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Traditional Ecological Knowledge and Opportunities for Reducing Human-Wolf Conflicts in Mongolia

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TRADITIONAL ECOLOGICAL KNOWLEDGE AND OPPORTUNITIES FOR REDUCING HUMAN-WOLF CONFLICTS IN MONGOLIA

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ABSTRACT

TRADITIONAL ECOLOGICAL KNOWLEDGE AND OPPORTUNITIES FOR REDUCING HUMAN-WOLF CONFLICTS IN MONGOLIA

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Conflicts between humans and wolves occur anywhere these two inhabit the same area. This research explored traditional ecological knowledge (TEK) of Mongolians and potential opportunities that this knowledge could offer to improve relationships between humans and wolves (*Canis lupus*) in Mongolia. Research questions include: what is the local understanding of TEK as it applies to wolves; what are the perceptions of different stakeholder groups on the wolves; and what opportunities are there to draw upon TEK to reduce human-wolf conflicts?

This research, using the case study and mixed methods, involved 128 individuals who represented four stakeholder groups (herders, urban residents, hunters, and environmental officials). Four sites were chosen for this research, Ulaanbaatar and three provinces that are within the forest-steppe or Khangai region.

Findings suggest that Mongolians generally viewed wolves from neutral to positive. Respect towards wolves was high in all four groups. The respect arose from various reasons, including the wolf's role in the ecosystems, the wolf's "intelligence and bravery", the spirituality of Mongolian people, and the history of Mongolia.

Results included findings that most herders live in a type of balance, both harmony and rivalry, with wolves. I also found that there was a broad acceptance among herders that wolves can actually help them become more responsible and accountable in their practices. All stakeholder groups consider the wolf as an ecologically and culturally iconic species and is perceived as a keystone species in keeping the ecological balance. Recommendations from across all stakeholder groups support new comprehensive laws and regulations for managing the wolf population in an ecologically balanced manner. This dissertation is available in open access at AURA, http://aura.antioch.edu/ and OhioLINK ETD Center, https://etd.ohiolink.edu/etd.>

Keywords: traditional ecological knowledge (TEK), pastoralists, herders, wolf hunters, stakeholder groups, wolf management, adaptive wolf management, Khangai region, forest-steppe zone, Mongolia.

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Chapter one. Introduction

Prologue

I would like to explain how I came to my research question by sharing a story of my life. I was born in a simple urban family in Mongolia during the period of communistic socialism. After I passed nearly a decade of my life, I experienced a dramatic shift in my country. The changes were so sudden that my child brain could barely fathom and understand what was happening. I am confident that most of the adults were not ready for this kind of a sudden transition. This was a transition from centralized socialism to democracy that occurred in 1990. Both positive and negative changes began to rapidly occur. People's values and beliefs started changing. Things we were not supposed to say or do became normal. Some people became richer and some became poorer. Hunger to get to know the western world was very strong in Mongolians. I recall that nearly anything traditional seemed so old fashioned and outdated.

I remember when I was in a grade school, herders were praised as wise people whose knowledge was accumulated through many generations and their knowledge was equivalent to multiple professions. As a city kid, the herder's lifestyle always seemed like a wonderful world to me. While herders were admired, wolves were usually presented as bad or in a negative manner. Wolves were introduced to school children as greedy enemies of livestock and their population had to be controlled. I was never taught that the wolf and Mongolians had a cultural connection, and that the wolf was the mythical ancestor of Chinggis Khaan, the founder of the Great Mongol Empire. It was prohibited to mention his name during the socialist era.

Today, nearly every Mongolian proudly talks about Chinggis Khaan and the wolf as our ancestors, possibly a bit too much. My observation is that Mongolians started to realize that

without knowing our own culture and customs, we might end up like the "shallow rooted tumbleweed" without strong foundational roots that holds a culture together. Today I observe that more attempts are being given to revive our traditional knowledge and historic customs. This spirit stimulates curiosity in me as to whether this newly grown awareness and pride in Mongolians history and culture could positively influence us to treat wolves more as an essential part of our environmental ecosystem and cultural heritage.

Research goal and questions

To reduce conflicts between humans and wolves and to improve the wolf management in Mongolia, my dissertation research aims to explore the question *How can Mongolian nomadic Traditional Ecological Knowledge (TEK) help inform and potentially improve the existing relationships between humans and wolves in Mongolia?* Under the main question, this research addresses three sub-questions:

- What is the local understanding of TEK as it applies to wolves in the Khangai region of Mongolia?
- What are perceptions of different stakeholder groups on the wolves of Mongolia?
- What opportunities are drawn upon TEK to reduce human-wolf conflicts in Mongolia?

Description of chapters and appendices

This dissertation focuses on exploring Traditional Ecological Knowledge (TEK) and opportunities for reducing human-wolf conflicts. It is organized in seven chapters and appendices. A prologue, research goal and questions, and outlines of the chapters are summarized in this chapter (Chapter One).

Chapter Two presents the overall literature review of this research. It describes the background understanding and research associated with TEK and wolves. This chapter also describes gaps in the literature that I attempt to address through this research.

Chapter Three provides the overall methods. A case study approach that was used for this research, site description, data collection methods, and data analysis are included in this chapter. The analysis led to 16 general themes that are presented in Chapters 4-6. At the end of this chapter, ethical considerations, and research validity are presented.

Chapter Four, *Understanding of Traditional Ecological Knowledge as It Applies to Wolves in the Khangai Region of Mongolia,* is the first of three stand-alone manuscripts. It describes the lifestyle of pastoral herders of the Khangai region, their relationships with wolves, and their traditional ecological knowledge that is applied to co-exist with wolves.

Chapter Five, *Perceptions of Different Stakeholder Groups on the Wolves of Mongolia,* is the second stand-alone manuscript. The wolf was historically a totem animal to Mongolians and viewed as an integral part of Mongolian culture. This chapter presents how stakeholder groups (herders, urban residents, hunters, and environmental officials) perceive wolves in modern Mongolia and what drivers influence their perceptions of wolves.

Chapter Six, *Opportunities to Improve Wolf Management in Mongolia,* is the final stand-alone manuscript. This chapter presents stakeholder groups' opinions (herders, urban residents, hunters, and environmental officials) on occurring problems that wolves and humans cause to each other and the situation of current wolf management used in Mongolia. The chapter also presents recommendations by stakeholders how to improve Mongolia's wolf management.

Chapter Seven presents the overall conclusions and a discussion that draws upon the three stand-alone manuscripts (Chapters 4, 5, and 6). It also provides a summary of the key overall findings of this research, limitations, and implications.

The appendices include questionnaires for four stakeholder groups and informed consent form. The questionnaires and informed consent form are written in English and Mongolian.

Chapter Two. Literature Review

Conflict between humans and carnivores is a subject that has concerned policy makers and engaged researchers from around the world. Commonly, human encroachment into wildlife habitat increases the frequency of encounter of humans with carnivores as well as livestock predation by predators (Mech 2017; Mech and Boitani 2003; Treves and Karanth 2003). In Mongolia, human-wolf conflict is a common issue. Livestock predation by wolves is considered as the main cause of conflicts between humans and wolves and a threat to livestock production (Davie et al. 2014; Hovens and Tungalaktuja 2005; Kaczensky et al. 2008). This predation problem leads to retaliatory killing of wolves, which could negatively impact the wolf population (Li et al. 2013; Linnell et al. 2002; Subba et al. 2017). This research aims to explore whether Traditional Ecological Knowledge (TEK) of Mongolian people can contribute to a deeper understanding of and the identification of potential approaches for reducing this common conflict.

Traditional Ecological Knowledge

For thousands of years, Indigenous peoples around the world have used knowledge of their local environment to sustain themselves and to maintain their cultural identity (Houde 2007). From the 1980s, TEK has been recognized by western scientists and scholars as a valuable source of knowledge of sustainable use of natural resources, agriculture, ethnobotany, ethnozoology, soil and water conservation (Alexander et al. 2011; Berkes 2012; Johnson 1998; Moffa 2016). In the early 1990s, Indigenous people and their knowledge were declared as a main contribution to sustainable development by the Rio Declaration on Environment and Development (Principle 22) and the UN's Agenda 21 (Chapter 26; UNCED, 1992). The

Convention on Biological Diversity also recognizes rapid loss of TEK among indigenous communities. Article 8 and Article 10 stress the necessity to respect, protect, and conserve TEK (CBD 1992). Multiple international agencies, e.g., the United Nations Conference on Trade and Development (UNCTAD), World Intellectual Property Organization (WIPO), and Investing in Rural People (IFAD), have been working towards addressing this issue (Twarog and Kapoor 2004). More recently, Aichi Biodiversity Targets 2020 emphasizes that participation of indigenous or local people and their traditional knowledge were significant and appealed to nations to integrate traditional knowledge into implementation of national biodiversity strategies and action plans at all relevant levels (CBD 2018).

According to Berkes (2012), TEK is enriched and amended by observations and practices of local community members. It is non-linear, flexible, dynamic and multi-scalar. TEK is well established over a long period of time and is an inherent part of societies with historical continuity in resource use of a specific group, in a specific place. Every member in the local community benefits from nature, therefore members are responsible for the well-being of their living environment (Berkes 2012; Fernandez-Gimenez 2000; Nakashima and Roue 2002).

TEK is often encoded in rituals and in the cultural practices of everyday life (Feyerabend 1987), which could be a challenge for western science to understand and accept the usefulness of TEK (Berkes, Colding, and Folke 2000). However, there have been successful attempts to integrate TEK and western science (Hoagland 2017). Especially in northern North America, exploring collaborative opportunities through integrating TEK and wildlife management has been encouraged by conservation organizations, environmental agencies, and indigenous people (Polfus, Heinemeyer, and Hebblewhite 2014). TEK can be a valuable source that

provides data and different insights about wildlife species (Leeney and Poncelet 2015). It also can be used for the monitoring of wildlife (Van Vliet et al. 2018). For example, Native Americans helped western scientists to solve the behavioral conundrum between ravens and wolves (Pierotti 2010) and, in Canada, wildlife researchers used both a western scientific approach and a Native scientific approach of the Heiltsuk people for grizzly bear monitoring (Housty et al. 2014).

Because indigenous resource users have direct dependence on local ecosystems, TEK usually focuses on effective and adaptive management options (Berkes et al. 2000). Since long-term adaptive management is based on culturally embedded natural resource institutions, implementation of TEK-based conservation and wildlife management can be much less costly than conventional conservation and management approaches and can benefit sustainable local resource management (Mickey 2015). Furthermore, employing TEK in conservation and management will increase the opportunity of Indigenous Peoples to be authenticated and their voices to be heard. (Berkes et al. 2000; Briggs 2005).

Some scholars criticize mainstream biodiversity conservation and natural resource management approaches as top-down and too centralized (Berkes 1999; Folke, Berkes, and Colding 2000; Guichard and Gouhier 2014). According to these scholars, mainstream management approaches, which tend to focus on equilibrium dynamics of ecosystems, neglect to apply an adaptive approach to management. These approaches attempt to accomplish controllable yields of natural resources, which often ends up with overlooking environmental feedbacks and failing to adapt to those feedbacks (Berkes et al. 2000; Folke et al. 2000). On the other hand, TEK has disadvantages too. TEK is not always capable of producing detailed

information and projections that western scientific models and methods can provide. When it comes to analyzing different phenomena and different scales, such as the planetary scale of ecological problems, western science is more capable than TEK (Mickey 2015).

Traditional Ecological Knowledge in Mongolia

Pastoral livestock husbandry has been the traditional lifestyle of Mongolians since the Bronze Age (~3,500 – 1,200 BCE) (Frachetti 2008; Hanks 2010; Honeychurch 2010). Even today, almost half of the Mongolian population still live as pastoral herders (National Statistics Office of Mongolia 2019). Through many generations, pastoralists have accumulated a rich pool of TEK (Fernandez-Gimenez 2000). The main strategy of pastoral herders is to move livestock seasonally through choosing appropriate pastures (Dyson-Hudson and Dyson-Hudson 1980; Sumya 2005).

In Mongolia, a few studies have explored pastoral herder's TEK in rangeland management, prediction of harsh winter conditions, and changes in climate extremes (Fernandez-Gimenez 2000; Soma and Schlecht 2018; Tumenjargal et al. 2020). According to these scholars, TEK, with its significant historic contributions to natural conservation, has been disappearing among modern Mongolian herders (Fernández-Giménez et al., 2015; Soma & Schlecht, 2018). Fernandez-Gimenez (1999) viewed the loss of TEK as a consequence associated with internationally influenced political shifts.

According to Fernandez-Gimenez (2000), Mongolia has experienced four major political shifts in its history: 1) collapse of the Great Mongol Empire; 2) becoming a vassal state of the Qing (or Manchu) dynasty; 3) transition to communism; and 4) transition to democracy. The last three shifts brought intense foreign political influences to Mongolia, which strongly

impacted Mongolian traditional herding patterns and practices as well as wildlife (Fernandez-Gimenez, 1999; Sukhbat & Shagdarjav, 1990; Wingard & Zahler, 2006).

From the 17th century, Mongolia became a vassal state of the Qing Dynasty and the people of Mongolia were oppressed by the extreme taxation of the Manchu (Ochir and Enkhtuvshin 2003). Manchurian rulers compelled Mongolians to pay taxes in valuable furs. Examples include species with most expensive furs, e.g. sable (*Martes zibellina)*, stone marten (*Martes foina)*, common otter (*Lutra lutra)*, and beaver (*Castor fiber*) and species that grow velvet antlers and produce musk, such as red deer (*Cervus elaphus)*, saiga antelope (*Saiga tatarica)*, and musk deer (*Moschus moschiferus*) (Sukhbat and Shagdarjav 1990). Fur trade with China and Russia continued expanding until the early 20th century. For example, in the year of 1908, Mongolia exported nearly 4 million pelts to its northern and southern neighbors (Sukhbat and Shagdarjav 1990). According to these authors, populations of many species were dramatically declining during the more than 200 years under the ruling of the Qing Dynasty.

After Mongolia declared its independence in 1911, the country chose communistic socialism (Ochir and Enkhtuvshin 2003). Even though Mongolia was never a part of the Soviet Union, it followed a lot of decisions made by the USSR. One of many examples is that collectivization was implemented according to a decision made by Russia. By the end of the 1960s, all herders were affiliated with the collective system (Humphrey and Sneath 1999). Fernandez-Gimenez (1999) has pointed out that during the communist years, collectives made nearly all decisions for herders. For example, collectives were responsible for allocating pastures to herders, assisting herders with transportation when they had to move, providing veterinarians, and building motorized wells (Sneath 2003). In other words, the major influence

of the communist system was that it pushed Mongolian herders to get used to ready-made things supplied by the state and to slowly lose their traditional knowledge that was essential for sustaining their livelihoods (Fernandez-Gimenez 1999, 2000).

When communism collapsed in 1990, the entire collective system also broke down. Mongolia officially became a democratic country and stepped into free market economy (Ochir and Enkhtuvshin 2003; Pomfret 2000; Rossabi 2005). All livestock was privatized (Humphrey and Sneath 1999; Sneath 2003). In the first half of the decade, urban-to-rural movement dominated and people with different backgrounds and professions became herders, lacking herding knowledge and experience (Hanson 2003; Rossabi 2005). Along with the collapse of the collective system and privatization of livestock, herders did not only lose free veterinary services and technical advice, but also had to make decisions for themselves, such as composition of herds and selection of pastures (Pomfret 2000). Since this period, the composition of herds has dramatically changed: people grew more interest in raising more goats for profitable cashmere (Sneath 2003). According to Fernández-Giménez (1993), people, who recently became herders, give greater importance to economic and social criteria than ecological criteria.

Rural-to-urban migration began to increase from the second half of the 1990s, when a lot of herders discontinued living a traditional pastoral lifestyle (Solongo 2007). Several severe winters in a row played one of the main roles in people deciding to seek an urban lifestyle (Fernández-Giménez et al., 2015). Redford & Stearman (1993) argue that more and more indigenous peoples are getting tied to the market economy presently because of the impracticality of relying only on traditional knowledge and traditional ways. Fernández-

Giménez (1993) defines that ecological knowledge and worldviews are related to socio-economic conditions. The market economy has strong influences on traditional livelihoods and may also change the value system of an indigenous population (Redford and Stearman 1993).

Conflicts between humans and wolves in Mongolia

Wolves predate any kind of livestock and livestock predation by wolves is considered as the main cause of human-wolf conflicts and a threat to livestock production in Mongolia (Davie et al., 2014; Van Duyne et al., 2009). There is no official reported data for domestic animals that are killed due to wolf attacks; however, various studies indicate that a significant part of the wolf diet (more than 50 percent and in some cases up to 96 percent) consists of livestock (Ekernas et al. 2017; Van Duyne et al. 2009). On average, herders lose 1-4 percent of their herds to wolves every year (Davie et al., 2014; Ekernas et al., 2017; Hovens & Tungalaktuja, 2005; Hovens et al., 2000; Van Duyne et al., 2009). In some extreme cases, wolf destruction can cause 50 percent loss of a herd (Davie et al., 2014).

In the South Gobi of Mongolia, besides natural disasters, carnivores, especially wolves, are viewed as the second source of livestock losses (Mijiddorj et al., 2018). Roughly estimating the economic loss per herding household per year based on the market value of livestock, it can be as low as $16 U.S. dollars (USD) or as high as multiple hundreds of dollars. For example, livestock losses due to wolf depredation were reported to be $600-1900 USD per herder per year in Hustai Nuruu National Park in Mongolia (Van Duyne et al. 2009) and $825 USD in the South Gobi (Mijiddorj et al., 2018).

Herders kill wolves to mitigate this problem (Davie et al., 2014; Ekernas et al., 2017; Kaczensky et al., 2008). Wolf cubs also become victims of population control activities of

herders (Hovens et al., 2000). Killing young game animals and destroying their lairs and holes are prohibited (Secretariat of the State Parliament of Mongolia 2012). However, digging wolf cubs out of dens has been a regularly used method for wolf population control. This issue has also been noticed in several studies (Davie et al., 2014; Hovens et al., 2000). Killing wolves to protect livestock, however, may succeed only temporarily. Wielgus & Peebles (2014) argue that killing wolves can increase wolf depredation on livestock the following year. The reason behind this may be tied to changes in pack behavior. If one of the alpha wolves gets killed, the pack can split up and establish several breeding pairs, which may lead up to an increase in wolf population and livestock depredation. Livestock losses caused by wolves decrease when at least 25 percent of the wolf population is eliminated every year (Wielgus and Peebles 2014), which may lead to a critically unstable wolf population.

Wolves are the only large predator species that inhabit every region of Mongolia (Clark et al. 2006). Depending on their habitats, wolves hunt different wild prey (Mech and Boitani 2003). Unfortunately, many of wolves' wild prey are categorized as critically endangered or endangered in the Mongolian Red List of Mammals (Clark et al. 2006). For example: Przewalski's horse (*Equus ferus przewalskii*) and red deer (*Cervus elaphus*) are critically endangered; and argali sheep (*Ovis ammon*), gazelle (*Procapra gutturosa*), saiga antelope (*Saiga tatarica*), asiatic wild ass (*Equus hemionus*), bactrian camel (*Camelus bactrianus ferus*), moose (*Alces alces*) and Siberian marmot (*Marmota sibirica*) are endangered (Clark et al. 2006).

The government of Mongolia, international and local organizations, NGOs, and institutions have implemented many conservation programs and projects to protect these endangered animals and increase their population numbers. Wolves, as their natural

predators, are considered as a threat to these animals (Kaczensky et al. 2008). Due to their vulnerability, wolves tend to prey on juveniles more than adults, which negatively impacts the population growth of endangered species (Ekernas et al., 2017; Feh et al., 2001; Hovens et al., 2000; Kaczensky et al., 2014).

There have not been any studies conducted to determine wolf population, distribution, pack size, or range in Mongolia (Wingard & Zahler 2006). In the 1980s, the Mongolian Academy of Sciences estimated the wolf population at 30,000 and the most recent estimation indicated that there are less than 10,000 individuals (Clark et al. 2006). It is unclear what methodology was used to estimate wolf population. The most commonly used method to estimate wolf density was a snow-tracking method. This method alone is often not accurate (Fuller, Mech, and Cochrane 2007; Fuller and Snow 1988). Therefore, there might be a great deal of uncertainty in these numbers. In 2006, the regional status of the species was considered to be 'Near Threatened' in 2006 (Clark et al. 2006). This information has not been updated since then. Kaczensky et al., (2008) states that there is no law that indicates anything about wolf hunting. People usually interpret this as wolves can be hunted anywhere and anytime, which could be one reason for increased interest of urban men in wolf hunting. Urban hunters usually hunt wolves in the eastern part of the country, where the vast plain of Mongolia is located (Olson and Fuller 2017).

Traditionally, Mongolians considered wolves as a totem animal (Erdenetuya 2014). Today, wolves are seen more as a highly profitable trade item than a totem animal. The wolf trade is developing fast, especially on the borders of Mongolia and China (Kaczensky et al., 2008; Wingard & Zahler, 2006). According to Kaczensky et al. (2008), a factor that motivates

wolf hunting is the high prices in China for frozen wolf carcasses. Every part of the wolf, including its fur, organs, bones, and teeth has monetary value (Wingard & Zahler, 2006). As of 2006, one wolf was equivalent in value to $300-350 USD on the domestic market of Mongolia and wolf trophies cost $375 USD on the international market (Wingard & Zahler, 2006).

There are only a few studies that have explored pastoral herders' TEK, which were focused on herders' TEK in rangeland management, potential winter disaster prediction, and changes. I am unaware of any research that has focused specifically on the topic of pastoralists' TEK that applies to wolves and its potential roles to reduce conflicts between humans and wolves in Mongolia. Considering this, my dissertation research focuses on the following question: *How can Mongolian nomadic TEK help inform and potentially improve the existing relationships between humans and wolves in Mongolia?*

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Chapter Three. Methods

Case study approach

I selected a case study approach to explore the main question of my research "*How can Mongolian nomadic Traditional Ecological Knowledge (TEK) help inform and potentially improve the existing relationships between humans and wolves in Mongolia?*" Yin (2017) suggests that a case study is appropriate to answer to 'how' and 'why' questions (p. 9). This was a single case study with multiple stakeholder groups (i.e., herders, urban residents, hunters, and environmental officials). Criteria of choosing stakeholder groups are presented in the three manuscripts (Chapter 4-6).

A descriptive case study approach was chosen for the reasons of generating an in-depth and multi-faceted understanding of individuals and/or communities in their real contexts (Crowe et al. 2011; Yin 2017). A descriptive case study approach urges the use of multiple sources of evidence, including both quantitative and qualitative data such as documents, surveys, interviews, and observations to enhance data credibility (Patton 2014; Stake 1995; Yin 2017). Moreover, conducting a case study is not timely restricted. The period of a case study can take as short time as a week, or as long as a year (DeMarrais and Lapan 2003). The flexibility of timeframe was essential for this study because the study site was overseas. Regular visits to the study site were basically impossible. Additionally, findings of a case study do not need to be generalized, which aligned well with my intention for this research that it was not about establishing generality of findings (Yin 2014, 2017).

