Design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage Publications Inc.

Davenport, M. A., Leahy, J. E., Anderson, D. H., & Jakes, P. J. (2007). Building trust in natural resource management within local communities: A case study of the Midewin National Tallgrass Prairie. *Environmental Management*, *39*(3), 353–368.

Deblinger, R.D., Rimmer, D.W., Vaske, J.J., & Vecellio, G. (1995). Efficiency of controlled, limited hunting at the Crane Reservation, Ipswich, Massachusetts. In J.B. McAninch (Ed.), *Urban deer: A Manageable Resource?* (pp. 82-86). Proc. of the 1993 Symposium of the North Central Section, The Wildlife Society.

Decker, D. J., Raik, D. B., & Siemer, W. F. (2004). Community-based deer management. *Northeast Wildlife Damage Management Research and Outreach Cooperative, Ithaca, NY*. Retrieved from http://northeastdeermanagement.com/files/DeerGuide_1_.pdf

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. https://doi.org/10.1111/j.1469-1795.2010.00368.x

Eanes, F.R., Singh, A.S., Bulla, B.R., Ranjan, P., Fales, M., Wickerham, B., Doran, P.J., Prokopy, L.S. (2019). Crop advisers as conservation intermediaries: Perceptions and policy implications for relying on nontraditional partners to increase U.S. farmers' adoption of soil and water conservation practices. *Land Use Policy*, 81, 360-370. https://doi.org/10.1016/j.landusepol.2018.10.054

Eve, H.J. & Kellogg, F.E. (1977). Management implications of abomasal parasites in southeastern white-tailed deer. The Journal of Wildlife Management, Apr., 1977, Vol. 41, No. 2 (Apr., 1977), pp. 169-177.

Fabricius, C., & Collins, S. (2007). Community-based natural resource management: Governing the commons. *Water Policy*, *9*(SUPPL. 2), 83–97.

Friesen, P. (2017, September 8). Missoula City Council sets sights on urban deer. *Missoulian*. https://missoulian.com/news/local/missoula-city-council-sets-sights-on-urban-deer/article_5dcba46f-db36-5248-b8c4-f61d2b2a0fb9.html

Goguen, A. D., Riley, S. J., Organ, J. F., & Rudolph, B. A. (2018). Wild-Harvested Venison Yields and Sharing by Michigan Deer Hunters. *Human Dimensions of Wildlife*, *23*(3), 197–212.

Gramatina I, Rakcejeva T, Silina L, & Jemeljanovs A. (2011). Comparison of Venison and Beef Chemical Composition. *Meat Science and Technology*, (August), 7–12.

Gray, B. (1985). Conditions facilitating interorganizational collaboration. *Human Relations*, Vol. 38, No. 10, 911-936.

Gruber, J. S. (2010). Key principles of community-based natural resource management: A synthesis and interpretation of identified effective approaches for managing the commons. *Environmental Management*, *45*(1), 52–66.

Harper, J.K., Roth, G.W., Garalejić, B., Škrbić, N. (2018). Programs to promote adoption of conservation tillage: A Serbian case study. *Land Use Policy*, 78, 295-302. https://doi.org/10.1016/j.landusepol.2018.06.028

Heberlein, T. (2012). *Navigating Environmental Attitudes*. Oxford University Press.

Kellert, S. R., Mehta, J. N., Ebbin, S. A., & Lichtenfeld, L. L. (2000). Community natural resource management: Promise, rhetoric, and reality. *Society and Natural Resources*, *13*(8), 705–715.

Kilpatrick, H.J. & Walter, W.D. (1997). Wildlife Society Bulletin (1973-2006), Summer, 1997, Vol. 25, No. 2, Deer Overabundance (Summer, 1997), pp. 388-391.

Klein, D. (1981). The problems of overpopulation of deer in North America. In P.A. Jewell & S. Holt (Eds.), *Problems in management of locally abundant wild mammals* (pp. 119-127). Academic Press.

Krausman, P. R., Christensen, S. A., McDonald, J. E., & Leopold, B. D. (2014). Dynamics and social issues of overpopulated deer ranges in the United States: A long term assessment. *California Fish and Game*, *100*(3), 436–450.