Site description

The research was conducted in Mongolia, a landlocked country between Russia and China. Mongolia is sparsely populated (2 people per square kilometer), however the population density in the capital city of Ulaanbaatar is highest (317 people per square kilometers; National Statistics Office of Mongolia, 2018). Most of Mongolia's land is used for agricultural purposes, especially for pastureland (Ministry of Environment and Tourism 2015). The country's ecosystems are divided into six natural zones: steppe (20%), forest-steppe (25%), taiga forest (5%), high mountain (5%), desert-steppe (20%), and desert (25%; Badarch & Zilinskas, 2015). I chose four sites as my research sites, including the city of Ulaanbaatar and three provinces (Arkhangai, Bayankhongor, and Uvurkhangai). Parts of these provinces lie in the forest steppe zone (also known as the Khangai region; Figure 1, 2).

The capital city of Ulaanbaatar is the largest and most crowded city in Mongolia with nearly half of the country's population (Statistics Department of Capital City 2019). It is the political, social, financial, and cultural center of the country. The nation's infrastructures, market capacity, and qualified professionals are heavily concentrated in the city, and the majority of domestic and international investments is spent in Ulaanbaatar. In comparison to the countryside, there are also higher job opportunities, better health services, and better schools. Because of these main reasons, migration from rural areas to Ulaanbaatar has been consistently high in recent decades (Statistics Department of Capital City 2019).

The Khangai region has specific natural characteristics which consist of grassland, mountain peaks, rugged terrain, meadows, and mixed coniferous forests, such as Siberian larch (*Larix sibirica*), Siberian birch (*Betula sibirica*), and Siberian pine (*Pinus sibirica*) (Ministry of

Environment and Tourism, 2015). The average altitude in the mountainous parts ranges 1,500-2,000 meters above the sea level (MASL) and the altitude in the parts of valleys and open steppes is between 800 and 1,200 MASL. The highest peak reaches 4,021 MASL (Chimed-Ochir et al. 2010). Annual precipitation ranges from 300 mm to 450 mm (Ministry of Environment and Tourism 2015). The Khangai region's natural characteristics are considered to be favorable for wolves (Davie et al., 2014; Kaczensky et al., 2008). Some researchers have suggested that the Khangai region has one of the highest wolf populations in Mongolia (Bannikov, 1954, as cited in Enkhsaikhan, 2004; Clark et al., 2006). Also, this region has the highest amount of livestock (National Statistics Office of Mongolia 2019).

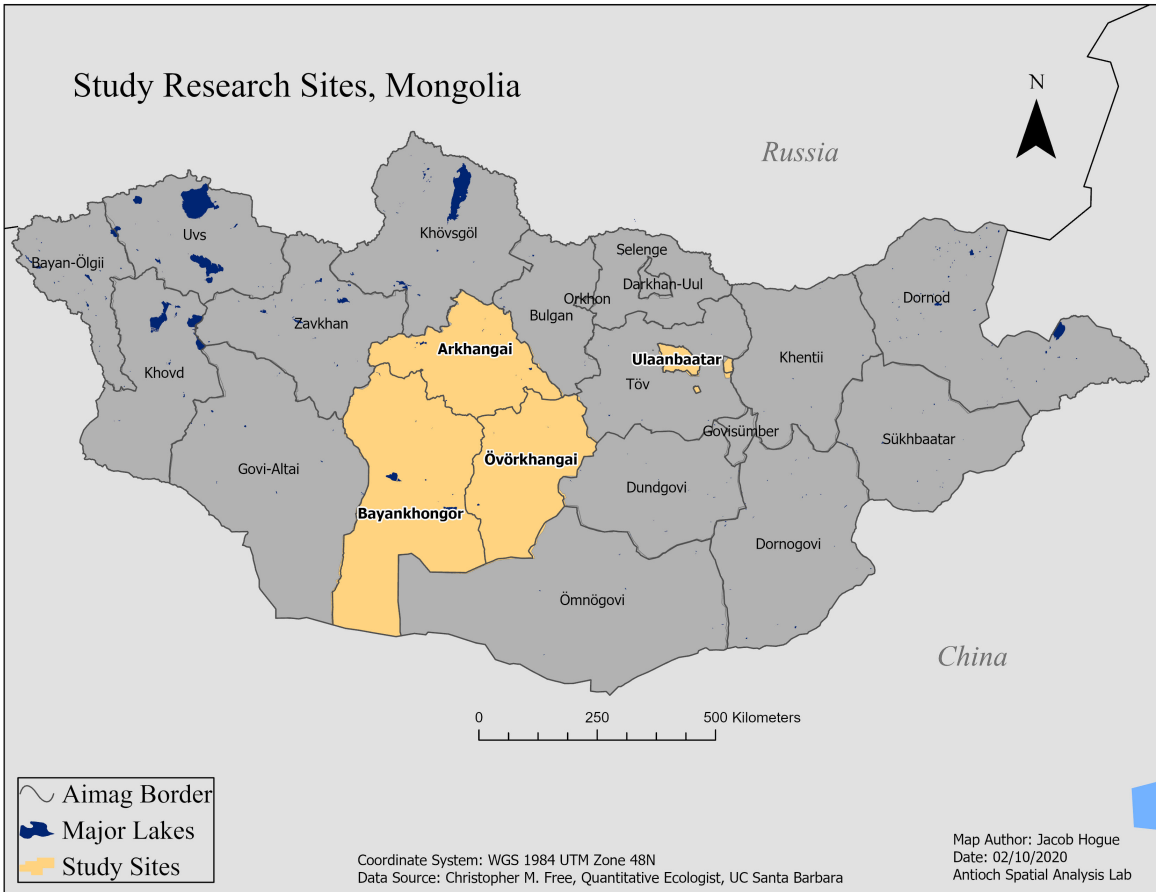

Figure 1. Map showing the locations of the research sites (Arkhangai, Bayankhongor, Uvurkhangai, and Ulaanbaatar).

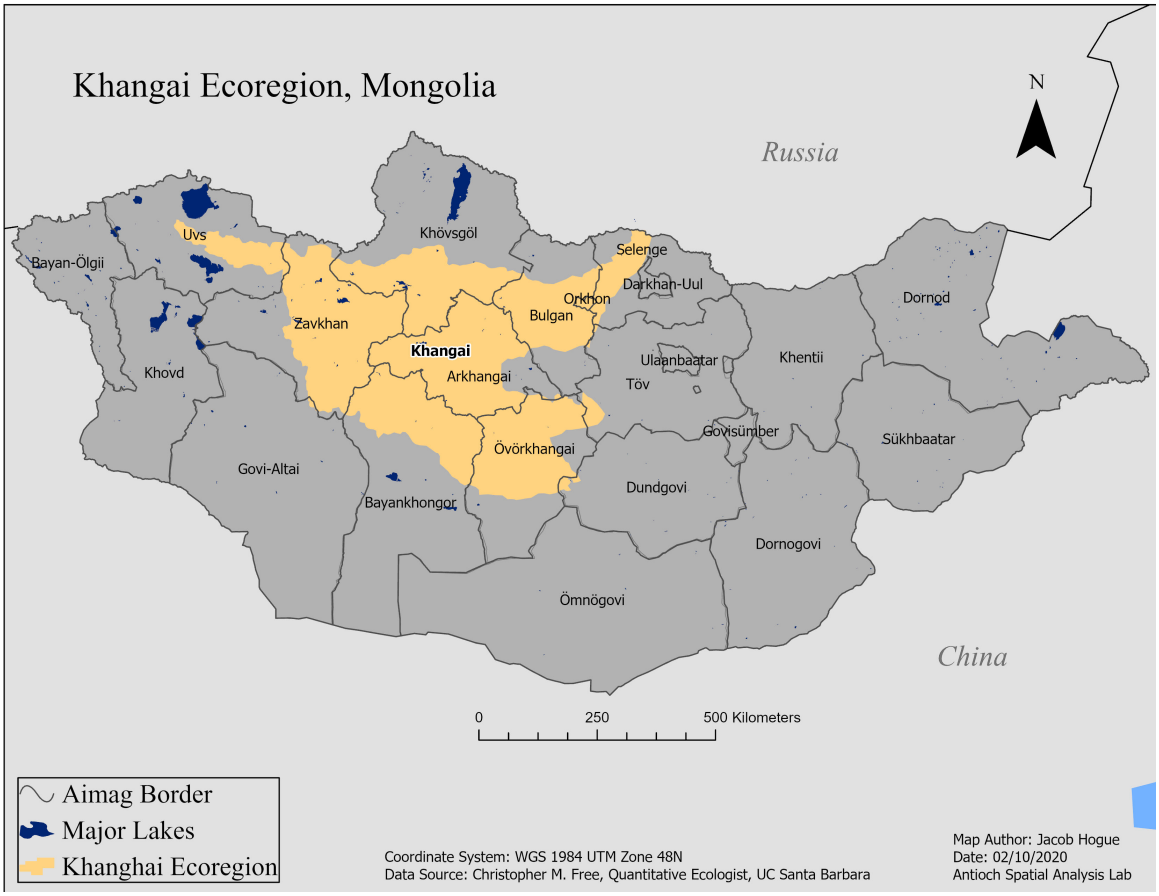

Figure 2. Map showing the location of the Khangai region.

Data collection methods

I chose the convergent parallel mixed methods design for data collection, because both qualitative and quantitative data are prioritized equally. This design combines qualitative and quantitative research components, providing researchers with robust and detailed information and understanding of the research problem compared to either approach alone (Creswell and Plano Clark 2010). This approach also increases validity, interpretability, breadth and depth, and meaningfulness of research through triangulation, complementarity, development, initiation, and expansion (Greene et al., 1989).

I collected qualitative and quantitative data simultaneously, analyzed separately, and then merged (Creswell & Plano Clark, 2010; Creswell, 2014). Before I began the data collection,

I prepared a questionnaire for each stakeholder group that consisted of three sections, including demographic section; survey section; and interview section (Appendices I-VIII in English and Mongolian). The demographic and survey sections of each questionnaire included questions for quantitative data. These parts consisted of closed-ended questions and six-point Likert-scale statements. Most of the survey questions, especially the Likert-scale statements, were defined from frequently repeated reports from different Mongolian sources, such as conversations with various people from different regions of Mongolia, national newspaper articles, online articles, and interviews on TV. I also paid attention to people's comments that were posted under online news articles discussing wolves.

The interview section of the questionnaire was intended for qualitative data to get more detailed insights to questions in the survey section. This section was composed of open-ended questions. In addition to open-ended questions, a field observation and informal conversations with individuals during the field observation were also counted as qualitative data sources. The data collection process is included in greater details in each manuscript (Chapter 4-6).

Data analysis

Quantitative data analysis. I began data analysis with quantitative data analysis. I first organized quantitative data from the four questionnaires (i.e., gender, age, education, location, attitude, and Likert-scale responses) and converted them into digital form. Using Microsoft Excel, I then conducted a descriptive analysis (e.g., the mean, median, and interquartile range). Participants' responses for six-point Likert scale statements and closed-ended questions were analyzed in the two-way contingency table fashion (Kateri 2014). These responses were paired with variables (i.e., stakeholder group, gender, age, and residency) to examine and summarize

relationships among them (Bartlett, 1935; Fienberg, 2007). A software Stata/IC 15.1 (StataCorp, Texas, USA) served the purpose of analyzing contingency tables and to define degrees of freedom and *p*-values. The Pearson's Chi square test was used to obtain the *p*-values. Results that yielded *p*-values of $\leq .05$ were considered as significant.

Qualitative data analysis. A part of the questionnaires consisted of semi-structured and open-ended questions, which I refer to these interview questions. I transcribed all the interviews and then translated them from Mongolian to English. Qualitative data were important to find more detailed information, interpret quantitative data and to recognize patterns emerging from the data. I used MAXQDA Analytics Pro18 (VERBI GmbH, Berlin, Germany) to initiate codes and themes from qualitative data.

Ethical considerations

Prior to the start of data collection, the research proposal was approved by the Institutional Review Board at Antioch University New England. Because this was not a medical research, I did not need any ethical approval from Mongolia. Participation of every individual in this study was entirely voluntary. Each participant was given an informed consent form (Appendices IX and X in English and Mongolian). Although the form explained the purpose of the study, procedures, potential risks, benefits, and the confidentiality, I still verbally presented the consent information when I met participants in-person.

Validity

In general, I remained cautious throughout the data collection process to increase the validity of this research. I used triangulation by including multiple sources of evidence, including documents, surveys, interviews, and observations in data collection (Creswell & Plano

Clark, 2010). Building trust with participants was an important step in this study. I made sure to do this from the beginning and throughout the process. Hiring a local guide from each research site was helpful to quickly gain trust of individuals and have open conversations. I also explained the purpose and benefits of the research well and let participants know that their honest answers would be most helpful to enhance the research quality and benefits. I also checked out the consistency of findings generated by data collected and did not include responses that seemed to me dishonest (Bashir et al., 2008). For example, during a few interviews, I observed that respondents were giving me answers that I would like to hear. In addition, I provided "thick descriptions" (Lincoln and Guba 1985, p.125). In each manuscript (Chapter 4-6), I gave a robust and detailed description of my experience during data collection, such as where, when, and how all data were collected.

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Preface to Chapter Four

Chapter Four is written as a stand-alone document in journal article format. This chapter focuses on herders in the Khangai region of Mongolia and addresses the following main questions?

- What is the lifestyle and culture of herders in the Khangai region?
- What relationship do herders and wolves have in the Khangai region?
- What is the role of TEK that applies to wolves in the Khangai region?

Chapter Four contains four sections, including introduction, research design, results, and discussion and conclusion. The introduction involves a brief description of TEK and its current situation in Mongolia. It also provides some general information of wolves in Mongolia and herders' traditional methods used to protect livestock from wolf attacks. The research design section begins with an explanation of methods that were used for the research. This section also provides a definition of study sites and explains processes about participant selection and data analysis. The results section reports themes that were generated from interviews with herders. Finally, the discussion and conclusion sections describe the interpretation of the results.

Chapter Four. Manuscript A. Understanding of Traditional Ecological Knowledge as it applies to wolves in the Khangai region of Mongolia

Abstract

Wherever humans and grey wolves (*Canis lupus*) inhabit the same area, conflicts occur between them. As longstanding neighbors of wolves, Mongolian pastoral herders have accumulated a rich pool of traditional ecological knowledge (TEK) of co-existing with wolves. However, there is little research investigating their relationships and co-existence in Mongolia. This case study examines pastoral herders of the Khangai region of Mongolia and their TEK that relates to wolves. The aims of this study were to: a) understand the lifestyle and culture of herders in the Khangai region; b) understand the relationship between herders and wolves in Khangai; and c) evaluate the role of TEK that applies to wolves in the region. I used a mixed-methods approach for data collection. Both quantitative and qualitative data were collected concurrently, using a questionnaire. A total of 50 herders participated in this research. Results suggest that there have been some negative changes in the lifestyle of herders due to effects of large-scale livestock overgrazing that has been detrimental to pastures. Younger people are also less inclined to live as a herder. They move to urban areas for better education and wider opportunities to pursue different careers. Almost all of the methods they use to prevent wolf predation were used by their ancestors. Although they do not like wolves much due to their perceived threat to livestock, herders still express respect, astonishment, and amazement towards the species, which reflects a common dichotomy between people and wolves observed elsewhere. This case study suggests that Khangai herders' respect, knowledge, and

understanding of wolves' ecological roles could be a potential rallying factor for working towards sustainable wolf management.

1. Introduction

Mongolia is a country with a long, vibrant history with nearly half its population living as pastoral herders. Livestock is the core financial capital of herders and the primary economic source of their livelihood (Sumya 2005). The main strategy of pastoral herders is to move livestock seasonally between pastures (Dyson-Hudson and Dyson-Hudson 1980). Over generations, Mongolian herders have accumulated a rich pool of traditional ecological knowledge (TEK) (Fernandez-Gimenez 2000).

TEK is a complex system that encompasses the integration of knowledge, practice, and belief of a certain group of people in a particular place (Berkes 2008). The term TEK was not widely used before the 1980 (Berkes 1993). However, more recently, an increasing number of researchers in different fields and policymakers are becoming more aware of TEK (Berkes, Colding, and Folke 2000; Moffa 2016). TEK offers various benefits for advocating sustainable resource management and environmental conservation (Brown 2006; Fernandez-Gimenez 2000; Langdon 2006), advancing wildlife behavioral research (Pierotti 2010), maintaining indigenous cultural identity and practices (Houde 2007), and supporting indigenous empowerment (Berkes 2008; Nadasdy 1999).

Since the early 1990s, the United Nations and other international organizations have produced declarations and agreements that included numerous references to TEK. For example, the Rio Declaration on Environment and Development (Principle 22) and the Agenda 21 (Chapter 26) acknowledge indigenous people and their knowledge as a key to contribute to

sustainable development (UNCED 1992). Articles 8 and 10 of the Convention on Biological Diversity (CBD) also recognize the rapid loss of TEK among indigenous communities and draw attention to the need for respecting, preserving, protecting, and maintaining TEK and promoting wider application of TEK (CBD 1992). Various agencies, including the United Nations Conference on Trade and Development (UNCTAD), World Intellectual Property Organization (WIPO), Investing in Rural People (IFAD), and others, also take actions towards addressing this issue (Twarog and Kapoor 2004). More recently, the Aichi Biodiversity Targets 2020 emphasized the need for participation of local and indigenous communities and for their traditional knowledge to be considered and integrated into implementation of national biodiversity strategies and action plans at all relevant levels (CBD 2018).

During the past two decades, researchers have started to describe and examine aspects of Mongolian herders' TEK. Studies have explored TEK in rangeland management (Fernandez-Gimenez 2000) and its relevance for predicting and coping with harsh winter conditions (Soma and Schlecht 2018). According to these scholars, TEK with its significant historic contributions to natural conservation has been disappearing among modern Mongolian herders (Fernández-Giménez et al. 2015; Soma and Schlecht 2018). Fernandez-Gimenez (1999) viewed the loss of TEK as a consequence associated with internationally influenced political shifts, such as communist socialism to democracy that occurred in Mongolia in the early 1990s. These shifts have strongly impacted Mongolian traditional herding patterns and practices (Fernandez-Gimenez 1999).

The loss of TEK has led to different livestock husbandry and management practices by herders that may lead to higher rates of wolf predation in some areas (Kikvidze and Tevzadze

2015). Wolves (*Canis lupus*) occur throughout Mongolia and are often considered a threat to livestock and livelihoods (Fritts et al. 2006). Wolf predation on livestock is an issue that requires strategies that reduce retribution killing of wolves and mitigate for livestock losses (Bisi et al. 2007; Gehring, VerCauteren, and Landry 2010; Harper et al. 2008; Imbert et al. 2016). Based on the market value of livestock in 2018, the yearly loss caused by wolves per herding household ranged widely in Mongolia. For instance, Van Duyne et al. (2009) reported that livestock losses due to wolf predation reached $600-1,900 U.S. Dollars (USD) per herder per year around Hustai Nuruu National Park. Wolves are considered as the second major source of livestock losses following natural disasters in the Gobi (Mijiddorj, Alexander, and Samelius 2018).

There are different traditional strategies that herders have developed to protect livestock from wolves. Hunting has been one commonly-used strategy for livestock defense (Erdenetuya 2014; Sumya 2005; Valdez 2013). Furthermore, herders have used other methods that are specific for Mongolian herders, including guard dogs, scarecrows, and putting up a rope in a circle around the campsite (Erdenetuya 2014; Lugli 2016; Narankhuu 2000; Yondonsambuu 2014). However, perhaps the most important strategy for herders to protect their livestock is to study and observe wolves in the neighborhood closely (Narankhuu 2000). As Narankhuu (2000) noted, knowing the population of wolves, their pack composition, and travel patterns helps herders to carefully choose a pasture to keep livestock away from wolves and enable them to fatten and strengthen livestock with less wolf risks. In addition, according to Erdenetuya (2014) pastoralists also use traditional spiritual rituals for livestock protection.

For example, a ritual called “Choniin am haah” (translates as closing the wolf’s mouth) is used among herders, wrapping a pair scissors’ with wool (p. 169).

The low abundance of wildlife prey and the increase in wolf predation on livestock have a direct correlation (Chavez and Gese 2005; Mech, Fritts, and Paul 1988; Van Duyne et al. 2009). Wolves are likely to prey on livestock, when their primary prey species are less available (Chavez and Gese 2005). For example, at a site in western Mongolia where livestock density is low, wolves consume mainly wild prey, including rodents and hare (Feh et al. 2001). Elsewhere in Mongolia, livestock represents a major component of wolf diet (Davie et al. 2014a; Hovens and Tungalaktuja 2005; Huashan et al. 2014; Van Duyne et al. 2009).

The wolf inhabits every region of Mongolia, but their abundance is highly variable due to persecution, and they may be locally extinct in some parts of the country (Clark et al. 2006). However, the Khangai region of Mongolia, also referred to as the forest-steppe zone, has always been recognized as a region with a higher density of wolves compared to the desert and semi-desert zones (Enkhsaikhan, 2004). Despite this, most wolf research efforts in Mongolia to date have been conducted in the desert and semi-desert regions (Davie et al. 2014a; Enkhsaikhan 2004; Kaczensky et al. 2008; Van Duyne et al. 2009).

This study aimed to: 1) understand the lifestyle and culture of herders in the Khangai region; 2) understand the relationship between herders and wolves in the Khangai region; and 3) evaluate the role of TEK that applies to wolves in the region. I chose the Khangai region as my research site because, due to the higher wolf population, I posit that people from Khangai have been in co-existence with wolves and may hold richer TEK that applies to wolves. Results of this research present several contributions to the both research fields of TEK and wolf

management. First, it contributes to the documentation and preservation of nomadic herders' TEK of the Khangai region. Second, this research contributes to the broader literature of wolf-human relationships, which have largely focused on conflict in North America. Third, the results may help policy makers to better understand wolf-herder relationships and develop more effective wolf management approaches in Mongolia and other culturally similar countries.

2. Research design

The research design consists of methods, study sites, participant selection, data collection, and data analysis.

2.1. Methods

I chose a descriptive case study design for this research. According to Yin (2017), this kind of case study design helps researchers to closely investigate and understand individuals and/or communities in their real time contexts, usually by answering 'how' and 'why' questions. In my view, this case study design is most appropriate to contextually and holistically study and understand Mongolian herders' relationships with wolves. It seeks to produce in-depth descriptions and interpretations by using holistic and comprehensive investigations. In other words, a case study opens up researchers opportunities to see different aspects of the research problem (Meyer 2001). The timeframe to do a case study is also flexible. It can take relatively short time such as a few weeks, or as long as a year (DeMarrais and Lapan 2003). The case study method also encourages researchers to use mixed methods to collect data from multiple sources of evidence (Yin 2014, 2017). For data collection, I used the convergent mixed methods design, in which both quantitative and qualitative methods are

considered to be of equal priority (Creswell and Plano Clark 2010). I used a questionnaire with quantitative and qualitative questions, a field observation, and fieldnotes as sources of evidence.

2.2. Study sites

The study was carried out in the Khangai region of Mongolia (Figure 1). This biogeographic region is a transition zone between forest and steppe ecosystems and covers 16.4% of Mongolia. It contains mountain peaks, meadows, grassland, and coniferous forests, e.g., Siberian larch (*Larix sibirica*), Siberian birch (*Betula sibirica*), and Siberian pine (*Pinus sibirica*). Annual precipitation ranges from 300 mm to 450 mm (Ministry of Environment and Tourism 2015). The average altitude varies between 1,500-2,000 meters above sea level (MASL) in the mountains and 800-1,200 MASL in the valleys. The highest peak of the region reaches 4,021 MASL (Chimed-Ochir et al. 2010).

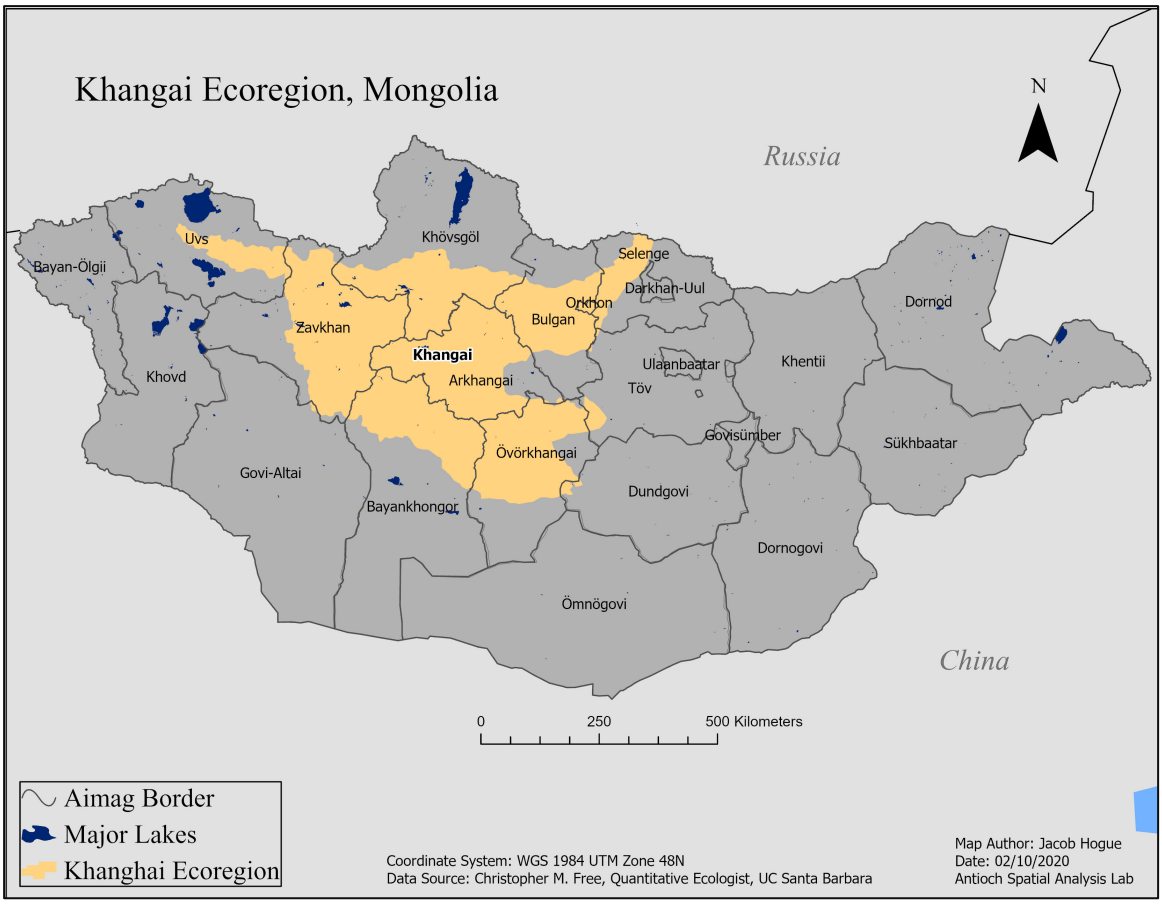

Figure 1. Map of the Khangai region.

I collected data in three provinces (Aimags) of the Khangai region: Arkhangai, Bayankhongor, and Uvurkhangai. All three provinces are very rural and characterized by having a high percentage of agricultural land for livestock production. Human population density is also low. A significant percentage of each province's land is reserved for special needs (Ministry of Environment and Tourism 2015). Land for special needs includes protected areas, border strip land, interprovincial reserve rangeland, and more (Secretariat of the State Parliament of Mongolia 2002).

Nearly all of Arkhangai is part of the Khangai region (Figure 1). Arkhangai covers 55,300 square kilometers, and the population density is 1.7 persons per square kilometer.

Approximately 70% is agricultural land, predominantly pastureland and hayfields. Arkhangai has more forest cover than the other two provinces, covering about 20% of the province territory. And 10% of the land is reserved for special needs (Ministry of Environment and Tourism 2015).

Bayankhongor is one of the largest provinces of Mongolia, covering 116,000 square kilometers. The northern part of the province (approximately one third of the territory) lies in the Khangai region. This province borders Arkhangai to the north and Uvurkhangai to the east. The population density is 0.7 persons per square kilometer. Agricultural land covers 76.6% of the province's territory and areas under special needs cover 19.8% (Table 1) (Ministry of Environment and Tourism 2015).

Uvurkhangai covers 62,900 square kilometers. About one third of the province's territory belongs to the Khangai region (Figure 1). The population density is 1.8 persons per square kilometer. The vast majority or 91.3% of the land is used for agriculture, and 5.1% is kept for special needs. Compared to the other two provinces, Uvurkhangai has less forest cover, which constitutes 2.4% of the territory (Ministry of Environment and Tourism 2015).

2.3. Research team

I hired a >30-year-old adult I personally knew as my assistant. The assistant had two main roles: to help with conducting the interviews and to drive. In addition, he had a reliable vehicle appropriate for off-road driving, required to travel to herder families. The assistant was trained by shadowing me during the first few interviews. Often times, there were more than one person when stopped at a yurt (traditional herder dwelling). In these situations, it was advantageous to conduct two interviews simultaneously with the aid of the assistant.

We were also in need of a local guide, who was familiar with local roads. Driving in rural areas can be challenging due to lack of road signs. Besides a few main roads, most roads in the rural areas of Mongolia are unpaved dirt roads that head in undefined directions. I engaged one local guide from each province, and I found those guides through relationships that I had built during my previous trips in those provinces. For example, local people whom I met during the time I worked in Arkhangai from 2007 to 2009 helped me set up a meeting with a guide. In Bayankhongor, I hired an individual whom I met during my trip in 2015. He was my guide for that trip as well. In Uvurkhangai, I hired a person whom I also met in 2015. These guides were all > 35 years old.

2.4. Participant selection

A total of 50 herders (n=27 female and n=23 male) participated. My attempt was to involve both male and female herders evenly to be inclusive of both perspectives. Looking at interview studies in Mongolia, most of them focus on the male head of household, which largely excludes the perspectives of women. A main criterion that was used to select herders was that every herder must live a pastoral herder life all year around. Individuals who only seasonally lived a pastoral lifestyle and spent the rest of a year in an urban center were not considered as herders in this research. Another criterion I used was that herders needed to be located distant from busier and more crowded places, such as tourist camps, urban centers (e.g., soum[1] center or province center), and main roads. Wolves generally avoid humans (Fritts

et al. 2006). Considering this statement, I surmised that herders who live near crowded places might have less interaction with wolves.

To select participants, the research team used the random sampling method (n=39), snowball sampling method (n=7), and convenience sampling method (n=4). While driving in research sites and searching for potential participants, numerous yurts that we stopped by were empty, or parents were absent. We were informed that the adults were invited to a wedding, and only young kids were at home. Late summer and fall are typically the peak period for weddings in Mongolia. In some cases, only women were at home. According to them, husbands were gone to tend the livestock. Only a couple of times, men were home and said that their wives left for the city for a few days.

The participant selection process was slightly different in each province. In Arkhangai, nine herders from four different soums, including Ikh Tamir (n=4), Tariat (n=3), Tsenkher (n=1), and Undur-Ulaan (n=1), participated in this research. In Tariat, Tsenkher, and Undur-Ulaan soums, the research team selected participants randomly by stopping at one of every five yurts. In Ikh Tamir soum, we used the snowball-sampling method (Goodman 1961). Some herders suggested to us other herders to meet that they thought might be potentially helpful for our research.

In Uvurkhangai, there were 24 interviews of herders from six different soums, including Arvaikheer (n=8), Bayangol (n=1), Taragt (n=1), Tugrug (n=1), Ulziit (n=4), and Zuun Bayan-Ulaan (n=9). The snowball sampling method was used for all 13 interviews conducted in Ulziit and Zuun Bayan-Ulaan soums. We started by visiting households that our local guide from Uvurkhangai suggested. Members of those households he recommended included elderly

herders whose herding experiences were well recognized by local people. We used the convenience sampling method for the remaining 11 herders that were selected at a wool-processing factory at the province center. These herders came to the factory to deliver wool. We approached every herder who came to the factory and asked if they were comfortable with participating in the research. Only three herders refused to participate because they did not have time.

In Bayankhongor, 17 herders participated. All herders were from Jargalant soum. We used the snowball-sampling (n=13) and convenience sampling methods (n=4). As in Uvurkhangai province, we began visiting herders who were recommended by the local guide. Due to a river flood, we were not able to continue our trip further and stayed at the center of Jargalant soum. While staying at the soum center, we asked individuals at a small general store to participate in the research. These individuals were all herders from Jargalant soum that were waiting for the river level to go down.

2.5. Data collection

Prior to the data collection, my research proposal was reviewed by the Institutional Review Board of Antioch University New England (Appendix 1). Data collection started in late July 2018 and ended early October 2018. Because my intention was to collect both quantitative and qualitative data simultaneously, I developed a questionnaire which consisted of quantitative and qualitative questions. The questionnaire had three parts, including demographic part, survey part, and open-ended interview part (Appendix 2). Demographic questions and survey questions (closed-ended questions and Likert-scale questions) were the

sources of quantitative data, while open-ended interview questions, a field observation, and fieldnotes were the sources of qualitative data.

Demographic questions included participant's name, age, gender, education, address, and kinds and amount of livestock that the participant owned. The survey questions consisted of closed-ended questions and Likert-scale questions. These questions were mainly focused on acquiring an understanding of participants' experiences with herding and their experience with wolves. Open-ended interview questions were aimed to determine herders' traditional approaches and strategies to mitigate wolf problems.

At the beginning of each interview, I explained to each participant the purpose of the study and informed them that their participation was voluntary. I clarified that they could stop their participation at any time. Every participant was provided with a hard copy of the survey, which was written in Mongolian. All participants spoke and read only Mongolian. All participants gave me permission to record their interviews, however, several interviewees were visibly nervous when they were recorded. In these situations, I voluntarily turned off the recorder. The length of interviews ranged from 15 minutes to 1 hour.

Most interviews (n=34) were conducted in herders' yurts. In general, interviews were conducted in a quiet environment. However, sometimes, herders' yurts were crowded with multiple people (neighbors visiting and/or relatives from urban areas spending their vacation). In these situations, I interviewed the wife or the husband, while the local guide and the assistant keep visitors in the yurt busy by having a conversation with them. In some cases, only women were at home. According to them, husbands had gone to tend livestock. Only a couple of times only men were home and said that their wives left for the city for a few days. When

both husband and wife were present at home, I and the assistant interviewed them simultaneously, but separately. In some cases, we could not conduct interviews with wives because they were busy with household work, such as making dairy products, cooking, and taking care of little children. On a few occasions, wives directed the interview to their husbands. However, in some of these situations, wives would still comment during the interview and answer some questions or tell husbands they should answer questions their way. In one occasion, we interviewed a herder, while he was tending his flock of sheep in the pasture.

Interviews at the wool-processing factory (n=11) were taken in a quiet room, without any disturbance by other people. The owner of the factory was helpful and provided us with an office room to conduct interviews with herders. The interviews with herders we met in a general store (n=4) were conducted outside the store. Besides the wind picking up a few times, there was no distraction.

Once all interviews were conducted, I stayed with a herder family in Uvurkhangai province to conduct a field observation. I was introduced to the family by one of the interviewees. The family was her older brother's family. I stayed with them for a week. My goal for the field observation was to develop a holistic perspective about Khangai herders through carefully observing them in their natural setting and participating in their daily activities (DeWalt and DeWalt 2010). During the field observation, I actively looked at how the family members interacted with each other, how they co-operated with their neighbors, who was responsible for what activities, and more. I participated in household chores and tried to

understand herders' lives as much as possible in a short time. Every evening, I sat down and wrote extensive fieldnotes about what I observed (Emerson, Fretz, and Shaw 2007).

2.6. Data analysis

Once I completed the data collection, I converted both quantitative and qualitative data into digital format using spreadsheets. The use of spreadsheets was suitable for further steps to analyze both quantitative and qualitative data. I analyzed quantitative and qualitative data separately and merged them in the results section**.**

2.6.1 Quantitative data analysis. I used Stata/IC 15.1 (StataCorp, Texas, USA) for quantitative data analysis. General descriptive statistics (i.e., the mean, median, and standard deviation) of participants' ages, education, amount of livestock, and herding experience were determined. I grouped herders' education into three groups based on the number of years that they attended in school: 1-4 years - elementary school education; 5-8 years - middle school education; and 9-10 years - high school education.

Participant's herding experience was represented by the number of years of herding. I generated six groups based on people's herding years: $\leq$9 years; 10-19 years; 20-29 years; 30-39 years; 40-49 years; and $\geq$50 years. Number of livestock was also categorized into groups: $\leq$299 heads of livestock; 300-499 heads of livestock; 500-699 heads of livestock; 700-999 heads of livestock; and $\geq$1000 heads of livestock.

Two-way contingency tables were used to process Likert-scale data. Contingency tables are used to analyze cross-classified data, summarizing the relationship between variables (Kateri 2014). I used participants' age, gender, education, herding experience, and number of livestock as categorical variables. I paired these variables with each Likert-scale statement and

tested each pair using Pearson's Chi Square. If a *p*-value is equal or less than 0.05 ($p \leq .05$), it was considered that there was a significant difference between two variables.

2.6.2 Qualitative data analysis. I transcribed interview responses and converted fieldnotes into digital format. I translated transcripts from Mongolian to English. Using MAXQDA Analytics Pro18 (VERBI GmbH, Berlin, Germany) software, I first searched whether participants' responses had any potential patterns and then created initial codes. Codes were grouped into five general themes and nine sub themes. General themes are presented as Herders in the Khangai region (Section 3.1.); Wolf predation (Section 3.2.); Herder's knowledge about wolves (Section 3.3.); Herders' practices used for co-existing with wolves (Section 3.4.); and Herders' beliefs related to wolves (Section 3.5.).

2.6.3 Data integration. Both quantitative and qualitative data were prioritized equally. After analyzing quantitative and qualitative data separately, I compared findings from quantitative and qualitative data sources to see whether any contradictions exist between the findings. Furthermore, I incorporated qualitative data into quantitative to give broader understanding and explanation to findings from the quantitative data.

3. Results

3.1. Herders in the Khangai region

3.1.1. Demographics of herders in the Khangai region. We involved relatively even numbers of men (n=23) and women (n=27) in the study, whose ages ranged from 32 to 93 years old ($\overline{X}$=51; Median=46.5; σ=14.2). Of the interviewees, 58% were under 50 years old. Elderly interviewees who were 65 years old or older mentioned that the average "age of herders was becoming younger." Out of all participants, 46% of them were 32-45 years old; 30% were 46-55

years old; 4% were 56-65 years old; 10% were 66-75 years old; and 10% were older than 75 years old.

The majority of herders who were interviewed had classroom education in a public grade school and received 3-10 years of education ($\overline{X}$=8; Median=8; σ=2.0). Of the interviewees, 14% attended school for 3-4 years, which is equivalent to elementary school education; 42% attended school for 5-8 years and received middle school education; and 38% attended school for 9-10 years and obtained high school education (32%) or specialized secondary education (6%). The remaining 6% of the participants did not give any response. They were all elderly people who were >75 years old. None of the participants went to college or university for higher education. According to a herder's statement, "if one received an academic degree, there is no need to live as a herder."

Most herders claimed that their ancestors were herders. Only 12% of them said that they were first generation herders and 6% were second generation herders. The other 82% of herders stated that they were third or more generation herders. The difference between herders' herding experience was great (Min=5 years; Max = 80; $\overline{X}$=32; Median=25; σ=17.9). The majority of the participants (86%) had >20 years of experience in livestock husbandry. Some herders (28%) stated that they had been living as a herder since their childhood. Regardless of their number of years of herding, the participants all grew up helping their parents or grandparents to herd livestock, which means they already had background knowledge about herding.

Most participants owned four types of livestock (sheep, goats, cattle/yaks, and horses). Sheep and goats are called *bog*[2] and cattle/yaks and horses are called *bod*[3]. The number of livestock varies greatly from a household to another. The lowest number of livestock was 5 and the highest was 1400 livestock ($\overline{X}$=487; Median=385; σ=355.4). There were five households that had more than a thousand livestock. They all received an award "Myangat malchin" (it translates as a herder with thousand or more livestock) from the government. Several other households that had nearly a thousand livestock would be getting the award soon. It appeared that herders had a big interest in increasing the quantity of their livestock. A female herder stated:

> If one has livestock enough for his livelihood, it is better to live in the countryside than in the city. But 200-300 livestock are not enough for anything. When we were little, it was fine. Just a *deel*[4] and boots were enough. Now, people's consumption and needs are so different. [People use] household appliances and vehicle. Herders herd livestock with a motorcycle. We didn't use to spend much money. We used to buy everything we needed by cashmere and still had enough money until the next cashmere season. We didn't need to get loans and credit.

However, some herders expressed their dislike against too much livestock. They mainly pointed out that too much livestock was not good for pastures. A few people mentioned that

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[2] small livestock: goat and sheep
[3] large livestock: horse, cattle, yak, and camel
[4] Mongolian traditional robe

having a large number of livestock was not great for herders' health and not easy to protect the herd from wolves. A male herder said:

> It is not easy to have a lot of livestock in the Khangai region. For example, when 1000 livestock go over a hill, it is hard to watch the entire herd. A part of the herd is on one side of the hill and the other part is on the other side of the hill. There have been incidences that wolves stole a sheep or two from the side of a hill that the herder couldn't see.

According to an older male herder, "Too much livestock is not good. The pasture capacity would reduce. It's better to have livestock that is enough for livelihood. I think that 400-500 livestock is most appropriate." A female herder stated:

> Lately, the carrying capacity of pasture has become bad. Field mice have multiplied a lot. Plus, a lot of livestock deteriorate pastures with hooves. Especially, goats and horses deteriorate pastures. I think that 600-700 livestock is good to get enough revenue. More than 700 is enough, but hard to find pastures. Less than 500 is really hard to get revenue from livestock sell.

On average, a herder family had four children. Only a small portion of herders' children decide themselves to continue the herder lifestyle. Herders commonly expressed that their children did not have much desire to live as herders. Only one child or in some cases none of their children wanted to continue their parents' nomadic lifestyle. A herder stated, "I have two daughters. They are not interested in becoming herders. Kids prefer cities and urban areas these days. They say that livestock is not interesting enough to them." Another individual said,

"…[Kids] prefer school better these days. They don't like the countryside that much. Hopefully, one of them will come to live in the countryside."

Younger parents do not want their children to become herders. They find the herder lifestyle is too difficult: "When *dzud*[5] occurs often, it is hard to live in the countryside." In some cases, adults (parents or grandparents) in the family make a decision for a child as to whether he or she will grow up as a herder: "… Well, if you purposefully pull a child out of school after 3rd or 4th grade, the child will become a herder. We just pulled one of my grandchildren out of school after he completed the 5th grade."

Herders appeared to use motorcycles more than horses for travel, stating that motorcycles were faster and more convenient than horses. Even though motorcycles are easier and faster, it is not an ideal tool to herd livestock. An elder herder pointed out, "letting sheep and goats wander slowly and graze is one of the essential ways to make the animals fat and fit. Therefore, horses, especially the ones that are trained for herding, are most ideal. Motorcycles are never able to go at the perfect pace for *bog*. In addition, a herder on a motorcycle has a lower chance of noticing injured, sick, or unfit animals in the herd."

3.1.2. Lifestyle of herders in the Khangai region. Herders move multiple times a year to provide their livestock with nutritious pastures and water sources as well as to prevent the land from being exhausted and deteriorated from overgrazing. Moving frequency varies due to pasture conditions. The majority (approximately 70%) of the participants claimed that they move three to five times a year, 16% move less than three times a year, and 14% move more

[5] Severe winter

than five times a year. Herders who prefer moving more often explain that being mobile is good for fattening animals and suitable for pasture health as well. To give an example, a herder stated, "My family moves ten times a year. The importance of regular moving is: first, animals get fat; second, the pasture gets to rest; and third, I can be a role model to others. Moving a few times is the fundamental of desertification…"

It seemed to me that herders liked to have people over to help, especially in warmer months. While visiting families, I observed that school children came back home during their summer vacation and helped parents and grandparents. At some herders' homes, I met their relatives from urban areas who were visiting their countryside families for a couple of weeks. Generally, it is common in Mongolia for urban people to spend time in the countryside to temporarily get away from city pollution. The family I stayed with was appreciative to have me as someone who could help their daily chores. As the host female stated, "Spring and summer are the busiest time of the year. There are so many extra works, such as receiving baby animals, take care of them, milking mares, cows, and goats, and preparing wool and cashmere." She added, "If there is no harsh disastrous weather, the winter is nice. Herders have a lot less to do and rest a bit."

Khangai families set up their yurts relatively closer to each other. In many cases, three to four families' yurts are right next to each other. Neighbors help each other a lot. For example, when I was at the herder family, foot-and-mouth disease vaccination was going on. Every family wanted their sheep and goats to get vaccinated. Two specialists from the province government administered the vaccine. I did not ask for greater details about these specialists. The family I stayed with had about 700 bog and their neighbors had approximately the same

amount of bog. The timeframe was short, therefore they had to come up with an effective system to complete the work. They built a temporary fence with a narrow exit. They put goats and sheep into the fence by small manageable groups. Goats and sheep would still try to escape. I never knew that sheep and goats were so strong and stubborn. Every family member of both families and myself participated to make sure every single one got vaccinated. We started early in the morning and finished in the late afternoon.

Herders' days start early in the morning. All household members have specific daily chores. There is a distinctive difference between household members' chores. Men are responsible for duties that are done away from home, such as searching and retrieving their livestock. Horses are not fenced and are free-ranging at night. Sheep and goats need to be fenced at night due to the potential risk of wolf attacks. Men's job around home is to help women by holding foals and calves while women milk mares and cows. To milk a mother animal, the baby needs to have milk first, then she lactates better. Milking cows is hard, but manageable by one person. However, milking mares is at least a two-person job. Compared to cows, mares are more difficult to milk. A person who is milking remains standing and has to be fast. Someone has to be holding her foal next to her. Foals seem to act impatient as well.

Women spend much of their time milking cows, goats, and mares. Cows are normally milked in the morning and evening. However, if a family has many milking cows and not enough people, then they milk cows only in the morning. Goats are milked in the evening. Mares are milked multiple times a day. The more mares with foals a family has, the more

airag[6] they can make, and possibly sell. Some families milk mares every two hours. As a female herder said, "Women's chores are simply non-ending. We do the same things every day." I had to agree with her. According to my observation, it looked like female herders accomplish a lot more a day. They get up early in the morning, milk the cows, make tea, make dairies such as yogurt, *aarts*[7], and *eezgii*[8], milk the mares, rest or more household chores (e.g., laundry), milk the mares again, milk sheep, make dinner or just have snacks, milk the mares once more, boil milk, and go to bed.