Kuglin, T. (2020, May 31). Helena receives approval for deer cull but no funding for second year. *Helena Independent Record*. https://helenair.com/outdoors/helena-receives-approval-for-deer-cull-but-no-funding-for-second-year/article_3f9a2e52-6d79-56ef-a8cf-5a9b5013427c.html

Kuser, J. (1995). Deer and people in Princeton, New Jersey, 1971-1993. In J.B. McAninch (Ed.), *Urban deer: A Manageable Resource?* (pp. 47-50). Proc. of the 1993 Symposium of the North Central Section, The Wildlife Society.

Lauber, T. B. (2010). Community-Based Deer Management: Learning and Community Capacity. *HDRU Series*, (10).

Lauber, T. B., Brown, T. L., & Gore, M. L. (2004). Learning by Doing: Deer Management in Urban and Suburban Communities. *HDRU Series No 04-2*, (2), 47.

Lauer, F. I., Metcalf, A. L., Metcalf, E. C., & Mohr, J. J. (2018). Public Engagement in Social-Ecological Systems Management: An Application of Social Justice Theory. *Society and Natural Resources*, *31*(1), 4–20.

Lee, M. E., & Miller, R. (2003). Managing elk in the wildland-urban interface: Attitudes of Flagstaff, Arizona residents. *Wildlife Society Bulletin*, *31*(1), 185–191.

Leopold A., Sowls L.K., & Spencer D.L. (1947). A survey of over-populated deer ranges in the United States. *The Journal of Wildlife Management*, *11*(2), 162–177.

Leong, K.M. & Decker, D. (2005). White-tailed Deer Issues in NPS units: Insights from Natural Resource Managers in. *HDRU Series*, *05*. http://www.dnr.cornell.edu/hdru/PUBS/Hdrupubs.htm

Leong, K. M., Decker, D. J., & Wild, M. A. (2006). Examining the Role of Community Participation in Biological Resource Management: Human Dimensions of Deer Issues in Northeastern National Park Service. *People, Places, and Parks: Proceedings of the 2005 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites, November*, 108–114. http://www.georgewright.org/0517leong.pdf

Levesque, V. R., Calhoun, A. J. K., Bell, K. P., & Johnson, T. R. (2017). Turning Contention

into Collaboration: Engaging Power, Trust, and Learning in Collaborative Networks. Society and Natural Resources, 30(2), 245–260.

Mahajan, S. L., Jagadish, A., Glew, L., Ahmadia, A., Becker, H., Fidler, R. Y., Jeha, L., Mills, M., Cox, C., DeMello, N., Harborne, A. R., Masuda, Y. J., McKinnon, M. C., Painter, M., Wilkie, D., & Mascia, M. B. (2020). A theory-based framework for understanding the establishment, sustainability, and spread of community-based conservation. *Conservation Science and Practice*, September, 1–18. https://doi.org/10.1111/csp2.299.

Manfredo, M.J. (1989). Human dimensions of wildlife management. *Wildlife Society Bulletin (1973-2006)*, Winter, 1989, Vol. 17, No. 4 (Winter, 1989), pp. 447-449.

Manfredo, M. J., Salerno, J., Sullivan, L., & Berger, J. (2019). *For US Wildlife Management, Social Science Needed Now More Than Ever*. *69*(12), 960–961. https://doi.org/10.1093/biosci/biz122

Mango, N., Makate, C., Tamene, L., Mponela, P., Ndengu, G. (2017). Awareness and adoption of land, soil and water conservation practices in the Chinyanja Triangle, Southern Africa. *International Soil and Water Conservation Research*, 5, 122-129. http://dx.doi.org/10.1016/j.iswcr.2017.04.003

Matta, J.R. & Alavalapati, J.R.R. (2006). Perceptions of collective action and its success in community based natural resource management: An empirical analysis. *Forest Policy and Economics*, 9, 274-284.

McCloskey, M. (1996, May). The skeptic: Collaboration has its limits. *High Country News*.