3.2. Wolf predation

Herders were asked to rate their agreement with the statements related to wolf predation (Table 1). I originally planned to use six-point Likert-scales (strongly agree=1, agree=2, neutral=3, disagree=4, strongly disagree=5, and not sure=6) to rate the statements. However, due to the lower number of respondents, I decided using four-point Likert-scales through merging 'strongly agree' with 'agree'; and 'disagree' with 'strongly disagree'. Unfortunately, nearly one third of participants either chose 'not sure' answer or left the question unanswered. Herders with 300-499 livestock and 1000≤ mostly answered to all statements. The majority of the respondents stated that wolves predate on livestock more when: 1) the wolf population increases; 2) the livestock population increases; 3) when wild prey of wolves decline; 4) when a herder lacks experience; and 5) when a herder lacks attentiveness.

[6] fermented horse milk, a favorite drink of Mongolians.
[7] dried sour curds
[8] dried toasted cheese curds

Table 1.
Responses to questions about wolf (Canis lupus) predation on livestock in the Khangai region of Mongolia based on interviews with herders.

The wolf predation on livestock is relevant to:	1	2	3	4
	Agree	Neutral	Disagree	Not sure/no response
the wolf population growth;	32	1	1	16
the decline of wolves' natural preys' populations;	30	2	1	17
livestock population growth;	21	2	7	20
lack of herders' herding experience;	30	2	2	16
lack of herders' attentiveness.	32	-	2	16

Although most herders stated that wolves predate on livestock more because of the increasing number of livestock, there was also a considerable number of disagreements as well. Herders, who chose 'disagree', often owned higher numbers of livestock (500-1400 heads of livestock). Only one herder had less than 200 livestock. According to one of these herders, "if a herder can be careful and responsible enough, they still can protect their livestock from wolves despite the large size of a herd."

3.3. Herders' knowledge about wolves

3.3.1. Wolf population according to herders. In the Khangai region, most local people called the wolf different nicknames, such as hangai, boohoi, hangain amitan (Khangai's animal), and heeriin amitan (animal from the wilderness). During some interviews, I was told to say hangai instead of wolf. Herders explained that calling the wolf by its name escalates the wolf's spirit and gives it more power of predation.

The majority of the respondents claimed that the wolf population in their areas decreased, especially in the last two years (Figure 2). However, in Jargalant soum, Bayanhongor, herders gave noticeably different answers. Because of its remoteness and challenging road conditions, fewer hunters are able or willing to travel to this area. Considering this reason, it is possible that the wolf population has increased or not changed in Jargalant, Bayankhongor.

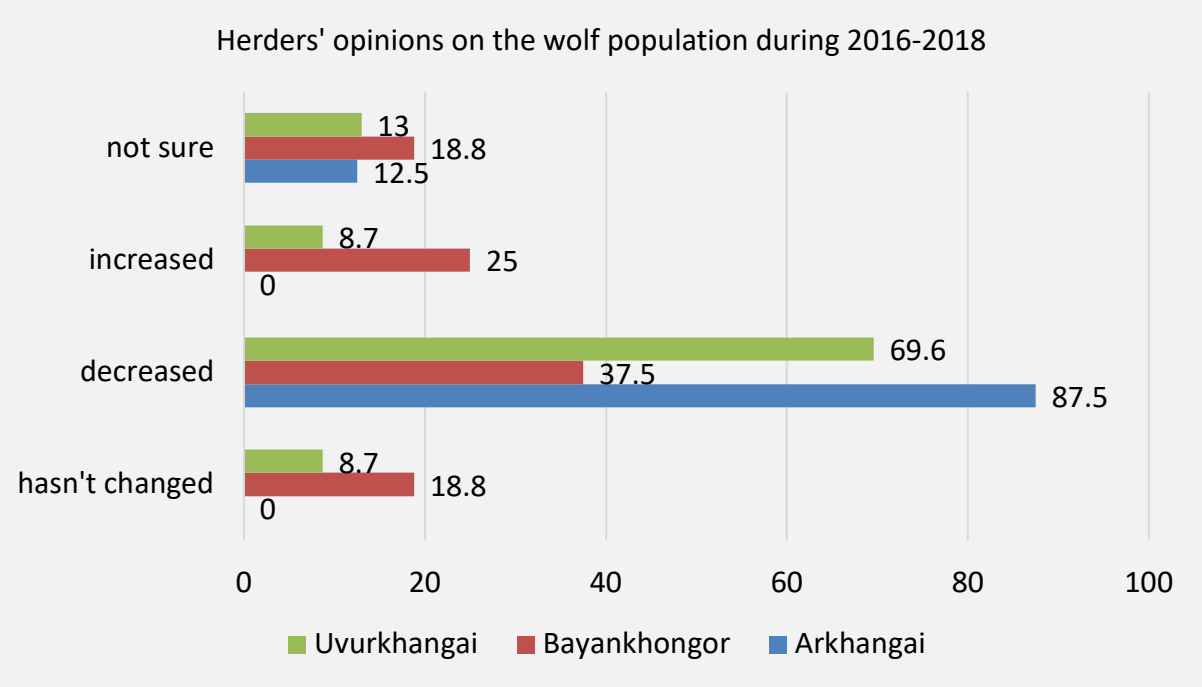

Figure 2. Herders' opinions on the wolf (*Canis lupus)* population by province in the Khangai region based on interviews.

According to most herders, wolves have been indiscriminately hunted in recent years. Herders mostly related the increasing motive of wolf hunting with high prices of wolf skins and body parts on the market. For example:

> Wolves are hunted more because their price has increased. When winter comes, its price reaches 100-300 thousand tugrugs [40-120 USD]. I heard their fangs are expensive.

> Based on the fang size, the price varies. I don't know how true it is. Maybe wolf fangs are used for medicine.

Another interviewee stated:

> Wolves are just killed indiscriminately. There is nothing to waste from a wolf. Every part such as the tongue, gallbladder, fauces of the mouth, and brain is good for some illness. Anklebones are to bring luck. And the meat and lungs are good for chronic respiratory diseases. Because of these reasons, wolves have been dramatically hunted.

Many people mentioned wolf fangs or canine teeth being sold at very high prices: "Wolf population is decreasing because of hunting. Wolf fangs have gotten expensive." A few interviewees told me that they had heard that a fang could reach a couple of hundred thousand Mongolian tugrugs (approximately 80 USD) depending on its size. I went to the Narantuul market[9] in Ulaanbaatar city to check wolf fang prices. At the antique section of the market, nearly every vendor was selling wolf fangs and anklebones. Vendors stated that wolf fangs were both from Mongolia and China. They clarified that Mongolian wolf fangs were more expensive, because they were real and large. Wolf fangs were priced from 15,000 up to 40,000 MNT (approx. 6-16 USD) depending on the size. A small fang with a length of 4.9-5 cm was 15,000 MNT (approx. 6 USD). Anklebones were priced at 25,000-35,000 MNT (approx. 10-14 USD) also depending on the size. The prices were not nearly as high as herders said. I was not able to see other wolf items' prices at the Narantuul market.

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[9] the most popular market in Ulaanbaatar

3.3.2. Wolf behaviors observed by herders. Because the wolf is the most concerning predator, every interviewee had either direct or indirect experiences with wolves. Herders often watch and observe how wolves behave. Based on their observations, they take suitable steps to protect their livestock.

Wolf behavior towards untended livestock. There is a saying in Mongolia that "wolves make herders better herders." In many interviews, people pointed out that wolves would always take advantage of untended herds. It is very important for a Khangai herder to keep their bogs in a fence area at night and be watchful during the day. While talking to herders, I noticed that most herders do not always blame wolves for losing livestock. This was consistent through all three provinces where I collected data. They rather criticize laziness and negligence of herders. For instance, a herder from Bayankhongor expressed, "If a herder is a slack then he will just give all his livestock to wolves. So, it entirely depends on the herder. Nothing else..." A woman from Arkhangai stated:

> Herders should stay next to their herds and protect their livestock. If you follow your herd all the time, you may lose a maximum of one or two *bog* to wolves, or no animal. *Hangai animal* is savage, if you leave your livestock untended.

In another herder's words: "Wolves greedily devour herds that are untended at night. Otherwise, they take only one or two animals while on a pasture. Wolves are not that evil." A man from Uvurkhangai also emphasized the significance of herder's responsibility: "…Wolves are sinless compared to livestock disease or *dzud*. Wolf attack is relevant to a herder's responsibility…"

Several interviewees pointed out that wolves predate on horses often as well. Horses usually are left untended, especially at night. Foals, especially, are vulnerable prey for wolves. A man from the same area also said:

> Herders tend to dislike wolves. They are predators. A few winters ago, [B]'s family lost all of their foals, [N] lost some, and we lost some too. Altogether almost 40, 50 horses were eaten by wolves. This is an example just from this neighborhood.

Herders have to watch their horses at night during the period when foals are born. However, families with fewer men or older men do not have the ability to do so.

Wolf's aggressive behavior. There are certain periods that herders perceive that wolves become more aggressive and attack livestock more frequently. These periods include the scarcity of wild prey, the mating season, and the period when wolf pups' start eating solid food. According to most of the interviewees, wolf predation increases in fall when wild prey species (e.g., Siberian marmots, *Marmota sibirica*) enter hibernation. They pointed out that during summer time, wolves depend on the marmot and rabbits more and wolf predation on livestock is not high. I found it interesting that nobody talked about the interaction between wolves and larger wild prey species. Perhaps, their relationship is not observed in comparison to the relationship between wolves and small prey.

A considerable number of herders reported that another increased hostility period of wolves occurs around their mating season. Wolves mate in winter. During this time, wolves are seen more often in packs. According to a herder from Uvurkhangai:

In winter during their mating period, wolves are noticed running around in packs. They are more aggressive around that time. A lot of snow falls here. I saw tracks of five to ten wolves were left. I saw six wolves running together in one winter.

However, some people had contradictory statements about the increase in wolf attack during winter. A herder from Arkhangai stated, "… Winter is fine. We put several scarecrows around our winter camp and dump ash around the sheep fence. People say that the wolf doesn't step over ash. When it steps over ash, then its *hiimori* dies."

Herders also reported that the period when wolf cubs become available ingest solid food is another concerning time for them: "When wolf cubs start eating meat, wolves are really ruthless towards small livestock or younglings, such as *bog* and foals." Wolf pups become able to ingest solid food from the age of two months (Mech and Boitani 2003). In addition, herders also pointed out that wolves sometimes took a goat kid or lamb alive in order to train their pups to kill.

As I observed, herders from the Khangai region do not feel too upset about a small amount of livestock loss. However, there are occasions that wolves killed livestock in large numbers. This is probably the most unacceptable behavior of wolves to herders. A number of interviewees used a Mongolian tale to describe the wolf's surplus killing behavior, saying, "God (or Buddha) allowed the wolf to eat one out of one thousand sheep. But the wolf misheard him that he should leave only one sheep alive out of thousand." Another interviewee said, "When wolves catch one, they just want to finish the entire herd. They run through a herd, gnawing and ripping the throat and the tail of sheep."

During interviews, I heard some stories about massive killings by wolf packs. Some interviewees shared stories about others and some shared personal stories on what happened to themselves. A man from Bayankhongor mentioned in his interview, "younger mischievous wolves tend to kill more than they need." A woman from Uvurkhangai said, "Wolves sometimes destroy a herd on pasture by injuring and biting. They basically amuse themselves with sheep and goats. In that case, people decide to [hunt] and scare them away." A herder from Arkhangai complained "If there is a beautiful foal, wolves will just eat it, if there is a lone horse, wolves will eat it too." A female herder from Bayankhongor, whose family experienced various losses, clearly did not show sympathy towards wolves: "Wolves are bad animals. When they attack, they kill three to four animals at once."

While talking to the interviewees, I observed that herders become highly frustrated when wolves injure numerous livestock at once and make them not able to survive. Herders claimed that wolves usually harm livestock by biting the throat and tail. A woman from Uvurkhangai said, "There have been many incidents that wolves attacked inside the sheep fence and severed the sheep's throats and tails…" Another woman from Bayankhongor also expressed a similar complaint: "When wolves get into the fence sheep, they destroy the sheep and goats, and injure multiple. They would cut the throats and tear the tails off. When they chase livestock on a pasture, they always leave many injured."

The livestock injured by wolves does not bring any monetary value to herders. Also, herders do not consume the meat for their own use either. Eating livestock meat that was killed by a wolf is a local taboo. This taboo could be related with potential disease prevention, because wolves may carry serious transmissive diseases such as rabies.

My understanding from herders' comments is that surplus killing happens rarely. There was only one interviewee who lost a lamb to a wolf a few days prior to being interviewed. For example, according to a male herder from Uvurkhnagai stated, "Compared to other areas, wolf attacks happen relatively less." Also, a man from Arkhangai said, "Once in a while, wolves predate on livestock. They usually take two foals a year." Some herders expressed that wolf attacks occurred less frequently due to the reduction in wolf numbers. An elderly woman from Bayankhongor stated:

> For a while there were many wolves. Wolves are so mean. When they attack, they tear 3 to 4 animals. But in the last two years, wolves have decreased. People say that *hangai* has been nice. People's livestock overnight without fencing, and I haven't heard that there was any wolf attack.

Because people were not very specific about their livestock losses to wolves, it is difficult to estimate their economic losses. In my understanding, in most cases when wolves do not predate multiple adult animals (perhaps $\geq$3) or *bod*s, herders care less about their losses.

Wolf's vengeful behavior. Mongolians always say that wolves take revenge on humans. According to some interviewees, *beltreg suilah*[10] is usually a major cause for wolves to act vengeful: "People say that wolves are revengeful. In spring, people steal the cubs and leave the mother lonely. So, it's understandable that she bears a grudge."

Beltreg suilah is one method that is used to control the wolf population. Generally, the one who is taking cubs shall not take the entire litter. At least one or two cubs need to be left

[10] taking cubs from their dens

in the den. The usual perspective amongst herders is that the mother wolf takes revenge when all her cubs are taken. As herders explained, the mother wolf tracks down the person who killed her cubs and destroys his livestock.

There is a common customary rule that everyone needs to follow after taking cubs from the den. It is important that if someone killed wolf cubs, that person has to go home directly without stopping at any other people's homes. Otherwise, the mother wolf may kill those families' livestock as well.

Wolf's behavior near its den. There is a proverb in Mongolia "*Chono uurendee ulziitei*." It basically means the wolf is gracious in its den. Herders explained this proverb two ways. A group of people said wolves do not do anything against an intruder who crawls into the den to take the cubs. A male herder shared his experience taking cubs: "I used to take wolf cubs from their dens. I even got into the den when the mother was inside. The mother does not do anything in the den against anyone who is taking her puppies." Another group of herders explained the proverb much differently. According to them, wolves do not predate on livestock near their dens. This is a perception that has been held amongst herders for a very long time. An elderly interviewee recalled that her parents used to say to her about wolves not predating on livestock near their dens:

> My parents used to tell me that it seems like *hangai* gave birth recently, so it would be alright to graze the sheep around its den… I think there is truth to that that wolves don't eat livestock near their den. That may be their way to defend their cubs. They probably know that if they attack on livestock in the close neighborhood, humans will devastate their den.

In another herder's words: "*Chono uurendee ulziitei* is true. When a wolf gave birth near [a campsite], she doesn't attack livestock of near families, even when horses graze near the den. However, if someone takes her cubs, then she becomes very aggressive and devastates [livestock in the neighborhood]."

Although the majority of the interviewees agreed that wolves do not attack livestock in the close range of their dens, two younger herders disagreed with the statement. According to them, "wolves predate on livestock anytime they want."

3.4. Herders' practices used for co-existing with wolves

Wolves are controlled both non-lethally and lethally in the Khangai region. Non-lethal methods are basically preventative actions taken by herders in daily life. Lethal control is taken when the frequency of wolf predation on livestock increases.

3.4.1. Non-lethal methods. Herders use various non-lethal wolf control methods. Always watching the livestock, using guard dogs, making smoke, erecting scarecrows, and projecting a bright light are popular methods used by herders. Nearly every interviewee stated that they used these methods. There are other several less popular methods as well, including scaring wolves away by shooting into the air with a gun, putting ash on the ground as a spiritual barrier, and making a perimeter with a rope around sheep fences.

According to herders, wolves detect untended herds. Interviewees from all three provinces consistently stressed the importance of always watching the livestock. An elderly herder, for example, emphasized the significance of paying close attention to the livestock, saying, "Herders need to watch their livestock well and enhance their herders' responsibilities, then there will be less wolf predation."

Every yurt has at least one dog outside, mostly two to three, and in some cases even more. It is easily observable that the dog is not a pet to herders; rather it has a job to guard the campsite. Only younger kids are sometimes seen playing with a dog. Herders admire good guard dogs. For example, an interviewee said "During wolves' aggressive period, I watch my herds with my dog all the time. A dog's discipline depends on its owner." Another elderly herder said:

> Dogs are as responsible as humans. Dogs are alert and have keen sense of smell. Shepherd dogs sleep a lot during the day and watch the animals at night. We have a good dog. It is important to receive a good dog's offspring before he gets too old. Bad dogs are like *hatavchnii hog*[11].

Bankhar is a Mongolian mastiff with a large body, a thick neck, and a strong chest. Because the dog's neck gets so thick, a collar does not sit on the neck properly, instead it just slides out. In some cases, herders complained that it had become hard to find a real *Bankhar* in the modern days. In an interview, a herder criticized her dog, saying, "We have a young dog. He's so scared of wolves. When he sees a wolf, he runs away with his tail tucked between his legs." During an interesting conversation with a man from Ulaanbaatar, I was told that more urban young people have increasing interest in raising *Bankhar* and using them in dogfights (Bold B., personal communication, September 21, 2018).

Herders burn frozen dung with wool debris to make smoke around their campsite. This method is used more in winter and spring seasons, and appears to be an effective way to keep

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[11] *Hatavchnii hog* translates dirt in the jamb of a yurt, meaning that a bad dog just uselessly lies at the door.

wolves away. One herder claimed that the smoke is the best method to keep wolves away: "We use a scarecrow, a light, and smoke. The most effective method is smoke. Wolves stay away from smoke and don't come close." Some herders said that the smoke would be still smoking in the morning.

Nearly every interviewee said that they used a scarecrow. However, while visiting herders' yurts, I never saw any scarecrows outside. Possibly, scarecrows are only used in colder months. A herders' scarecrow is basically a hanging *deel*[12] on a simple T shaped wooden object. The *deel* has to be very old, because wolves can sense the human scent better. "If there is a scarecrow near the sheep fence, a wolf would avoid it and not directly attack the sheep." When wolves are used to coming to campsites, scarecrows lose their effectiveness.

Projecting a bright light at night seemed to be a newer method among Khangai herders. I spotted that almost every herder's yurt had a small scale portable solar panel on roof and a car battery inside the yurt. During daylight, the battery would be charged by the solar panel and during nighttime the battery would be used to project a bright light. According to a herder, a blinking light is more effective to keep wolves away, "I bought a blinking light at a market. A blinking light seems better than a plain bright light."

Some herders shoot into the air to scare wolves away. Even though this method was stated regularly, it is not used as much. Perhaps, it is because not every household owns a rifle. A few herders mentioned that they put ropes around their *bog* fences or dump ashes around

[12] Mongolian traditional robe

campsites. There are Mongolian folklores and legends that wolves do not go over or under any twisted strand or wolves do not jump over ash.

3.4.2. Lethal methods. In general, most herder households in the Khangai region experienced animal losses due to wolf attacks. More regular wolf attacks anger herders, create fear in some, and trigger people to take lethal population control actions. There are two main lethal methods that are commonly used in the Khangai region, including hunting and *beltreg suilah* (mentioned in section Wolf's vengeful behavior). Before the socialist era in Mongolia, a very few people who hunted owned simple rifles, known as *tsahiur buu*[13] in Mongolia. Due to the scarcity of guns, people used traps more often than guns to hunt wolves. As one male herder said: "Traps are out of fashion" in the present time. Nobody mentioned other hunting methods, such as bow hunting. From the interviews, I posit that *beltreg suilah* was regularly used among herders in the past. Especially during the socialist years, a *beltreg suilah* campaign was organized by the state every spring (Wingard and Zahler 2006).

Currently, retribution killing is used when wolves regularly visit herders' campsites and predate on livestock. When these incidents occur frequently, herders hunt wolves to reduce potential harms by wolves and the wolf population as well: "When there are too many wolves, people hunt them and take cubs from dens in spring." According to most herders, if the loss is minor (e.g., 1-2 sheep or 1-2 goats or 1-2 juveniles), they do not rush to take any lethal action. Here is a related response from an interviewee in Arkhangai: "We don't care if wolves take one *bog* or two. We just see that *hangai* as a nature's animal has taken its share from [us]. But if it

[13] Flint rifle

happens too many times, then we handle it differently." When wolves take adult *bod*s or a considerable amount of *bog*s, herders hunt wolves: "When wolves take three to four sheep, then we will attempt to hunt them. Men kill some if they can. But mostly they can't. They come back home later with broken guns and motorcycles (laughter)." Losing an adult *bod* is a costly loss to a herder:

> It is fine, if the loss is not much, such as one foal. It is difficult for us if wolves kill adult animals. If a large pack attack on adult horses or if wolves come to the campsite and take sheep regularly, then men decide to go to scare them away or hunt. [Otherwise] wolves become accustomed to coming to the [campsite].

The *belrteg suilah* method has controversial views among herders. People who do not hunt use this method more to prevent wolf attacks. A male herder said, "It is difficult in the Khangai region if wolf cubs are not taken in spring… This [action] used to be done cooperatively. It hasn't been done lately since [the free market]. Now, there are not many people who do that." Some herders also claimed that the wolf population increased because *beltreg suilah* was not currently used as much. Most of these interviewees supported using this method:

> Mongolians have controlled the wolf population by hunting and *beltreg suilah*. The wolf population increases when people don't steal cubs from the den these days. One should kill wolves, whenever he can. In spring, *beltreg suilah* should be done if it is possible.

Interestingly, this interviewee told me that wolf attacks were rare and her family typically lost a foal a year; she still showed a strong dislike towards wolves. Unlike this interviewee, others were not supportive about *beltreg suilah* at all. A male herder stated,

“There is nothing profitable from killing cubs. Even their skins are not worth to use. So, there is no need to kill wolf cubs.”

3.5. Herders’ beliefs related to wolves

3.5.1. Wolf, the spirited animal. It was evident that Mongolians see wolves as *hiimoritoi* or spirited animals. In the Great Thesaurus of Mongolian (n.d.), *hiimori* is defined as spirit, demeanor, glory, mightiness, and more. When I asked the interviewees to explain *hiimori*, few could explain or articulate the meaning. For instance, one herder indicated: “I myself understand *hiimori*, but I can’t really explain it… [Hiimori] is more than just luck.” Herders referred to wolves many times as brave, intelligent, lucky, strong, and animals uneasy to hunt. These definitions were mostly used to describe the spiritedness of wolves. Especially, ‘wolves are not easy to hunt’ was repeated more often than others. A man described the wolf’s *hiimori*, saying: “Wolves are spirited animals. [For example], while hiding to ambush a wolf, it gets away as if it knew that someone was waiting for it there [to hunt it].”

Both male and female interviewees told me about the difficulty of hunting wolves. A man, for instance, said: “They are spirited. They don't get killed or seen easily by anyone.” A woman said: “Wolves don't get killed by man that easily. They are born to remain standing.” I never met a woman who hunted in Mongolia. Also, not every male herder I interviewed hunted. I speculate that hunters shared their stories and adventures about wolf hunting, and the interviewees referred to their experiences.

Based on the interviewees’ answers, it seemed to me that most herders indicated *hiimori* as good luck and good fortune. There is a Mongolian proverb: “Wolves are seen by men who are equally spirited/fortuned and killed by men who are more spirited/fortuned.” The

interviewees frequently brought up this saying during interviews: "[Seeing a wolf] is almost better than hearing mantras from a higher ranked lama. Everybody says that coming across a wolf is a good thing. People say that I am *hiimoritoi* because I saw a wolf." Another example stated:

> Wolves are seen by people who are fortunate to see them. People who are fortuned to kill wolves kill them. For example, there goes a wolf and some people could see it, while some people wouldn't see it. Lately, people hunt wolves to *hiimori sergeeh*[14].

It was interesting to hear people saying that wolves can feed themselves without any help as if any other wild animals do not do the same: "Wolves are spirited because they find their food themselves"; and also: "Wolves feed themselves using their natural strength." This suggests to me that people may admire and respect wolves, because wolves hunt to eat, and in some cases, they need to steal from humans putting their lives in risk.

3.5.2. Wolf, the respected animal. The majority of the herders said that they showed respect towards wolves. According to them, the main reason for their respect is *hiimori* of wolves. Wolf's *hiimori* is about its bravery, intelligence, and capability to survive:

> Wolves are lucky, intelligent, and alert. They can protect their lives and are good at escaping from bad things. Wolves are so brave. A wolf can bite its own foot off to free itself from a trap. That is so much bravery.

[14] heighten the spirit

My prediction prior to the data collection was that most people would say they respected wolves because of Chinggis Khaan, as a mythological descendant of a wolf and a deer. However, besides two interviewees, nobody mentioned Chinggis Khaan's name.

A few interviewees also stated that herds grow in areas with wolves. In their words, herds that were attacked by wolves grow fast again: "If *hangai* takes an animal [from a herd], the herd grows again fast." An elderly man shared a story about a large loss caused by wolves:

> When I was young, I experienced a very bad harm by wolves. After I had come back from the army in 1969, I got married and received a herd of horses with nine mares with foals. I lost seven of the nine foals. Someone told me that now your horses would grow. I had about 20 horses. Within in the next few years, my horses reached 100. It is so true that *hangai hayatai*[15]. After that incidence, no wolf ate from my herd, even my herds grazed in areas with many wolves.

In addition, respect to wolves may also be associated with Mongolians' spirituality. In nature, everything has a mythical master or nymph. The wolf is viewed as the master of Khangai. When wolves attack on a herder's livestock, they consider it as the master taking his share that he is supposed to take. For instance, herders prefer losing animals to a wolf rather than to a thief: "Compared to different types of diseases and thieves, wolves are sinless animals that take what they have to take. When a wolf eats an animal from us, we just consider it as a loss that we are supposed to have."

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[15] *Hangai hayatai* means wolf is giving.

A Mongolian proverb insists, "*Choniin am tsagaan, khulgain gar har*." It translates "wolf's mouth is white and a thief's hands are black." The color white represents pureness and holiness, while the black color represents the opposite, such as bad, dirty, and evil. In other words, when a wolf takes an animal, the outcome of it is not bad. On the other hand, if a thief steals livestock, that is very bad and this would "*open a door of continuous bad luck*" to the family.

3.5.3. Wolf, the healer. When herders were asked "What benefits do wolves have?", many of them talked about the wolf's healing characteristics. According to the interviewees' statements, wolf meat and organs are used to cure certain illnesses, especially respiratory related diseases: "… [Wolf] flesh is good for various illnesses. Many years ago, I used wolf tongue for chronic tonsillitis and it's cured now." Another individual stated: "Wolf's organs, stomach, and tongue are used for curing illnesses. My youngest son used to have laryngitis. I wrapped wolf tongue on his throat. Since then he didn't suffer from laryngitis."

Another healing characteristic of a wolf is its roles in ecology. Respondents often mentioned that "wolves keep ecosystems in balance," "wolves eliminate livestock diseases," "wolves eat ill animals," and more. During my data collection, numerous *soums* of Uvurkhangai and Arkhangai were quarantined due to outbreak of foot and mouth disease. Thousands of livestock were infected, and had to be put down. A common opinion was that diseases such as foot and mouth spread in the Khangai region because of the decreasing population of wolves in the last two years:

> I don't know what roles they have in nature. But I believe they do have their own roles in nature. I think various diseases in livestock spread due to the decreasing population

of wolves. In the old days, wolves were abundant. Foot and mouth disease and rabies were not too bad. So, I guess wolves eliminated diseases, not sure.

Although people were generally aware that wolves played an important role in ecosystems, a significant number of people stated that they did not know the ecological benefits of wolves. Some interviewees said that wolves did not have any benefits at all. Interestingly, herders talked about medicinal benefits of wolves more than their ecological importance.

4. Discussion

This case study had three aims. The first aim was to understand the lifestyle and culture of herders in the Khangai region. Most herders in the Khangai raise four types of livestock. They usually have more *bog*s and fewer *bod*s. On average, Khangai people move once in every season. Depending on the weather and pasture conditions, herders go for *otor*[16] to use distant pastures for fattening their livestock (Suttie, 2005). Going for *otor* is usually a hard job because using pastures in different provinces usually raise conflicts between *otor* herders and local herders. More frequently occurring *dzud* in winter and droughts in summer are a main cause for herders to go for *otor*. These weather events can be severe and affect herders' lives and livelihoods. For example, in the winter of 2017, over 700,000 livestock died in *dzud* in Mongolia. Fernández-Giménez et al. (2012) suggested that the severity and periodicity of extreme weather conditions might relate to global climate change.

[16] Migrating to faraway reserved pastures during dzud

Although Khangai herders have kept nomadic' traditions. Some negative changes in the herding style have been occurring. The most noticeable example is that every herding household has one motorcycle or more. Although motorcycle use is not a new thing, it has become a common thing, especially among herders (Fraser 2018). This is happening in many regions of Mongolia (e.g., Davie et al. 2014b). During the socialist period, motorcycles were used only by collective chiefs, but were not owned by them (Fraser 2018; Humphrey and Sneath 1999). Motorcycles are practical and convenient; however, it is not viewed as an appropriate means to herd livestock. Elder herders recommend to "use livestock (a horse) to herd livestock" (Yondonsambuu 2014, p. 50). More widespread use of motorcycles probably allows herders to more effectively chase/hunt wolves. It perhaps results in higher levels of successful wolf kills.

Another negative change is that younger generation of herders move less often than the previous generations and have become more immobile. Moving often is critical for the pasture's health and regrowth. Elder herders criticize younger herders for settling near soum centers, where are more convenient and closer to the market, and for not grazing livestock in distant pastures. It results in weak livestock that is not capable to resist harsh weathers and pasture degradation (Yondonsambuu 2014).

Another significant change occurring in herding is the massive increase of livestock numbers. It appears that raising more livestock has become a trend among herders of Mongolia despite the limited capacity of the region's ecosystem to support larger herds. For example, in the eastern Gobi, where it is more arid and drier than the Khangai region, herders tend to have larger herds (Davie et al. 2014b). The government of Mongolia also encourages

herders to breed more livestock and award them with a "*Myangat Malchin*" title when a herder's herd reaches a thousand animals. According to the National Statistics Office of Mongolia (2019), nearly 71 million livestock were counted in 2019. The livestock population has more than doubled since 2010. All three provinces in this study were in the top five provinces with the most livestock (National Statistics Office of Mongolia 2018). Herders are well aware that too many livestock animals, especially horses and goats, negatively impact pastures. Also, herders know that it is difficult to protect large herds from wolf predation in certain landscapes, such as hills and woods.

The second aim of this case study was to understand the relationship between herders and wolves in the Khangai region. In general, based on the findings, I posit that Khangai people are accustomed to living in an area with wolves. People generally hold a neutral position towards wolves. Compared to other regions, such as the Gobi and eastern steppe, herders in the Khangai region might have a higher tolerance towards wolf existence and predation (Kaczensky et al. 2008; Mijiddorj et al. 2018; Reading et al. 1998). However, they still prefer to keep the wolf population at a low level. The major reason is probably related to financial losses caused by wolf attacks. Certain people, especially women, openly appreciated that there were fewer wolves in their areas in the last two years, even though they stated wolf predations happened '*not that often*' in their area. As female herders stated, they do not have much direct experience with wolves, because they stay at their campsites for most of the time. A lower level of wolf acceptance might be related to fear (Kellert and Berry 1987), which is also associated with a more negative attitude towards predators (Røskaft et al. 2007).

The third aim of this research was to recognize the role of TEK in relation to wolves. Khangai herders have observed wolves for many generations and accumulated knowledge on how to protect their livestock from wolves and how to co-exist with them. Their knowledge is based on their own individual experiences as well as those learned from others through oral traditions. As results show, Khangai herders understand that the wolf has an important role to hold the ecological balance and keep the ecosystem healthy. Some herders relate the outbreak of foot-and-mouth disease in the Khangai region with the wolf population decrease. The cause of the outbreak of the disease in Mongolia remains uncertain. I have not found any specific study on the connection between wolves and foot-and-mouth disease. According to the USDA report, dogs were a probable mode of foot-and-mouth infection in cattle in California in 1924 (Olitsky, Traum, and Schoening 1928). Also dogs and coyotes possibly played a role in spreading this disease in Mexico in 1950 (Lyon et al. 2018). In general, however, numerous studies have indicated that wolf predation directly and indirectly affects herd health and plays a key role in controlling infectious diseases (e.g., animal tuberculosis and prion disease) in prey animals (Laporte et al. 2010; Mech and Peterson 2006; Tanner et al. 2019; Wild et al. 2011). Also, it has been observed that the presence of wolves can affect behaviors of certain prey species, such as elk and cattle (Laporte et al. 2010).

Khangai herders use various methods to protect their herds from potential wolf attacks. All the methods have been used for generations. A relatively new method is to flash a bright light outside the *bog* fence at night. Wolves tend to be shy away from novel stimuli and therefore light can be a helpful tool to keep them away temporarily (Bangs et al. 2006). Nearly every interviewee uses the same methods, however, a herders' own carefulness and good

guard dogs are most reliable. Good dogs are a great help to herders, especially in deterring wolves and thieves (Lugli, 2016). Hovens & Tungalaktuja (2005) also recommended guard dogs being one of the most efficient ways to protect livestock from wolves. Unique methods, which are possibly only used by Mongolians, such as putting a rope around the livestock fence as a perimeter and dumping ash around campsites are also somewhat common. Perhaps these methods are relevant to Mongolian traditional folklore. However, they are not unanimously accepted by herders as reliable methods. They perhaps only work in areas where the wolf population is low. There is also a common belief among Khangai herders that wolves avoid to predate on livestock that is located near their dens. This is exactly opposite than a prevention recommendation given in other countries. Studies in the United States, for instance, demonstrate that wolf predation increases when livestock is located closer to wolf dens (Bradley and Pletscher 2005; Treves et al. 2004).

Talking to Khangai herders about wolves, they often expressed a certain level of respect, astonishment, and amazement towards the animals. According to Davie et al. (2014b), herders in the eastern Gobi also show admiration and respect because of the wolf's intelligence and skills to survive. Traditionally, the wolf was one of the totem animals and calling a totem animal by its name was a taboo (Punsag 2003). During some interviews, I was told to not call wolf as its name. This suggests that the taboo tradition may still exist in Khangai. Most herders agreed that they respected wolves because they were spirited animals. Herders' statements suggest to me that their respect towards wolves is related more with the people's spiritual connections with nature. Because the wolf is the messenger of Khangai, losing livestock to wolves is considered as an offer to the Khangai spirit, who would help to grow more livestock.

Some herders strongly believe that wolves predate on livestock of people who have done bad things to nature, mentioning cutting trees and polluting water. In other words, wolves are nature's way of giving warnings and punishments to humans who are destructive to ecosystems.

Hunting has always been a part of nomadic culture. Historically, wolf hunting was done when it was necessary. As results suggest, local men living in close proximity usually go hunting or retribution killing of wolves as a group when wolf danger increases. If there is an experienced wolf hunter in the area, herders usually invite him. Herders also call hunters from urban areas to hunt wolves when wolves attack livestock regularly. In most cases, hunters are not able to show up immediately. Besides hunting, *beltreg suilah* or taking wolf cubs from den is another method that is used among Khangai herders. *Beltreg suilah* might be used in every region of Mongolia, because this method was heavily used in entire Mongolia during the communist socialist era (Wingard and Zahler 2006). In the eastern and western Gobi regions, for example, this method is still in used by herders (Davie et al. 2014b; Kaczensky et al. 2008). Outside Mongolia, in former soviet countries, such as Russia, Poland, and Czechoslovakia, removal of cubs from den was one of the most common methods of wolf destruction (Pimlot 1975). In the U.S.A, killing wolf cubs was recommended by some wolf hunters, when the country had a goal to exterminate wolves (Corbin 1900). In Mongolia, however, when using this method, at least one or two pups must be left in the den. Saving some cubs has to the effect of not eliminating all wolves from the area, which could be an alternative conservation aspect behind the method.

Results suggest that wolves started to decline in the study area in 2016. Herders' perceived cause for this decline is excessive hunting by urban recreational hunters. Wolf hunting could be associated with the increasing demand of wolf meat and the high price for wolf meat, organs, and other body parts on the market. Traders openly sell wolf carcasses and parts at domestic markets (Parkinson et al. 2008). Wingard & Zahler (2006) reported that a wolf was equivalent in value to 300-350 USD on the domestic market and 375 USD on the international market in 2006. Also, Kaczensky et al., (2008) reported that wolf hunting was increasing on the southern border of Mongolia because of the high prices in China for frozen wolf carcasses. According to a survey by Wildlife Conservation Society Mongolia, wolf meat and parts are used to treat high blood pressure, thyroid, stomach and lung diseases (Parkinson et al. 2008). Khangai herders also seem to be convinced that wolf meat and organs have some quality to cure illnesses. It is possible that the demand for wolf carcasses and organs could still be high even in present days.

In conclusion, the findings of this case study demonstrate that herders live in a type of balance, both harmony and rivalry, with wolves in the Khangai region. Even though wolves cause challenges for herders, there is a broad acceptance among herders in the Khangai region that wolves make herders more responsible and accountable. It would be interesting to conduct similar research on herders in different regions (e.g., high mountain, taiga, steppe, and desert) and study their TEK that applies to wolves.

On one side, co-existence of Khangai herders and wolves is a medley of human responsibility, respect, care, understanding of nature, and some punitive approaches. On the other side, it is noticeable that Khangai herders are losing TEK or not valuing important aspects

of TEK of pastoralists. Traditionally, one of the essential roles of a herder is to raise livestock without compromising the wellbeing of other environmental elements, including pasture, water, wild animals, and more (Sumya 2005). In the present time, however, it has been observed that herders mostly want to increase livestock in higher numbers and prefer quantity over quality of livestock. Also, herders are willing to have fewer wolves, because wolves are a threat to their livestock. This study's findings indicate that wolves are only responsible for a small amount of livestock losses. But the overpopulation of livestock is probably a more significant and dangerous threat to the livestock industry, herders' future, and wildlife. According to the National Statistics Office of Mongolia (2019), livestock growth is not only occurring in the Khangai region, but rather in the entire nation. This rapid growth in livestock is already leading to serious environmental problems such as overgrazing, pasture degradation, and habitat loss of wild animals (Batkhishig 2013; Ito et al. 2013). The governmental incentive to raise more livestock is exacerbating these problems. Therefore, promoting actions towards sustainability is essential.

This study suggests several potential conservation actions that can benefit both herders and wolves. These include: developing incentives for herders to raise less livestock with better quality; promoting sustainable livestock herding based on traditional knowledge; promoting conservation activities towards natural prey species of the wolf; and developing wolf management strategies. I posit that improvement of livestock quality, promotion of traditional herding, and wildlife conservation need to be national policies that could be implemented in every region of Mongolia. But specific regional wolf management strategies should be developed taking into consideration the differences in ecosystems and natural landscapes.

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Appendix 1. IRB approval

Dear Tuul Sukhbaatar,

As Chair of the Institutional Review Board (IRB) for 'Antioch University New England, I am letting you know that the committee has reviewed your Ethics Application. Based on the information presented in your Ethics Application, your study has been approved.
Your data collection is approved from 07/20/2018 to 07/19/2019. If your data collection should extend beyond this time period, you are required to submit a Request for Extension Application to the IRB. Any changes in the protocol(s) for this study must be formally requested by submitting a request for amendment from the IRB committee. Any adverse event, should one occur during this study, must be reported immediately to the IRB committee. Please review the IRB forms available for these exceptional circumstances.

Sincerely,

…

Appendix 2: Questionnaire

- Name:
- Age:
- Sex:
- Education:
- Address:
- Since when have you been herding?
- What kind of livestock do you have? (Number of each kind of livestock)
- How many generations of your family have been herders?
- Do you have children who want to be or have become herders?
- How many times do you move in a year?
- How have Mongolians controlled the wolf population?
- How do you thing the wolf population in your area has changed over the last five years?
- Why has the wolf population changed?
- How often do wolves predate on livestock?
- How much loss of livestock in a year is acceptable to you?
- What methods do you use to protect your livestock from wolf predation?
- Who have you learned these methods from?

Please indicate how strongly agree or disagree with the following statements. Select one choice per statement.

Wolves predate on livestock more often:	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Not sure**
when the wolf population increases;						
when populations of wolves' natural preys decrease;						
when the livestock population increases;						
due to lack of herders' experience;						
due to lack of herders' attentiveness.						

Appendix 3. Mongolian terms used

Aarts	Dried sour curds
Aimag	A first level administrative subdivision of Mongolia, similar to province
Airag	Fermented horse milk
Bankhar	Mongolian mastiff
Beltreg suilah	Taking wolf cubs from their dens
Bod	Large livestock (i.e. horse, cattle, yak, and camel)
Bog	Small livestock (i.e. goat and sheep)
Boohoi	Local name for wolf
Chono uurendee ulziitei.	A Mongolian proverb: the wolf is gracious in its den.
Deel	Mongolian traditional robe
Dzud	Severe winter
Eezgii	Dried toasted cheese curds
Hangai	Local name for wolf
Hangain amitan	Local name for wolf
Hatavchnii hog	Dirt in the jamb of a yurt.
Heeriin animal	Local name for wolf
Hiimori sergeeh	Heighten the spirit
Otor	Migrating to faraway reserved pastures during dzud
Soum	A second level administrative subdivision of Mongolia, similar to county
Tsahiur buu	Flint rifle
Tugrug	Mongolian currency

Preface to Chapter Five

Chapter Five is written as a stand-alone document in journal article format (Manuscript 2). This chapter focuses on exploring differences and similarities in perceptions of different stakeholder groups on wolves of Mongolia. It also describes changes that are occurring in Mongolian traditional cultures and the impacts of these changes on people's perceptions of wolves.

Chapter Five begins with an introduction section that describes the importance of public perceptions in wildlife management and decision making. I then briefly describes changes in Mongolian peoples' perceptions of wolves and potential reasons that have likely caused these changes. The introduction section is followed by research design, results, and discussion and conclusion sections. The research design section describes methods that were chosen for the research, defines study sites, and explains participant selection and data analysis processes. The results section provides findings from quantitative and qualitative data analysis. The final discussion and conclusion section presents similarities and differences in perceptions of stakeholder groups on wolves in Mongolia.

Chapter Five. Manuscript B. Perceptions of Different Stakeholder Groups on Wolves of Mongolia

Abstract

In order to understand public perceptions on wolves in Mongolia, this study examined the perceptions of four Mongolian stakeholder groups (herders, urban residents, hunters, and government officials) on wolves (*Canis lupus*). I included 128 individuals from Ulaanbaatar city and three provinces located in the forest-steppe zone (Arkhangai, Bayankhongor, and Uvurkhangai provinces) between August and October 2018. Within this case study, I used mixed methods to collect quantitative and qualitative data. Results found that the perceptions of each stakeholder group were strongly influenced by a unique set of drivers, including experience with wolves, knowledge about wolves, and traditional and/or historical connections with wolves. Although general perceptions of the stakeholder groups varied, urban residents had the most positive attitudes toward wolves, hunters had the second-most positive attitudes, and herders showed the least positive attitudes compared to the other stakeholder groups. Findings indicated that direct experience with wolves affected herders negatively, but affected hunters positively. Urban residents had the least experience with wolves and their perceptions on wolves seemed more romanticized than others. Herders and hunters acquired knowledge about wolves mostly from experience, observation, and sharing information with each other. Urban residents, by comparison, learned about wolves from books, media, and stories shared by others. The connection between wolves and Mongolia's culture and history positively influenced the perceptions of all stakeholder groups. This study demonstrates that collaboration across stakeholder groups, particularly herders, hunters, and environmental

officials, is important, perhaps essential, to develop and implement a comprehensive wolf management approach in Mongolia. In addition, encouraging awareness of Mongolia's culture and history and improving traditional and scientific knowledge about wolves would be helpful to enhance positive attitudes towards wolves.

1. Introduction

Public perceptions are important to consider in wildlife management and conservation decision making (Bitanyi et al. 2012; Fernandez-Gimenez 2000; Gandiwa et al. 2014). Developing effective management practices for large carnivores is especially challenging as they are often in conflict with people and strongly associated with cultural values (Dickman, Macdonald, and Macdonald 2011; Treves and Karanth 2003). The wolf (*Canis lupus*) is one such species in Mongolia that is commonly in conflict with traditional livestock based livelihoods, but linked with cultural values and identity (Clark et al. 2006; Davie et al. 2014; Sukhbaatar et al. 2020).

Some researchers argue that the wolf was historically a totem animal in Mongolian culture and deeply respected as an integral part of Mongolian rural life and culture (e.g., Boldbaatar, 2002; Erdenetuya, 2014; Punsag, 2003). But as time passed, perceptions of wolves changed, leading some to call it an 'the enemy of state' for its negative impacts on livestock (Wingard and Zahler 2006). This shift in the value of wolves may be related to the loss and/or change in traditional ecological knowledge (TEK) among Mongolians. Loss of TEK can negatively affect local knowledge and values of land, flora and fauna, soils, and worldview of indigenous groups (Berkes 2008; Kikvidze and Tevzadze 2015; Tang and Gavin 2016; Turvey, Bryant, and McClune 2018). A wide variety of socio-economic, political, and environmental drivers have contributed to TEK loss among indigenous societies, including migration and urbanization,

change of traditional livelihood practices due to market integration, change of traditional beliefs, change of environment and natural resources, and change of traditional institutions (Fernandez-Gimenez 1999; Tang and Gavin 2016). Under these rapidly changing conditions, a society can face cultural loss within only one generation (Reyes-García et al. 2013; Reyes-García et al. 2005).