McCool, S. F., & Guthrie, K. (2001). Mapping the dimensions of successful public participation in messy natural resources management situations. *Society and Natural Resources*, *14*(4), 309–323.

McKinney, M. (2012). The role of facilitators and mediators. *Center for Natural Resources & Environmental Policy.*

McKinney, M. (2015). Analyzing the conflict or situation. *Center for Natural Resources & Environmental Policy.*

Messmer, T., Cornicelli, L., Decker, D., & Hewitt, D.G. (1997). Stakeholder Acceptance of Urban Deer Management Techniques. Wildlife Society Bulletin (1973-2006), Summer, 1997, Vol. 25, No. 2, Deer Overabundance (Summer, 1997), pp. 360-366

Metcalf, E. C., Mohr, J. J., Yung, L., Metcalf, P., & Craig, D. (2015). The role of trust in restoration success: Public engagement and temporal and spatial scale in a complex social-ecological system. *Restoration Ecology*, *23*(3), 315–324.

Meyer, K., DiDonato, J., & McCullough, D. (1995). California urban deer management: Two case studies. In J.B. McAninch (Ed.), *Urban deer: A Manageable Resource?* (pp. 51-57). Proc. of the 1993 Symposium of the North Central Section, The Wildlife Society.

Montana Fish, Wildlife, & Parks. (2020). *2020 White-tailed Deer Population Report*. [Population graphs]. http://fwp.mt.gov/fishAndWildlife/management/deer/

National Research Council (2008). *Public Participation in Environmental Assessment and Decision Making*. Washington, DC: The National Academies Press.

Nie, M. (2008). The underappreciated role of regulatory enforcement in natural resource conservation. *Policy Sciences*, *41*(2), 139–164.

Ostrom, E. (2000). Reforming the commons. *Swiss Political Science Review*. 6(1): 29-52.

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

Porter, W.F. (1995). Leadership: Key to successful management of urban deer. In J.B. McAninch (Ed.), *Urban deer: A Manageable Resource?* (pp. 132-135). Proc. of the 1993 Symposium of the North Central Section, The Wildlife Society.

Poteete, A.R. & Ostrom, E. (2008). Fifteen years of empirical research on collective action in natural resource management: Struggling to build large-N databases based on qualitative research. *World Development*, 36(1): 176-195.

Purdy, K.G. & Decker, D. (1989). Applying Wildlife Values Information in Management: The Wildlife Attitudes and Values Scale. *Wildlife Society Bulletin (1973-2006)*, Winter, 1989, Vol. 17, No. 4 (Winter, 1989), pp. 494-500.

Raik, D. B., Siemer, W. F., & Decker, D. J. (2004). Community-based Suburban Deer Management: Six Case Studies of Issue Evolution, Capacity, and Intervention. *World Wide Web Internet And Web Information Systems*, (04).

Raik, D. B., Lauber, T. B., Decker, D. J., & Brown, T. L. (2005). Managing community controversy in suburban wildlife management: Adopting practices that address value differences. *Human Dimensions of Wildlife*, *10*(2), 109–122.

Raik, D. B., Siemer, W. F., & Decker, D. J. (2005). Intervention and capacity considerations in community-based deer management: The stakeholders' perspective. *Human Dimensions of Wildlife*, *10*(4), 259–272.

Ratner, B.D., Meinzen-Dick, R., Hellin, J., Mapedza, E., Unruh, J., Veening, W., Haglund, E., May, C., Bruch, C. (2017). Addressing conflict through collective action in natural resource management. *International Journal of the Commons*, 11(2), 877-906.

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation*, *141*(10), 2417–2431.

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., … Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, *90*(5), 1933–1949.

Reed, M. G., Henderson, A. E., & Mendis-Millard, S. (2013). Shaping Local Context and Outcomes: The Role of Governing Agencies in Collaborative Natural Resource Management. *Human Dimensions of Wildlife*, *18*(4), 292–306.

Reed, J., Van Vianen, J., Deakin, E. L., Barlow, J., & Sunderland, T. (2016). Integrated landscape approaches to managing social and environmental issues in the tropics: learning from the past to guide the future. *Global Change Biology*, *22*(7), 2540–2554.