The traditional lifestyle in Mongolia is pastoral livestock husbandry, which has existed in Mongolia's territory since the Bronze Age (~3,500 – 1,200 BCE) (Frachetti 2008; Hanks 2010; Honeychurch 2010). Today, pastoral nomadism still remains as a significant part of Mongolian society; however, all of the previously mentioned changes are happening rapidly in Mongolia. For instance, every year, more and more rural Mongolians, especially younger people, abandon their herder lifestyle and migrate to urban areas for better education and different jobs. Currently, the majority of the country's population is concentrated in a few cities (National Statistics Office of Mongolia 2018).

Mongolian pastoralists have practiced wildlife conservation in various ways. Common practices include customary laws and taboos; spiritual and religious beliefs; and state laws and regulations (Erdenetuya 2014). Some common taboos (or prohibitions) that impact conservation are against polluting the water and the ground, digging into the ground, pulling out plants with roots, breaking green branches off trees, and hunting prominent animals (Punsag 2003). Nomads' spiritual and religious beliefs have played a more prominent role in conservation. According to some nomads, every aspect of nature, including waters and mountains, have guardian spirits, and those spirits are to protect a certain locality against unexpected catastrophe and danger (Boldbaatar & Demberel 2002). Furthermore, formal state

laws and regulations played a critical role for wildlife protection in Mongolia (Wingard and Odgerel 2001). Krausman and Cain (2013) have indicated that Mongolia is a pioneer in legalizing hunting. According to these two authors, three basic elements of wildlife population management were practices in the 13th century: managing to maintain populations, managing to increase populations, and managing to reduce populations.

Despite the overall conservation efforts in the past, today's wolf management in Mongolia needs adequate improvement. Reducing wolf numbers has been a widespread practice throughout the country, mainly to protect livestock and rural livelihoods (Gittleman et al. 2001; Reading et al. 1998). Due to years of unsustainable hunting, the wolf population has been severely decreased in the eastern steppe of the country (Wingard and Zahler 2006). Wolves have also faced declines in other regions of Mongolia; for example, local people of the forest-steppe region consider the wolf population to be decreasing since 2016 (Sukhbaatar et al. 2020). As populations continue to decline, the need for a comprehensive wolf management approach that is reflective of and embraces Mongolia's traditional customs and culture will most likely be required for wolves to persist in the landscape.

Studying perceptions of multiple stakeholder groups on wolves is therefore helpful to understand how Mongolians view wolves in the modern day and how much they differ from each other depending on their residency, lifestyle, job positions, and other socio-economic factors. An understanding of local people's perceptions on wolves could help inform and influence the design and implementation of future wolf management policies in Mongolia. As a result, this study investigated differences and similarities of perceptions of wolves among different stakeholder groups in Mongolia.

2. Research design

2.1. Methods

This study followed a descriptive case study approach, aiming to answer how differently or similarly stakeholder groups perceive wolves in Mongolia and what are the main drivers that influence their perceptions. I used a convergent parallel mixed methods design, because qualitative and quantitative data could be collected at the same time, analyzed separately, and merged at the end (Creswell, 2014; Creswell & Plano Clark, 2010). To collect both quantitative and qualitative data simultaneously, I designed questionnaires that consisted of closed-ended questions, Likert-scale questions, and open-ended/semi-structured questions (Lavrakas 2008). Closed-ended and Likert-scale questions were the source of quantitative data and open-ended/semi-structured questions were the source of qualitative data.

2.2. Study sites

The study was conducted in Ulaanbaatar city and three provinces (Arkhangai, Bayankhongor, and Uvurkhangai) of Mongolia (Figure 1). I chose Ulaanbaatar, because it is the largest city in the country. Nearly half the country's population (approximately 1.5 million) lives in this city, so it is a logical location to find representatives of urban residents with different backgrounds (National Statistics Office of Mongolia 2018). The city is a home to people who were born and raised there as well as people who moved and changed their residency from rural areas to Ulaanbaatar.

In terms of the three provinces, these are advantageous locations for this research. First, wolves inhabit each of these provinces in high numbers (Clark et al., 2006; Enkhsaikhan, 2004; Wingard & Zahler, 2006). Second, these provinces are contiguous and share borders with

each other. Third, the landscapes of these provinces consist of open steppe, forested areas, high mountains, and rugged terrain (Ministry of Environment and Tourism 2015). Therefore, local people might have different experiences with wolves due to the different ecosystem's characteristics.

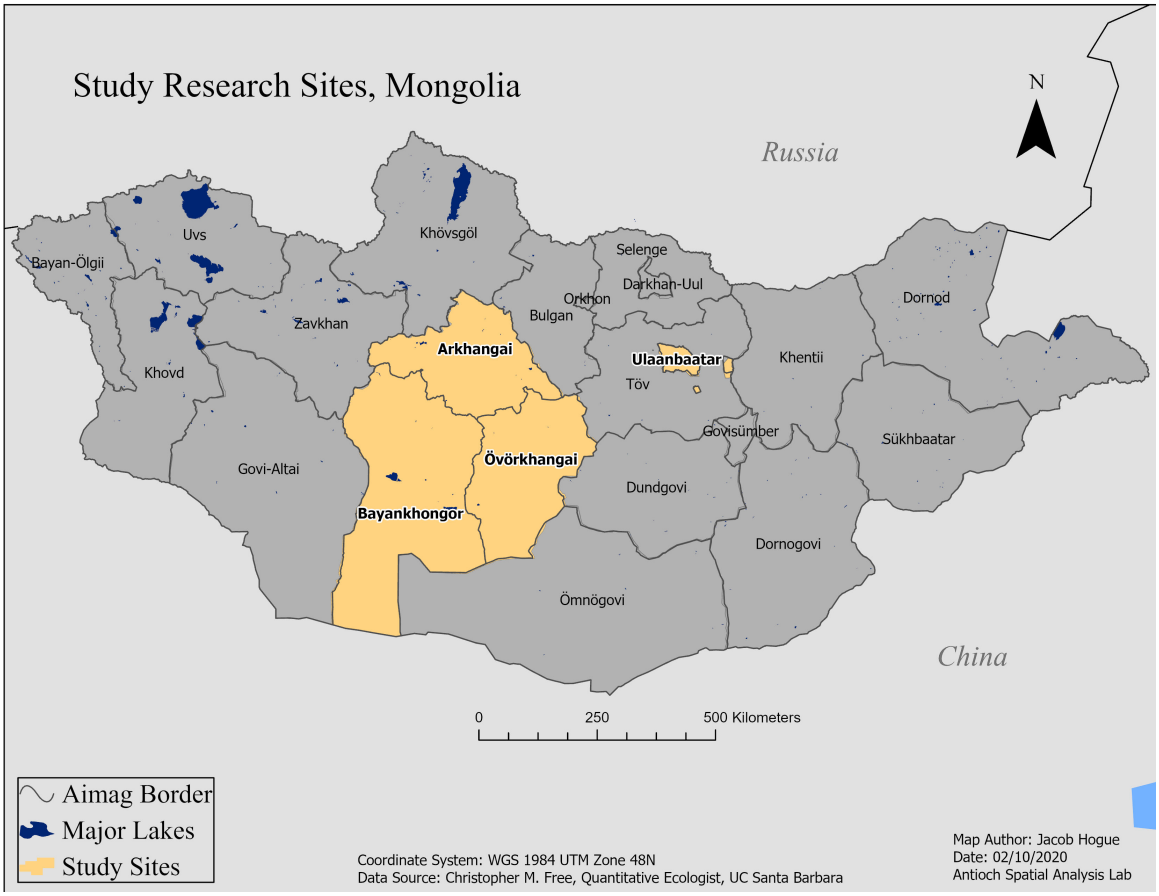

Figure 1. Study areas for data collection on perceptions of wolves (*Canis lupus)* in Mongolia. Areas included Ulaanbaatar city and parts of three provinces/aimags.

2.3. Participant selection

In this study, a total of 128 individuals represented four different stakeholder groups (n=50 herders, n=20 hunters, n=52 urban residents, and n=6 government officials). I had seven assistants for this research: four field assistants who were residents of Ulaanbaatar city, and a local guide from each province. They were all 24-32 years old. None of the assistants and local

guides contributed to this research as a participant. One field assistant aided me by driving and distributing questionnaires in the countryside. The other three field assistants helped me to distribute questionnaires in Ulaanbaatar. The three local guides were hired from each of the three provinces. They were individuals who were familiar with local roads. I met them during my previous trips to the provinces and they expressed their willingness to assist me to collect data.

For participant selection, several criteria were used:

1. Herders - individuals who currently owned livestock and lived in the countryside full time engaging in a pastoral nomadic lifestyle were considered as herders. If an individual lived as a herder, but also hunted, I counted the person as a hunter. Individuals who did not have any livestock but still lived in the countryside were not counted as herders in this research.
2. Urban residents - individuals who had permanent residency in a city or a province center were considered as urban residents. Any individual who seasonally moved between an urban area and the countryside was not included in this research. If an urban resident hunted, the person counted as a hunter.
3. Hunters - individuals, who hunted for recreational and/or subsistence purposes, were counted as hunters. Anyone who regularly hunted was considered as a hunter regardless of occupation or residency.
4. Environmental officials - individuals who worked on behalf of the national and local government to enforce environmental laws and regulations and/or participated in governmental decision-making processes. If an individual hunted, but meet the

environmental official criteria, I counted the person as an environmental official in this research.

I selected participants using the random sampling (n=39), snowball-sampling (n=27), and convenience sampling methods (n=62) (Evans and Rooney 2013; Goodman 1961; Lyon et al. 2018). The original plan was to use the snowball sampling and random sampling for herders, urban residents, and hunters; and use the convenience sampling method for environmental officials. However, we needed to make an adjustment to the plan because of unforeseen circumstances. We resulted in using all three methods for selecting herders; the convenience sampling method for urban residents; the snowball sampling method for hunters; and the convenience sampling method for environmental officials.

Overall, 39 herders were selected by the random sampling (n=39). In the beginning, the research team (myself, the assistant, and the local guide) stopped at one of every five yurts. Using this lottery approach was one way to avoid potential bias that could be associated with hiring a local guide (Evans and Rooney 2013). My intention was to include elderly herders in the research, considering that elder herders might have more knowledge and experience with wolves. The snowball sampling method (n=7) was helpful to find elderly herders. The convenience sampling method (n=4) was used when we were stuck at a soum[17] center for a few days due to a river flooding that we had to cross to meet herders. We had a chance to meet herders at a small general store at the soum center. In the store, we approached its customers and asked them if they were herders and would be interested in participating in the research. I

[17] A second level administrative subdivision of Mongolia, similar to town

avoided including town residents, because soum residents did not fit in any stakeholder group criteria of the study.

The convenience sampling (n=52) method was used to select urban residents. The majority of urban residents (n=28) were selected in-person in public places, such as a bank, a store, a coffee shop, and/or offices. At the beginning, I and the assistants attempted to select one in every five individuals to randomly select urban residents in these places. Unfortunately, many people we approached did not agree to participate in the study, therefore we decided to change the random sampling method to the convenience sampling method. Also, Facebook (n=24) was used to reach more urban residents.

Every hunter who participated in this research was found by the snowball sampling method. Hunters were from rural areas (n=12), province centers (n=6), and Ulaanbaatar city (n=2). Although, my intention was to involve relatively equal numbers of hunters from both rural and urban areas, it was challenging to find hunters in the city, especially in a short time (approximately 2 months) of data collection. It was relatively easier to reach out to hunters in the countryside, because herders helped to find local hunters.

The environmental officials were all selected through the convenience sampling method (n=6). In each study area, I stopped at an environmental department and approached any environmental official who was available to participate in the research. The convenience sampling method was an appropriate way to select environmental officials because of the struggle of finding contact information of environmental officials. In addition, this research was conducted during the typical vacation time of governmental workers. The environmental officials who did participate included a tour specialist of a national park administration; an

environmental specialist of a national park administration; a director of the environment and tourism department under a province government; a state environmental inspector; a ranger; and a head of an environmental NGO.

2.4. Data collection

The data collection was conducted during an approximately two-month period from late July 2018 until early October 2018. To collect data, I used a questionnaire that comprised demographic questions, Likert-scale questions, closed-ended questions, and open-ended/semi-structured questions (Lavrakas 2008) (Appendix 1). The questionnaire was written in Mongolian. The Likert-scale questions were focused on quantitatively indicating participants' opinions on whether the wolf is an ecologically and culturally important species in Mongolia. Closed-ended questions were to identify participants' attitudes towards wolves. Open ended/semi-structured questions were asked get a fuller picture and to elaborate on the participants' responses to the closed-ended questions and Likert-scale questions. Prior to the data collection, the research proposal was approved by the Institutional Review Board of Antioch University New England (Appendix 2).

Before completion of every questionnaire, the purpose of the study was clearly explained and each participant was informed that their participation was voluntary and they could stop their participation at any time. Depending on participants' locations, the participants completed the questionnaire in three different styles: in-person interview; online questionnaire; and printed questionnaire.

Out of 128 participants, 82 individuals (n=50 herders, n=9 urban residents, n=20 hunters, and n=3 environmental officials) completed the questionnaire in the in-person

interview style. These individuals preferred to orally answer the questions. Hereafter, I will call these questionnaires interviews. I conducted 66 interviews and an assistant conducted 16 interviews. He was trained by watching me interviewing the first few participants. The length of interviews ranged from 15 minutes to 1 hour. Most of the interviews were conducted at people's homes (n=61) and the remaining interviews (n=21) were at miscellaneous locations (i.e., n=7 outdoors, n=5 office, n=4 store, n=4 factory, and n=1 restaurant). The advantage of having in-person interviews was that the interviewer had opportunities to ask additional questions and clarify uncertain responses. Before we began an interview, I and the assistant asked each interviewee for a permission to use a voice recorder. Although every person gave us permission to record, some people looked nervous and uncomfortable while being interviewed. In these cases, we continued interviews (n=8) without a recorder.

Online and printed surveys were useful tools to reach residents in Ulaanbaatar and province centers. The online questionnaire approach was used in Ulaanbaatar and 17 people participated via the online questionnaire approach. I converted the questionnaire into an online format using Google Forms and shared it via Facebook. Because I personally do not have a Facebook account, I shared the questionnaire through the assistants' accounts. Although this approach was helpful to reach public, there were some disadvantages too. First, I could not tell how many people accessed to the questionnaire and how many of them completed it. Secondly, because I distributed the questionnaire through my assistants' accounts, the online questionnaire respondents' ages were at their age range (24-32 years old). Third, in comparison to the in-person interview style, online participants left multiple questions unanswered or often left "I do not know" answer.

The printed questionnaire approach was used in Ulaanbaatar and province centers. A total of 29 individuals completed printed questionnaires in a coffee shop (n=9), a bank (n=8), offices (n=3), a store (n=2), and homes (n=7). After handing printed questionnaires to the respondents, we waited around in close proximity for them to return the completed questionnaires to us. In average, it took a participant 15 minutes to complete a questionnaire. An advantage of staying near the respondents was that if respondents did not understand any specific question, they could directly ask us for clarification.

2.5. Data analysis

I prepared all quantitative data (i.e., gender, age, education, location, attitude, and Likert-scale responses) for analysis on spreadsheets and conducted a descriptive analysis of the quantitative data (e.g., the mean, median, standard deviation, and interquartile range) using Microsoft Excel. After the variables were determined, I presented them in the form of the two-way contingency tables (Bartlett 1935). The two-way contingency table examines and summarizes the relationship between variables by cross-classifying two variables at a time (Fienberg 2007; Kateri 2014). I used Stata/IC 15.1 (StataCorp, Texas, USA) to analyze contingency tables and to define degrees of freedom and *p*-values. The Pearson's Chi square test was used to obtain the *p*-values. Results that yielded *p*-values of $\leq .05$ were considered as significant.

I used MAXQDA Analytics Pro18 (VERBI GmbH, Berlin, Germany) for qualitative data analysis. First, I transcribed all the interviews and then translated them from Mongolian to English. Once all the interviews were transcribed and translated, I searched any potential patterns in the data to initiate codes. I created themes by grouping the codes this process

initiated. Qualitative data were used to help interpret the quantitative data analysis. Furthermore, I transformed answers of two qualitative questions to quantitative data: "What experience do you have with wolves?" and "How would it feel to you if Mongolia did not have any more wolves?" Originally, these questions were to be analyzed only as qualitative data. However, the frequencies of similar responses and clear patterns from the respondents appeared beneficial to use them in both qualitative and quantitative forms.

3. Results

The results section begins with brief information about the demographics of the stakeholder groups. Next, six themes that were generated from data analysis are presented. The themes include wolves' role in the ecosystem; wolves' role in Mongolia's culture; stakeholder groups' attitudes towards wolves; stakeholder groups' definitions of wolves; and stakeholder groups' experience with wolves; and stakeholder groups' opinions about wolf existence. I referred to rural people as country people (e.g., herders and hunters who live in the countryside) in this research.

3.1. Demographics of the stakeholder groups

Data were collected from 128 individuals (n=50 herders, n=52 urban residents, n=20 hunters, and n=6 government officials). Half the participants were from the countryside and the other half were from urban areas. The age of the respondents ranged between 18 and 93. The majority of the participants obtained some form of school education (Table 1). Prior to the 1990's, Mongolia followed a 10-year secondary school system. When a schoolchild did not pass exams to advance to the 9^{th} grade level, the child could go to a vocational school for two years

to obtain special secondary education. In the present time, Mongolia's school system settled into a 12-year grade level system.

Table 1.
Demographic characteristics of respondents to a survey about wolves (Canis lupus) in Mongolia conducted in 2018.

Total respondents (n=128)		
Category	**Count**	**% within a category**
Age	$\overline{X}$=47; Median=45; σ = 16.25	n/a
Gender		
Female	53	41
Male	75	59
Location		
Ulaanbaatar city	47	37
Province center	17	13
Countryside	64	50
Education level		
Elementary school (1- 4 yrs.)	8	6
Middle school (5-8 yrs.)	27	21
High school (9-12 yrs.)	34	27
Special secondary education (9-10 yrs.)	7	5
University degree	47	37
No response	5	4

Note: The numbers in parentheses refer to number of years spent in school.

3.1.1. Herders. A total of 50 herders (n=23 male and n=27 female), out of which nine herders were from Arkhangai; 17 from Bayankhongor; and 24 from Uvurkhangai, participated in this research. The majority of the herders were from 36 to 55 years old. Most herders received middle and high school education. Three herders, who were over 70 years old, did not give any response about their education (Table 2).

Table 2.
Education level of herders that participated in a survey of the perceptions of wolves (Canis lupus) in 2018.

Education level	Count	%
Elementary school education (1-4 yrs.)	7	14
Middle school education (5-8 yrs.)	21	42
High school education (9-12 yrs.)	16	32
Specialized secondary education (9-10 yrs.)	3	6
University degree	0	0
No response	3	6
Total	50	100%

Note: The numbers in parentheses refer to number of years spent in school.

3.1.2. Urban residents. A total of 52 urban residents (n=28 male and 24 female) participated in this research. The majority of them (89%) lived Ulaanbaatar city and the remaining 11% were from province centers. The youngest respondent was 18 years old and the oldest was 79 years old. The largest group (45%) of the respondents were from 26 to 35 years old. Compared to the herders, the residents' average educational level was higher: the vast majority of residents received a university degree (e.g. B.S., and/or M.S.) and very few people had lower than high school education (Table 3).

Table 3.
Education level of urban residents that participated in a survey of the perceptions of wolves (Canis lupus) in 2018.

Education level	Count	%
Elementary school education (1-4 yrs.)	0	0
Middle school education (5-8 yrs.)	3	6
High school education (9-12 yrs.)	7	13
Specialized secondary education (9-10 yrs.)	3	6
University degree	39	75
Total	52	100%

Note: The numbers in parentheses refer to number of years spent in school.

3.1.3. Hunters. A total of 20 hunters were interviewed. They were all male. I did not encounter any female hunters in Mongolia; hunting is generally considered an exclusively male

activity. Among the hunters, the youngest one was 34 years old and the oldest 82 years old. On numerous occasions, especially elderly hunters lead the whole interview, sharing their interesting adventures and stories. I did not necessarily try to stop them and stick to my interview questions, because I thought their oral stories were more valuable, and felt that it was rude to interrupt them. These hunters (n=5) did not answer the Likert-scale questions. However, I interspersed my interview questions during each interview.

The majority of hunters (n=17) claimed that they hunted wolves. The remaining three hunters said that they were more interested in hunting smaller prey, such as marmots. In terms of education, most hunters obtained high school education. The two hunters from the city and one hunter from a province center received a university degree (Table 4).

Table 4.
Education level of hunters that participated in a survey of the perceptions of wolves (Canis lupus) in 2018.

Hunters' education	**Count**	**%**
Elementary school education (1-4 yrs.)	1	5
Middle school education (5-8 yrs.)	3	15
High school education (9-12 yrs.)	12	60
Specialized secondary education (9-10 yrs.)	0	0
University degree	3	15
No response	1	5
Total	20	100%

Note: The numbers in parentheses refer to number of years spent in school.

3.1.4. Environmental officials. A total of six environmental officials participated in the research. Two of the officials were female and four were male. Only one environmental official worked in the countryside, and the other five were from Ulaanbaatar and province centers. The youngest official was 29 years old and the oldest was 55 years old. The working years at

their jobs ranged from 4 years to 22 years. All of the environmental officials obtained a university degree in economics, law, environmental assessment, biology, and engineering.

3.2. Wolves' roles in nature

One survey statement was used to assess respondents' agreement with: "*The wolf is an important species*." Respondents were asked to choose one response from six Likert-scale categories (1 = strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5 = strongly disagree; 6 = not sure). The majority of respondents overwhelmingly endorsed the statement. However, a relatively high number of respondents chose the option '*not sure*' (Table 5).

Table 5.
Stakeholder groups' opinions on the statement 'Wolf is an important species' based on survey data collected in 2018.

Stakeholder groups	1 Strongly agree	2 Agree	3 Neutral	4 Disagree	5 Strongly disagree	6 Not sure	N	*Median**	IQR*
Herders	19	15	2	2	0	12	50	1.5	1
	38.0	30.0	4.0	4.0	0.0	24.0	100%		
Urban residents	15	22	3	2	0	10	52	2.0	1
	28.9	42.3	5.8	3.8	0.0	19.2	100%		
Hunters	12	3	0	0	0	5	20	1.0	0
	60.0	15.0	0.0	0.0	0.0	25.0	100%		
Officials	3	3	0	0	0	0	6	1.5	1
	50.0	50.0	0.0	0.0	0.0	0.0	100%		
Total	49	43	5	4	0	27	128	2.0	1
	38.3	33.6	3.9	3.1	0.0	21.1	100%		

*Note: * The median and interquartile range (IQR) were calculated for Likert scale 1 to 5 only.*

I asked a follow-up question (*What roles do wolves play in nature?*) to measure respondents' understanding of wolves' roles in the environment. Considering the resemblance of the responses given, I divided all answers into five different groups: 1) wolves keep

ecosystems healthy; 2) wolves spread diseases; 3) wolves do not play any important role in nature; 4) I do not know; and 5) miscellaneous.

As shown in Table 6, approximately 62% of all respondents reported that the wolf was an important species for the ecological balance. Overall, 79% of residents, 70% of hunters, and 100% of officials, who participated in this research, stated in some form that "wolves were ecological balance holders." However, only 36% of herders gave positive answers about wolves' roles in nature, which is significantly different than the other three stakeholder groups. Additionally, some herders (4%) claimed that wolves did not play any positive roles in nature. No respondent from the other stakeholder groups gave such an answer. A substantial number of herders (32%) said that they did not know about wolves' roles in nature. Some respondents gave me answers that were not necessarily relevant to the question.

Table 6.
Wolves' (Canis lupus) roles in nature by stakeholder group based on responses to a survey in 2018.

	What roles do wolves play in nature?						
Stakeholder groups	Wolves keep ecosystems healthy.	Wolves spread diseases.	Wolves do not play any important role.	I do not know.	Miscellaneous	No response	**Total**
Herders	18	1	2	16	7	6	50
	36.0	2.0	4.0	32.0	14.0	12.0	100%
Urban residents	41	0	0	7	2	2	52
	79.0	0.0	0.0	13.0	4.0	4.0	100%
Hunters	14	2	0	1	0	3	20
	70.0	10.0	0.0	5.0	0.0	15.0	100%
Officials	6	0	0	0	0	0	6
	100.0	0.0	0.0	0.0	0.0	0.0	100%
Total	**79**	**3**	**2**	**24**	**9**	**11**	**128**
	62.0	**2.0**	**1.0**	**19.0**	**7.0**	**9.0**	**100%**

The most popular statements by representatives of each stakeholder group were focused on the wolf being the main species that keeps the ecological balance. For example, a herder stated, "…Wolves eliminate sick animals. They also feed on carrions. If wolves were not around, nobody knows what bad disease would spread out." A resident from Ulaanbaatar pointed out, "…Wolves are the main ecological balance keepers. They prevent overpopulation of animals, such as deer and field mice, that could be harmful to forests and pastures. However, the wolf population should be controlled." A hunter stated, "…Wolves prey on sick deer and gazelles, and don't get infected by their preys. In other words, they are the healers and cleaners of the environment. A very important species." According to an official, "…Wolves are important animals for the ecosystem. They control some species population and eliminate carrions."

A few hunters, however, expressed disagreement that wolves predate weak and sick animals. According to them, wolves favor healthy prey. For instance, a hunter stated, "[Wolves eat weak animals] is not true. I'll tell you an example. My neighbor has many sheep and goats. They had one big ram. Wolves ate that one. Wolves do not eat bad livestock. They prefer good ones." Another elder hunter said:

> Wolves are really clever. They would not eat bad animals, such as sheep with turning sickness. They were not born to eat something bad… Wolves usually eat evasive animals. They attack good stallions and studs. If wolves attack a herd of horses, weak ones stay and good ones gallop away. Wolves would chase one of those runaways. They would just ignore those weak and about to die animals.

Only one herder and two hunters mentioned that wolves can spread diseases as well. According to the herder, "…Wolves spread infectious disease to domestic livestock. Wolves are responsible for the current outburst of disease.' One of the hunters indicated both positive and negative sides of wolves, saying:

> Wolves have both positive and negative roles in nature. The negative side is that they spread diseases. And the positive side is that they prey on sick animals. Usually weaker wolves predate on sick ones. Strong and healthy wolves don't go after sick animals. They prefer good ones.

Another hunter stated:

> …wolves are not natural cleaners. They also spread diseases, such as rabies, cowpox, and glanders. Cowpox spreads from a cow that was killed by a wolf. But the wolf won't die because of the disease. When a wolf eats a marmot with plague, the wolf itself won't get affected.

Two herders stated that wolves did not play any ecological role. One of these herders said, "I do not think wolves play any role in nature." Some respondents gave me answers that were not necessarily relevant to the question. For example, a herder stated, "In this beautiful Khangai, if not wolves, then what should really exist." Another herder said, "Wolves are a little too harsh to livestock."

3.3. Wolves' roles in Mongolia's culture

One question assessed the opinions of the stakeholder groups on the statement '*The wolf is an important part of our culture'.* Respondents rated their opinions by choosing one response from six Likert-scale answers (1 = strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5

= strongly disagree; 6 = not sure). The majority of respondents chose '*strongly agree*' (36%) and '*agree*' (31%) options to the statement. Approximately 19% of respondents either did not answer the question or stated that they were not sure about the importance of the wolf in Mongolia's culture (Table 7).

Table 7.
Stakeholder groups' opinions on 'The wolf is an important part of Mongolia's culture' based on survey data collected in 2018.

	1	2	3	4	5	6			
Stakeholder groups	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure	**N**	**Median***	**IQR***
Herders	20	13	4	1	0	12	50	1.0	1
	40.0	26.0	8.0	2.0	0.0	24.0	100%		
Urban residents	13	24	9	1	0	5	52	2.0	1
	25.0	46.0	17.0	2.0	0.0	10.0	100%		
Hunters	10	0	2	0	0	8	20	1.0	0
	50.0	0.0	10.0	0.0	0.0	40.0	100%		
Officials	3	3	0	0	0	0	6	1.5	1
	50.0	50.0	0.0	0.0	0.0	0.0	100%		
Total	**46**	**40**	**15**	**2**	**0**	**25**	**128**	**2.0**	**1**
	36.0	**31.0**	**12.0**	**2.0**	**0.0**	**19.0**	**100%**		

*Note: * The median and interquartile range (IQR) were calculated for Likert scale 1 to 5 only.*

A follow-up qualitative question ("*What role does the wolf play in Mongolia's culture*?) was also asked. Although most respondents strongly supported the statement about the wolf being an important part of Mongolia's culture, many of them could not verbally explain what specific role the wolf played in Mongolia's culture. More than half the respondents (52%) did not respond to the question or said they did not know how exactly the wolf was culturally important to Mongolians (Table 8). About 26% referred to the legend of *Borte Chono* and *Gua Maral* that was indicated in the Secret History of the Mongols. In this legend, *Borte Chono* is a

Blue Wolf and *Gua Maral* is a Beautiful doe, who were the ancestors of Mongolian people. About 21% consisted of miscellaneous responses, such as "… Wolves are spirited animals;" "… wolves are the identity of Mongolians;" or "Wolves came from the eternal blue sky." Only one individual said that there was no connection between Mongolia's culture and wolves.

Table 8.
Comparison of responses of each stakeholder group to the statement 'What role does the wolf play in Mongolia's culture' based on survey data collected in 2018.

	What role does the wolf play in Mongolia's culture?				
The wolf is an important part of Mongolia's culture.	I do not know	*Borte Chono* and *Gua Maral*	Miscellaneous response	No role	**Total**
Herders	**33**	**7**	**10**		**50**
Strongly agree/Agree	18	7	8		33
Neutral	3		1		4
Disagree			1		1
Not sure	12				12
Residents	**20**	**20**	**11**	**1**	**52**
Strongly agree/Agree	11	16	10		37
Neutral	5	3	1		9
Disagree				1	1
Not sure	4	1			5
Hunters	**10**	**6**	**4**		**20**
Strongly agree	2	5	3		10
Neutral	1	1			2
Not sure	7		1		8
Officials	**3**	**1**	**2**		**6**
Strongly agree/Agree	3	1	2		6
Total	**66**	**34**	**27**	**1**	**128**
	52.0	**26.0**	**21.0**	**1**	**100%**

According to a herder, "…wolves do have roles in Mongolia's culture, but I can't think of it." A couple of individuals, however, pointed out that Mongolian shamanism and wolves are

related. For instance, a herder stated, "…Wolves are absolutely connected with our culture. For example, shamans use wolf hair and other stuff. Some shamans wear wolf tails and put the wolf's head on his forehead. I don't think shamans would use [stuff] from some non-spirited animal." An elderly herder claimed that wolves held a significant place in Mongolia's culture because Mongolians, especially Mongolian herders, live closely with wolves. He shared a story:

> There are many legends about wolves helping tired and starving people. Here is a story of an old man, whose nickname was Yellow Dog. He fell off of his horse on a turquoise blue steppe. There was nobody around. He walked a while and finally reached a mountain. He was drinking water when he felt really hungry. The next day, he noticed that a wolf was following him. He was scared that the wolf would eat him. Two or three days later, the wolf approached even closer to him. The first night, he really couldn't sleep and didn't feel sleepy at all. But the second night, he was too tired and fell asleep. When he woke up, he realized that the wolf's intention was not necessarily to eat him. One morning he woke up to the noise of something falling next to him. It was the wolf, dropping off a sheep's chest. It then stretched its body, howled, and left.

As indicated in Table 13, urban residents mentioned the story of Blue Wolf and Beautiful Doe more often than the other stakeholder groups. In the words of an urban resident:

> There is a lot of important information that proves the connection between the wolf and Mongolia's culture. The main source is the Secret History of the Mongols. In the book, it indicates that the Mongols were descended from *Borte Chono* and *Gua Maral*…

Besides this legend, a clan named *Chonos*[18] is also indicated in the Secret History. There is some archeological evidence as well, such as a wolf stone at the museum in Arkhangai province.

3.4. Self-reported attitude towards wolves

A closed-ended question was used to assess respondents' attitude towards wolves (*How would you rate your attitude towards wolves?*) rated as 1 = very good; 2 = good; 3 = neutral; 4 = bad; 5 = very bad; and 6 = not sure. Overall, n=9 respondents rated their attitude towards wolves as 'very good'; n=34 as 'good'; n=47 as 'neutral'; and n=16 as 'bad'. Nobody chose the option 'very bad'. A considerable number of respondents (n=22) either did not answer the question or selected the 'not sure' option. I did not ask respondents any direct follow-up question to clarify their choice of response. However, questions about participants' experience with wolves and their opinions on the wolf's existence provided more details on their self-reported attitudes towards wolves.

3.4.1. Respondents' gender and attitude. When comparing the respondents' attitude towards wolves by gender, there was no significant difference between attitudes of men and women ($X^2(4) = 6.5$, $p = .16$). However, as shown in Table 9, more men defined their attitude as 'very good' and 'good', and an equal number of men and women defined their attitude as 'bad'.

[18] Wolves

Table 9.10
Respondents' attitude towards wolves (Canis lupus) by gender based on survey data collected in 2018.

	How do you rate your attitude towards wolves?						
Respondents	1	2	3	4	5	6	
	Very good	Good	Neutral	Bad	Very bad	Not sure/no response	Total
Male	7	23	22	8	0	15	75
Female	2	11	25	8	0	7	53

When I compared the respondents' residencies to their attitude towards wolves, there was a significant difference between men and women ($X^2(12) = 28.5$, $p = .01$). As shown in Table 10, country women showed the most negative attitude towards wolves, while urban men showed the most positive attitude towards wolves.

Table110.
Respondents' attitude towards wolves (Canis lupus) by gender and residency based on survey data collected in 2018.

	How do you rate your attitude towards wolves?								
Respondents	1	2	3	4	5	6			
	Very good	Good	Neutral	Bad	Very bad	Not sure/ no response	**N**	**Median***	**IQR***
Country male	1	9	14	5	0	7	36	3.0	1
Urban male	6	14	8	3	0	8	39	2.0	1
Country female	0	1	16	7	0	3	27	3.0	1
Urban female	2	10	9	1	0	4	26	2.0	1

*Note: * The median and interquartile range (IQR) were calculated for scale 1 to 5 only.*

3.4.2. Stakeholder groups and attitude. When comparing the stakeholder groups on their attitude towards wolves, there was a significant difference ($X^2(12) = 25.4$, $p = .01$). Table 11 shows the self-reported attitude of stakeholder groups. The majority of herders defined their attitude as 'neutral' and 'bad', where the majority of other stakeholder groups defined their attitude as 'good' and 'neutral'.

Table 112

Attitude towards wolves (Canis lupus) by stakeholder group based on survey data collected in 2018.

Stakeholder groups	How do you rate your attitude towards wolves?						N	Median*	IQR*
	1	2	3	4	5	6			
	Very good	Good	Neutral	Bad	Very bad	Not sure/ no response			
Herders	0	5	26	10	0	9	50	3.1	0.6
Urban residents	6	20	14	3	0	9	52	2.3	0.8
Hunters	2	7	5	2	0	4	20	2.4	0.9
Officials	1	2	2	1	0	0	6	2.5	1.0

*Note: * The median and interquartile range (IQR) were calculated for scale 1 to 5 only.*

3.5. Stakeholders' definition of the wolf

Each individual was asked "*How would you define the wolf with one or a few words?*" There was no follow-up question for respondents to explain their definitions. In total, 109 individuals responded the question and 19 individuals did not respond or said they did not know how to answer the question. I sorted all of the answers into three groups: positive, neutral, and negative. Most respondents defined the wolf as 'spirited'. A few negative definitions were given by herders (Table 12). The negative definitions were all related to the wolf's predation of livestock.

Table 13

Examples of respondents' definitions of the wolf (Canis lupus) by stakeholder group based on interviews conducted in 2018.

Positive	Neutral	Negative
Herders		
Animal that must exist, brave, nature's balance holder, intelligent, spirited	Animal like us that tries to live, *hangai*, *boohoi*, animal that feeds itself using its own power, animal like us who tries to lives, wolf, nature's animal, Khangai's animal, wild dog	Animal that should be rare, animal who is harmful to smaller families, monster, enemy of livestock, predator, furious, harmful to livestock, vicious, wild, scary
Residents		
Heavenly, magnificent, majestic, pride, spirit, spirited animal, fire, symbol of force and power	Animal, carnivore, nature's species, wild dog, animal, *boohoi*	Wild, scary predator, predator, wild
Hunters		
Animal that should exist, brave, good animal, heavenly, spirited, vigilant	Animal, predator, wildlife	
Officials		
Ecological balance holder, heavenly animal, spirited animal	Animal	

3.6. Experience of each stakeholder group with wolves

All stakeholders were asked in the survey about their experience with wolves (i.e., "*What experience do you have with wolves?*"). Of the total 128 respondents, 119 individuals responded to this question with the other nine individuals not giving any response about their experience. Respondents' experience with wolves varied widely. Based on the respondents' answers, I grouped their answers into six categories:

1. no experience (e.g., never seen wolves or seen only dead wolves);
2. little experience (e.g., have seen wolves only from a distance);
3. some experience (e.g., have lost livestock to wolves);

4. moderate experience (e.g., seen wolves often and/or have encountered wolves a few times);
5. extensive experience (e.g., have encountered wolves often and/or killed wolves to protect livestock and/or hunted wolves); and
6. no response.

Overall, the majority of the respondents had some kind of experience with wolves. Figure 2 displays the overall wolf experience of all respondents.

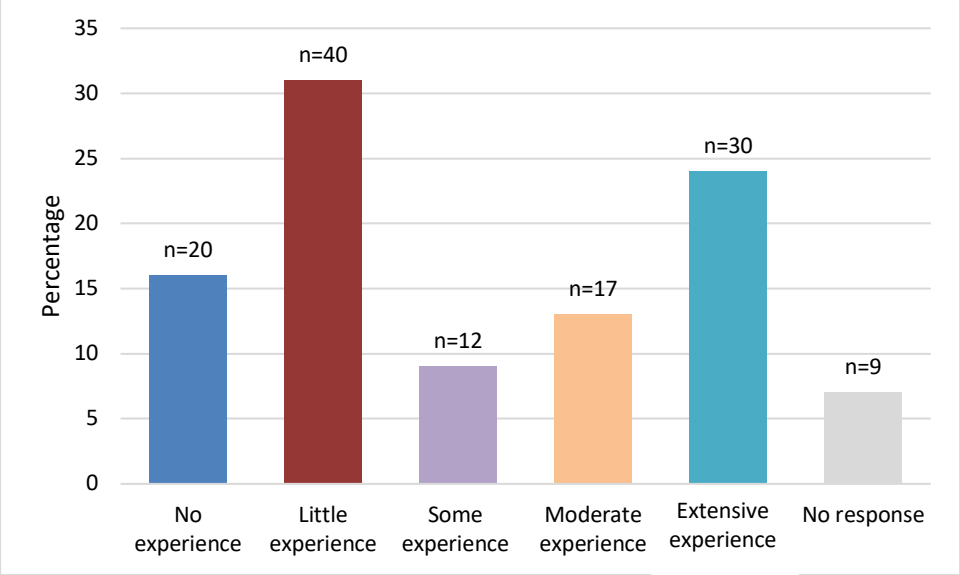

Figure 2. Experience of stakeholders with wolves (*Canis lupus)* based on survey data collected in 2018**.**

I assessed the respondents' experience with wolves by gender and country/urban residency (country male, country female, urban male, and urban female). There was a significant difference between respondents' genders and experience with wolves ($X^2(15) = 88.2$, $p = .00$). As shown in Table 13, country males had more experience with wolves, where urban females had less experience with wolves.

Table 14

Experience of respondents with wolves (Canis lupus) by gender and residency based on interviews conducted in 2018.

Respondents	1 No experience	2 Little experience	3 Some experience	4 Moderate experience	5 Extensive experience	6 No response	N	Median*	IQR*
Country male	0	6	7	5	18	0	36	4.5	2
Urban male	4	16	0	2	12	5	39	2.0	3
Country female	4	8	5	10	0	0	27	3.0	2
Urban female	12	10	0	0	0	4	26	1.0	1

*Note: * The median and interquartile range (IQR) were calculated for scale 1 to 5 only.*

I also compared each stakeholder group's experience with wolves ($X^2(15) = 136.9$, $p = .00$). Urban residents had least experience with wolves, while hunters had most experience with wolves (Table 14). Most herders had experience with wolves.

Table 15

Experience of respondents with wolves (Canis lupus) by stakeholder group based on interviews conducted in 2018.

Stakeholder groups	1 No experience	2 Little experience	3 Some experience	4 Moderate experience	5 Extensive experience	6 No response	N	Median*	IQR*
Herders	4	14	12	15	5	0	50	3.0	2
Urban residents	16	23	0	2	2	9	52	2.0	1
Hunters	0	0	0	0	20	0	20	5.0	0
Officials	0	3	0	0	3	0	6	3.5	3

*Note: * The median and interquartile range (IQR) were calculated for scale 1 to 5 only.*

Herders who did not have any experience with wolves were all female herders. A female herder with no experience with wolves said, "I've never seen a live wolf. I don't think I'll

be scared much if I encounter a wolf." Conversely, another female herder, who encountered a wolf, stated:

> It is really scary to face a wolf. One time, I was with my flock of sheep and goats. Suddenly the herd started making noise. A wolf came out from the front side and took a two-year-old lamb. Sheep and goats are really conscious, they wouldn't graze there again, running and spitting... …It seemed like all my hair was up when I faced that wolf. I tried to throw a rock. Even rocks were not available to be found in that case.

Herders' experiences with wolves were usually related with livestock. Numerous herders reported that they lost livestock to wolves. I could not determine an accurate number of livestock loss from herders. They mostly said that they lost 1-3 livestock of any age and size per year. However, every herder besides one stated that they did not lose any livestock to wolves in 2018. Male herders often encountered wolves, usually to protect their herds. A male herder shared a story, saying:

> About seven or eight years ago, a wolf got into our sheep fence. Cows were mooing like crazy and sheep and goats were crowded in the front side of the fence. I had a caliber that I used for marmot hunting. I shot the wolf. I couldn't hit it first time. It seemed like I shot the wolf with my second bullet. I was very nervous. I think I was scared of the dead wolf more than it was alive.

Besides livestock predation, wolves interact with herders in different ways. For instance, a herder stated:

> It was very snowy in Bayan-Ovoo two years ago. We left our second yurt at the winter campsite and went for *otor*[19]. When we came back, we found out that eight wolves got into the yurt and ate our *borts*[20]. We could see their tracks that went to the woods…

Another male herder stated:

> About 4 years ago, I went for *otor*. I came back to our campsite without bringing my otor yurt (a smaller yurt that is used for otor). In the spring, when I went back to pick up the otor yurt, I saw a wolf had given birth in the yurt. I left the cubs in there, hoping that the mother would move them soon…

Urban residents' experience with wolves was limited to seeing a wolf. Most urban residents either did not have any experience or little experience with wolves. Individuals who did not have experience with wolves pointed out that they watched about wolves on TV and/or read books about wolves. An urban resident stated, "I have no experience with wolves. I've watched TV programs about wolves and heard stories about wolves." Another one said, "I've never seen a wolf. But I've read many interesting books about wolves and heard stories. I also saw a movie that wolves saved a human child and raised it."

Only two male urban residents reported that they participated in wolf hunting and/or hunted a wolf. Most female urban residents said that they saw a wolf only once. A couple of females reported that they saw wolves more than once. A female urban resident who had seen a wolf more than once stated:

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[19] Emergency migration to faraway reserved pastures
[20] Dried meat, similar to jerky

> I've seen wolves two to three times. We were visiting a family in the countryside. A herd of sheep was attacked by a wolf on a nearby hilltop. I didn't see the wolf well, but the herd was swirling. I felt scared. Another time, we saw a wolf when we were driving. A big bird-like white thing was running next to our car and we realized it was a wolf. I realized there how fast a wolf could be. My dad wanted to shoot it. But while we were discussing who should shoot it, the wolf was already gone.

Every hunter who participated had a lot of experience with wolves. They encountered wolves and hunted wolves. Even the hunters who normally did not hunt wolves participated in wolf hunting and/or hunted wolves at least one time. In general, hunters agreed that they hunted wolves because "wolf hunting is more challenging than other types of hunt." According to a hunter:

> Wolves are brave. Two of us went [wolf hunting]. We got closer to seven wolves after we let them sleep. I shot three and 'D' shot one. The others ran away. It got dark when we were skinning the wolves. We started hearing wolf howling everywhere… The howling sounded even closer. Soon enough one of our horses ran away. 'D' told me that wolves are so brave. Today, we already hunted some of them and they are getting closer without being afraid of us… We eventually had to leave one wolf unskinned and found our horse and went home.

In terms of environmental officials, a young male and both female individuals stated that they saw wolves a few times from a distance. When female officials shared their knowledge about the wolf, I observed that they usually stated "I heard…" and/or "I read…" This made me assume that female herders might have learned about wolves from books and/or

media. For example, a female official said, “I read that wolves are important animals for the ecosystem. They control some species population and eliminate carrions.” Another one pointed out, “As I heard, wolves are alert, careful, and foresighted. Therefore, Mongolians respect wolves.” The other three environmental officials had a lot of experience: they participated in wolf hunting and hunted wolves as well. According to one of them, “wolf hunting is a hobby of mine.” Another one stated, “I participated in wolf hunting when there is wolf hunting organized by the local government.”

3.7. Stakeholder groups’ opinions on the wolf’s existence

Respondents were asked “*How would it feel to you if Mongolia did not have any more wolves?”* They gave various answers, which could be sorted into four different groups: A – it would feel bad; B – it might be bad; C - it would feel good; and D - I am not sure. The results are shown in Table 15. The majority of respondents (67%) reported that it would be bad. A few respondents (5%) stated that it would feel good.

Table 16

Responses to the question 'How would it feel to you if Mongolia did not have wolves anymore' by stakeholder group based on interview conducted in 2018.