Rogers, E. M. (2003). Diffusion of innovations (5th ed.). New York, NY: Free Press.

Rondeau, D. & Conrad, J. (2003). Managing Urban Deer. American Journal of Agricultural Economics, Feb., 2003, Vol. 85, No. 1 (Feb., 2003), pp. 266-281

Schuett, M. A., Selin, S. W., & Carr, D. S. (2001). Making it work: Keys to successful collaboration in natural resource management. *Environmental Management*, *27*(4), 587–593.

Schuett, M. A., & Selin, S. (2002). Profiling collaborative natural resource initiatives and active participants. *Northern Journal of Applied Forestry*, *19*(4), 155–160.

Schusler, T. M., Decker, D. J., & Pfeffer, M. J. (2003). Social learning for collaborative natural resource management. *Society and Natural Resources, 16*(4), 309–326.

Siemer, W.F., Decker, D.J., & Chase, L.C. (2000). Empowering local communities to co-manage deer. Wildlife Damage Management Conferences -- Proceedings. 24. https://digitalcommons.unl.edu/icwdm_wdmconfproc/24

Smith, P. D., & McDonough, M. H. (2001). Beyond public participation: Fairness in natural resource decision making. *Society and Natural Resources*, *14*(3), 239–249.

Stern, M. J., & Coleman, K. J. (2015). The Multidimensionality of Trust: Applications in Collaborative Natural Resource Management. *Society and Natural Resources*, *28*(2), 117–132.

Strazdiņa, V., Jemeaļjanovs, A., & Šterna, V. (2013). Nutrition value of wild animal meat. *Proceedings of the Latvian Academy of Sciences, Section B: Natural, Exact, and Applied Sciences*, *67*(4–5), 373–377.

Szpaller, K. (2012, May 31). City considers ways to rein in Missoula's urban deer. *Missoulian*. https://missoulian.com/news/local/city-considers-ways-to-rein-in-missoulas-urban-deer/article_29f5358a-aac0-11e1-a7da-0019bb2963f4.html

Szpaller, K. (2014, July 28). Urban deer: Cute but a growing nuisance in Missoula. *Missoulian*. https://missoulian.com/news/local/urban-deer-cute-but-a-growing-nuisance-in-missoula/article_4086fc72-de1f-11e3-8a08-0019bb2963f4.html

United States Census Bureau. (2019). *QuickFacts, Missoula city, Montana; Montana* (V2019) [Data set]. https://www.census.gov/quickfacts/fact/table/missoulacitymontana,MT/PST045219

United States Census Bureau. (2019). *QuickFacts, United States; Montana* (V2019) [Data set]. https://www.census.gov/quickfacts/fact/table/US,MT/PST045219

Urbanek, R. E., Allen, K. R., & Nielsen, C. K. (2011). Urban and suburban deer management by state wildlife-conservation agencies. *Wildlife Society Bulletin*, *35*(3), 310–315.

Warren, R. J. (2011). Deer overabundance in the USA: Recent advances in population control. *Animal Production Science*, 51, 259-266. https://doi.org/10.1071/AN10214.

Warren, R. J., & Krysl, L. J. (1983). White-Tailed Deer Food Habits and Nutritional Status as Affected by Grazing and Deer-Harvest Management. *Journal of Range Management*, *36*(1), 104.

Wiklund, E., Farouk, M., & Finstad, G. (2014). Venison: Meat from red deer (Cervus elaphus) and reindeer (Rangifer tarandus tarandus). *Animal Frontiers*, *4*(4), 55–61.

Wildlife removal in cities based upon ordinance or resolution, House Bill No. 249 § 7-31-4110 (2003). https://leg.mt.gov/bills/2003/BillHtml/HB0249.htm

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

Zanetell, B. A., & Knuth, B. A. (2004). Participation rhetoric or community-based management reality? Influences on willingness to participate in a Venezuelan freshwater fishery. *World Development*, *32*(5), 793–807. https://doi.org/10.1016/j.worlddev.2004.01.002