Stakeholders	**How would it feel to you if Mongolia did not have any more wolves?**					
	It would feel bad.	It might be bad.	It would feel good.	Not sure	No response	Total
Herders	27	10	6	1	6	50
	54.0	20.0	12.0	2.0	12.0	100%
Residents	36	3	1	8	4	52
	69.0	6.0	2.0	15.0	8.0	100%
Hunters	17	2	0	0	1	20
	85.0	10.0	0.0	0.0	5.0	100%
Officials	6	0	0	0	0	6
	100.0	0.0	0.0	0.0	0.0	100%
Total	**86**	**15**	**7**	**9**	**11**	**128**

67.0	**12.0**	**5.0**	**7.0**	**9.0**	**100%**

The common rationale of the participants who would feel bad for not having wolves in Mongolia was potential loss of the ecological balance. For instance, a herder stated, "Our land will become vacant. That shouldn't happen at all. When a wolf eats an ill animal, the wolf never gets sick from it. That is a very special character. These days diseases in livestock are so wide spread." Another one pointed out, "…it would be really strange. Wolves are majestic animals of nature." According to a herder, "It's not great if a natural species vanishes." An urban resident said, "The ecological balance will be lost. It will become tough if there is no ecological coordinator." In a hunter's words, "[Having no wolf] is wrong. When sickness spreads out among wild animals, domestic animals also get sick. For example, foot and mouth disease is spread everywhere." An environmental official also pointed out "Negative impacts will occur. Wolves are natural resources. It will be bad without them." Common answers from the people who might feel bad about wolf nonexistence in Mongolia were "[Having no wolf] would probably be bad, but I am not sure why" or "It probably should not happen, but their population needs to remain low." Individuals who would feel good about not having wolves claimed that it would be easier for herders to raise their livestock. For instance, a herder stated, "Having no harm to livestock would be nice." Another herder said, "It would be easy to raise my livestock. It is better when there are fewer wolves. When many wolves are around, they steal baby animals."

Several individuals of each stakeholder group gave different insights. An urban resident said, "If we eliminate something that we've respected from our ancestors, it would be bad for ourselves." Another resident stated, "In terms of spirituality, [having no wolf] will negatively

impact Mongolians' psychology." A herder said, "It wouldn't be nice. I think that wolves and Mongolia are like two supporting poles of a yurt." Hunters brought up some other opinions. For example, in a hunter's words, "With the wolf's existence, herders become better at herding." Another hunter said, "Urban people will probably stop going outdoors to get fresh air. [Wolf hunting] has become an excuse to drink vodka for them. …Also, herders might become less watchful." An elderly hunter stated, "Wolves must exist. Humans should not eliminate wolves. Nature doesn't create something useless. Mongolians need to have wolves that eat their livestock…" And environmental officials gave explanations to their statements as well. According to an environmental official, "If [there is no wolf], there will be a sorrow in the bottom of my heart." Another one stated, "It will be bad. The eastern steppe has lost its wolves and as a consequence its gazelles have become sick. Wolves beautify the environment."

4. Discussion and conclusion

This research aimed to explore differences and similarities in perceptions of four different stakeholder groups on wolves in Mongolia. Examining the results, there are a few major drivers that influence the stakeholder groups' perceptions of wolves (Figure 3).

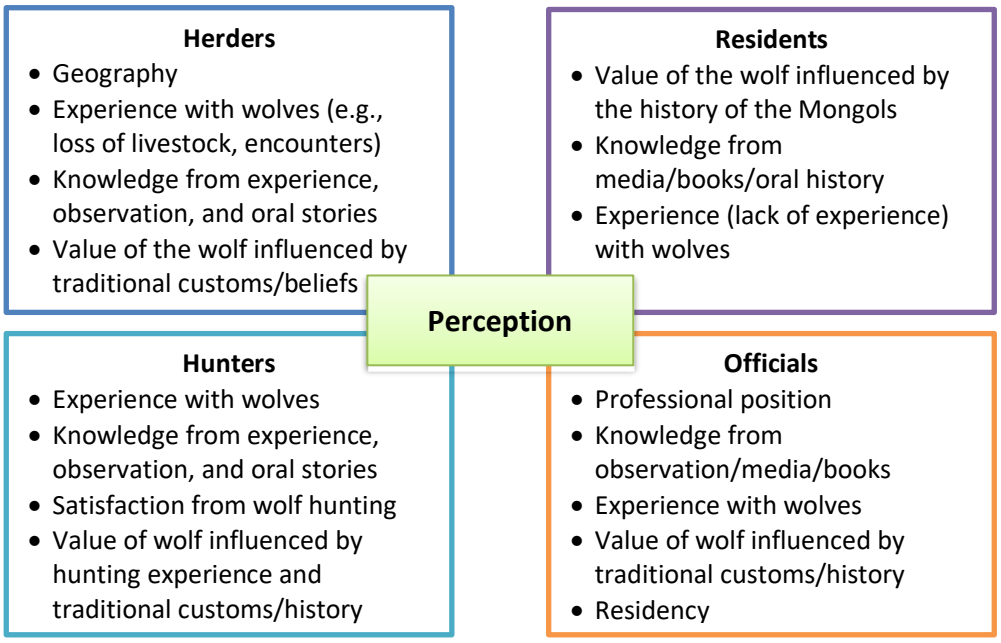

Figure 3. Drivers that influence perceptions of stakeholder groups on wolves (*Canis lupus)* in Mongolia**.**

***Herders*.** Findings suggest that herders' perceptions of wolves are shaped by their experience with wolves, knowledge about wolves, financial impact caused by wolves, ecological condition, traditional customs and beliefs, and wolf related stories that were passed through oral tradition. They perceive wolves as a highly spirited animal and/or a dangerous predator. Herders have witnessed different behaviors of wolves; therefore, a large part of their life is adjusted to wolves. For instance, herders select grazing areas for livestock based on observations of wolf travel patterns (Narankhuu 2000; Sukhbaatar et al. 2020). Also, they use various methods to protect livestock from wolf attacks, such as guard dogs. In wolf rich areas, people have more guard dogs outside yurts (Lugli 2016; Sukhbaatar et al. 2020).

In general, herders from the Khangai region hold a neutral position with regard to wolves (Sukhbaatar et al. 2020). However, when compared to the other three stakeholder groups, herders view wolves somewhat more negatively. Especially, female herders tend to be

more negative towards wolves, which could be related to fear. Fear of the wolf could be linked to both lack of personal experience or frequent interactions with the wolf (Kellert 1985; Kellert and Berry 1987). The landscape of this research area was a mixture of mountains and steppe. It had forests and rugged obstacles which wolves favor (Davie et al. 2014; Enkhsaikhan 2004). In other words, the landscape is perhaps one key reason that herders from the research area have higher frequency of interactions with wolves and have more direct experience with wolves. For herders, first-hand experience with wolves inclines negative attitudes towards the animal. Most herders from this research area have experienced some amount of livestock loss due to wolf predation. Wolf predation of livestock is the top reason of herders to express strong dislike against wolves (Dickman et al. 2011). Otherwise speaking, livestock is the main livelihood source of herders and wolf predation of livestock means financial damage to herders. Although financial harm caused by wolves is a major factor to perceive wolves negatively, herders also believe that a herd that was touched by a wolf grows faster (Sukhbaatar et al. 2020).

Herders' knowledge about wolves mostly arises from their long-term generation to generation observations. One of the main responsibilities of herders is how to protect their livestock from potential wolf attack. Therefore, knowledge of wolves and their behaviors and being prepared for any sudden attack is important to herders. Certain behaviors of wolves, such as excessive killing, are hard to tolerate for herders (Sukhbaatar et al. 2020). Because wolves make herders' lives more challenging and restless, herders prefer to have fewer wolves in the area. However, herders do not accept elimination of all wolves. Herders explain it with a statement '*the ecological balance will be lost*'. However, I speculate that there is some

apprehension of natural power inside herders. In other words, there seems to be a belief or a caution among herders that whoever mistreats nature will get punished by nature in some fashion.

Urban residents. In terms of urban residents, their perceptions of wolves were influenced by Mongolia's history, their knowledge, and their experience (or lack of experience). Results indicate that urban residents have a high degree of pride in the history of the 13th century of Mongolia led by Chinggis Khaan, who is presented as a descendant of the Blue Wolf (Onon 2001). I posit that even though many urban people do not have much experience with wolves, they may feel as if they are culturally and spiritually related to wolves.

Results also show that residents view wolves more positively than the other three stakeholder groups. Many of them perceive the wolf as a heavenly, majestic, and spirited animal, which makes me consider that urban residents may have more romanticized and glorified understandings and ideas of wolves. Because of their urban lifestyle and lack of experience in the wilderness, most urban residents lack direct experience with wolves, which could have a positive impact on their perceptions (Kellert and Berry 1987; Mech 2017). Instead of observation and direct experience, most of their knowledge about wolves comes from environmental TV programs, books about wolves, and oral stories told by others.

Hunters. Hunters commonly perceive the wolf as a necessary species that needs to exist in nature as well as a spirited animal that tests their hunting skills more than any other animal. Hunters come from different backgrounds, including herders, clerks, engineers, and others. Despite their background, hunters agree that having no wolf in the wilderness is unacceptable. According to some hunters, life would be too boring without wolves. From hunters' stories, I

comprehend that wolves make hunting experiences a lot more adventurous than other game animals. An often-used term by hunters was "the wolf is a food sharer just like hunters." I suppose that hunters admire wolves because of these two main reasons.

In many cases, herders provide hunters with information about wolves. Hunters mostly agreed with the common understanding that wolves keep their prey populations healthy by predating weaker and sick individuals. However, there are a considerable number of hunters who showed disagreement with this statement. Hunters claimed that a wolf does not necessarily target a weaker animal, instead it rather selects a prey depending on its own strength and health. According to hunters, older or younger wolves perhaps prefer preying on weak and sick animals, but strong and healthy wolves would usually choose healthy livestock. Hunters accumulated their knowledge about wolves from experience, observation, and oral stories.

Environmental officials. Officials, similar to other stakeholder groups, perceive wolves as a spirited animal that contributes to keep the ecological balance. I speculate that their knowledge about wolves varies depending on their job positions, residency, and gender. Officials in the countryside seem to have more direct experience with the wolf than officials who work in urban areas. Also, female officials have a lot less direct experience with the wolf than male officials. Female officials may gain knowledge about wolves more from literature and media, while male officials had assembled knowledge about wolves from direct experience as well as literature and media.

In the countryside, herders inform local officials and rangers of the soum government (a second level administrative subdivision) about wildlife, including wolves. Regardless their

personal attitudes towards wolves, local officials sometimes need to organize wolf hunting or wolf scaring activities in the area, often when complaints about wolves from herders increase. It is important to government officials to listen to herders and help them to keep the wolf risk at a low level.

In conclusion, the four stakeholder groups consider the wolf as both ecologically and culturally iconic species. Ecologically, the wolf is perceived as a species that plays a significant role to keep the ecosystems healthy and prey populations in balance. Stakeholder groups' cultural perceptions of wolves differ based on their residency. Urban participants perceive wolves as culturally important because of the heroic history of Mongolian ancestors. By comparison, participants from the countryside do not necessarily give much weight to the history of Mongolia. Instead, country people's lifestyle is a culture that is accustomed to co-existing with wolves.

All stakeholder groups in this study generally express positive to neutral perceptions of wolves. Herders perceive the wolf less positively than other stakeholder groups due to financial conflicts caused by wolves. Studies in other countries have reported similar findings that rural people (e.g., farmers and ranchers) who live near wolf territories perceive wolves negatively (Bjerke, Reitan, and Kellert 1998; Kellert 1985; Naughton-Treves, Grossberg, and Treves 2003). This study suggests that traditional values and spiritual beliefs have positive influence on herders of the Khangai region to accept and co-exist with wolves. However, conserving wolves might not be supported as much by herders. Similar findings have been noticed in Macedonia and Sweden that rural people opposed wolf conservation (Linnell 2010; Williams, Ericsson, and Heberlein 2002). Therefore, one wolf management strategy that could keep herders' attitude

stable is to allow sustainable hunting of wolves (Linnell 2010). Sustainable hunting can be helpful to stabilize wolf populations, prevent conflicts between humans and wolves, and enhance support for wolf conservation (Treves 2009). In Mongolia, hunters like to hunt wolves, which positively influence their perceptions of the wolf. In many cases, hunters tend to protect species that they like to hunt (Heberlein and Ericsson 2008).

Knowledge is an essential part in wolf management. Studies have shown that a higher level of knowledge about a species can make positive changes to people's perceptions (Glikman et al. 2012; Heberlein and Ericsson 2008; Houston, Bruskotter, and Fan 2010; Kellert 1985). In this study, unlike urban residents, herders and hunters are the most knowledgeable stakeholder groups about wolves. They gain more knowledge from direct experience, practice, and observation. For example, herders of the Khangai region of Mongolia have broad range of knowledge about wolf behaviors, which help them to prevent wolf damages and protect livestock (Sukhbaatar et al. 2020). Experience with the wolf usually have negative impacts on attitudes towards wolves (Heberlein and Ericsson 2008; Houston et al. 2010). However, due to a long-term relationship with the wolf, humans grow tolerance for the predator, which also increases more positive perceptions. For example, Alaskans show the most positive perceptions of the wolf than other states in America (Kellert 1985). Consequently, enhancing people's knowledge of Mongolia's history and traditional customs and educating them on traditional and scientific knowledge about wolves could be beneficial to increase positive attitudes towards wolves and successfully improve wolf management practices in the future.

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Appendix 1: Questionnaire

Demographic questions:

- Name:
- Age:
- Sex:
- Education:
- Address:

Wolf related questions:

- How do you describe 'the wolf' with one or a few words?
- How would you rate your attitude towards wolves?
    - Very good
    - Good
    - Neutral
    - Bad
    - Very bad
    - Not sure

Please indicate how strongly agree or disagree with the following statements. Select one choice per statement.

Wolves predate on livestock more often:	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**	**Not sure**
The wolf is an important species.						
The wolf is an important part of our culture						

- What roles does the wolf play in nature?
- What role does the wolf play in Mongolia's culture?
- What experience do you have with the wolf?
- How would it feel to you if Mongolia did not have any more wolves?

Appendix 2: IRB approval

Dear Tuul Sukhbaatar,

As Chair of the Institutional Review Board (IRB) for 'Antioch University New England, I am letting you know that the committee has reviewed your Ethics Application. Based on the information presented in your Ethics Application, your study has been approved.
Your data collection is approved from 07/20/2018 to 07/19/2019. If your data collection should extend beyond this time period, you are required to submit a Request for Extension Application to the IRB. Any changes in the protocol(s) for this study must be formally requested by submitting a request for amendment from the IRB committee. Any adverse event, should one occur during this study, must be reported immediately to the IRB committee. Please review the IRB forms available for these exceptional circumstances.

Sincerely,

…

Preface to Chapter Six

Chapter Six is written as a stand-alone document in journal article format (Manuscript 3). This chapter explores opportunities to improve current wolf management in Mongolia. It addresses:

- How familiar are Mongolians with the current wolf management?
- What potential opportunities can TEK offer to improve the current wolf management policies and practices in Mongolia?
- What do Mongolians, who participated in the study, recommend for effectively managing wolves?

Chapter six includes four main sections: introduction, research design, results, and discussion & conclusion. The introduction section describes conflicts between humans and wolves that are currently occurring in Mongolia. Methods, research sites, participant selection, and data analyses are described in the research design section. The results section reports problems that wolves and humans cause to each other, historic and current wolf management practices, and recommendations by participants towards wolf management improvement. The discussion section presents the interpretive summary of findings and what further steps could be taken to build appropriate wolf management policies in Mongolia.

Chapter Six. Manuscript C. Opportunities to improve wolf management in Mongolia

Abstract

Current wolf management practices in Mongolia appear to prominently aim at reducing wolf (*Canis lupus*) predation on livestock and wild prey through lethal means, which may lead to unsustainable wolf populations in the future. Therefore, Mongolia needs to develop sufficient wolf management policies and practices. This case study aimed to solicit Mongolian people's knowledge and perspectives on contemporary wolf management practices in Mongolia; to identify potential opportunities on how their Traditional Ecological Knowledge (TEK) could improve wolf management policies and practices; and to seek their opinions and recommendations on effective wolf management. I selected four stakeholder groups (herders, urban residents, hunters, and government officials) as representatives of the Mongolian people. I used a mixed methods approach to collect data. Data were collected between August and October, 2018. A total of 128 individuals from four locations (Ulaanbaatar city, Arkhangai, Bayankhongor, and Uvurkhangai) participated in this study. Results indicate that all stakeholder groups expressed broad support to develop and implement comprehensive wolf management policies and practices that include the participation and collaboration of multiple parties, including the government, public, and research institutions. Findings also indicate that hunters' taboos and beliefs about wolves and wildlife in general may provide younger generations a positive influence about respect for environment and animals and hunters' roles in wildlife conservation. Furthermore, wolf management recommendations by stakeholder groups indicated that Mongolia could benefit from a structured decision making (SDM) approach to wolf management by clearly defining objectives, developing alternative

management approaches, and evaluating alternative approaches to choose the most effective ones.

1. Introduction

Mongolia is a country where traditional pastoral livestock husbandry has a substantial role in its economic development, comprising 10.6 percent of the country's gross domestic product and 8.4 percent of export revenues (Batmunkh, Munkhnasan, and Byambadorj 2019). Livestock predation by wolves frequently occurs in Mongolia and is considered a threat to livestock production (Davie et al. 2014a; Hovens and Tungalaktuja 2005; Kaczensky et al. 2008; Sukhbaatar et al. 2020a). According to the current law on fauna of Mongolia, the Ministry of Environment and Tourism (MET) sets a quota of wolf hunting every year based on the wolf population density and the local government of each province issues hunting licenses. However, wolves can be hunted without a license to protect livestock and to reduce the wolf population in certain areas if necessary (Secretariat of the State Parliament of Mongolia 2012). In addition, to protect rare animals from wolf predation, wolves also can be hunted inside special protected areas (SPA) by the SPA administrations (Secretariat of the State Parliament of Mongolia 1994). By virtue of these actions, the Mongolian government appears to be supportive of lethal actions to reduce wolf conflict.

Research indicates livestock predation by wolves is the primary cause of human conflict with wolves in Mongolia, and in most other countries (Mech 2017; Mech and Boitani 2003; Treves and Karanth 2003). On many occasions, humans undertake retaliatory killing of wolves for livestock losses, which could result in unsustainable wolf populations (Li et al. 2013; Linnell et al. 2002; Subba et al. 2017). The current status of wolves in Mongolia is Near Threatened

based on an assessment using the International Union for Conservation of Nature (IUCN) criteria (Clark et al. 2006). The species is also listed under Appendix II of the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES; Clark et al. 2006). As a top predator, the wolf's role is important for ecosystem function by controlling prey populations and maintaining biodiversity (Bergerud et al., 1983; Mech & Boitani, 2003; Ripple et al., 2014). Besides hunting, other factors negatively influence wolf populations including a shortage of natural prey and habitat loss (Boitani 2006). For instance, Mongolia's livestock population recently reached nearly 71 million (National Statistics Office of Mongolia 2019), which has resulted in reduced prey populations (through competition) and habitat loss and degradation (Ito et al. 2013; Batkhishig 2013).

Many efforts have been made by governments, nonprofit organizations, scientists and conservationists to understand the dynamics between wolves and prey and to develop effective wolf management strategies to mitigate and resolve conflicts between humans and wolves (Bisi et al. 2007; Mech 2017; Mech, Fritts, and Paul 1988; Spencer et al. 2020; Treves and Karanth 2003). In recent decades, however, there has been a growing recognition of traditional ecological knowledge (TEK) in wildlife management and natural resource management, which could provide new dimensions to issues around human-wolf conflict (Berkes, Colding, and Folke 2000; Fernandez-Gimenez 2000; Gilchrist, Mallory, and Merkel 2005; Houde 2007; Van Vliet et al. 2018).

TEK, "a body of knowledge, practice, and belief" (Berkes 1999:8), is transmitted from one generation to another, and it evolves and is enriched by new observations and experiences of local community members (Berkes 1999; Fernandez-Gimenez 2000). Integration of TEK and

scientific approaches into wildlife management can be a useful step to manage wildlife, especially in areas where western conservation approaches alone might not be successfully introduced and implemented (Gilchrist et al. 2005). Moller et al. (2003) argued that the combination of scientific and traditional knowledge can help build better collaborations between wildlife and natural resource users and scientific institutions. TEK can be a valuable source that provides data, including the density and habitat of rare species, for estimating and assessing the status of the species (Leeney and Poncelet 2015). According to van Vliet et al. (2018), TEK and traditional techniques of indigenous people can be used for the monitoring of wildlife as well. In Mongolia, some studies have explored nomadic herder' TEK in rangeland management, prediction of harsh winter conditions, and changes in climate extremes (Fernandez-Gimenez 2000; Soma and Schlecht 2018; Tumenjargal et al. 2020). It is applaudable that Mongolians' TEK is acknowledged in studies; however, I have not been able to identify any research on TEK of wolves and its contribution to wolf management in Mongolia.

To develop effective wolf management and reduce human-wolf conflicts in Mongolia, the traditional knowledge of the Mongolian people could offer substantial contributions (Davie et al. 2014b). In addition to TEK, increasing the participation and hearing voices of different stakeholder groups could have benefits to wolf management development. Encouraging public participation could increase people's familiarity with conservation matters and may also motivate their involvement in overall environmental and conservation activities. Inclusion of a wide range of stakeholder groups reduces the likelihood of making decisions that serve only one or small group of beneficiaries (Decker et al. 2015).

In this study, I explored opportunities to improve wolf management in Mongolia. I, first, sought to understand the knowledge of stakeholder groups on contemporary wolf (*Canis lupus*) management practices in Mongolia. Second, I searched possibilities of TEK of Mongolians to positively influence and improve current wolf management in Mongolia. Finally, I sought to identify opinions and recommendations of stakeholder groups on opportunities for improvement of wolf management practices in Mongolia.

2. Research design

The research design consisted of five elements: methods; selection of study sites; participant selection; data collection; and data analysis.

2.1. Methods

This study used a convergent parallel mixed methods design for data collection. I chose this approach because there are multiple advantages of using mixed methods compared to using only a quantitative or qualitative method, for instance: stronger evidence through convergence and corroboration of findings; triangulation or increased validity of data by using one method's results to inform the others; increased generalizability of the results; and more complete knowledge necessary to inform theory and practice (Bryman 2016; Creswell 2014; Greene, Caracelli, and Graham 1989; Johnson and Onwuegbuzie 2004). Also, collecting data at the same time was appropriate for this study due to the limited timeframe of data collection and challenges of accessing the remote study areas where data were collected (Creswell, 2014; Creswell & Plano Clark, 2010).

I designed a questionnaire for each stakeholder group that included demographic, quantitative and qualitative questions (Appendices 1-4) (Lavrakas 2008). The quantitative part

consisted of Likert-scale questions. These questions were focused on quantitatively indicating participants' opinions on wolf hunting and wolf population control. The qualitative part included open ended/semi-structured questions. These questions covered the narrative aspects of the wolf inquiries including wolf management practices. All data collection methods were reviewed and approved by the Antioch University Institutional Review Board (Appendix 5).

2.2. Study sites

This study was carried out in four different sites of Mongolia, including the capital city of Ulaanbaatar, Arkhangai province, Bayankhongor province, and Uvurkhangai province (Figure 1).

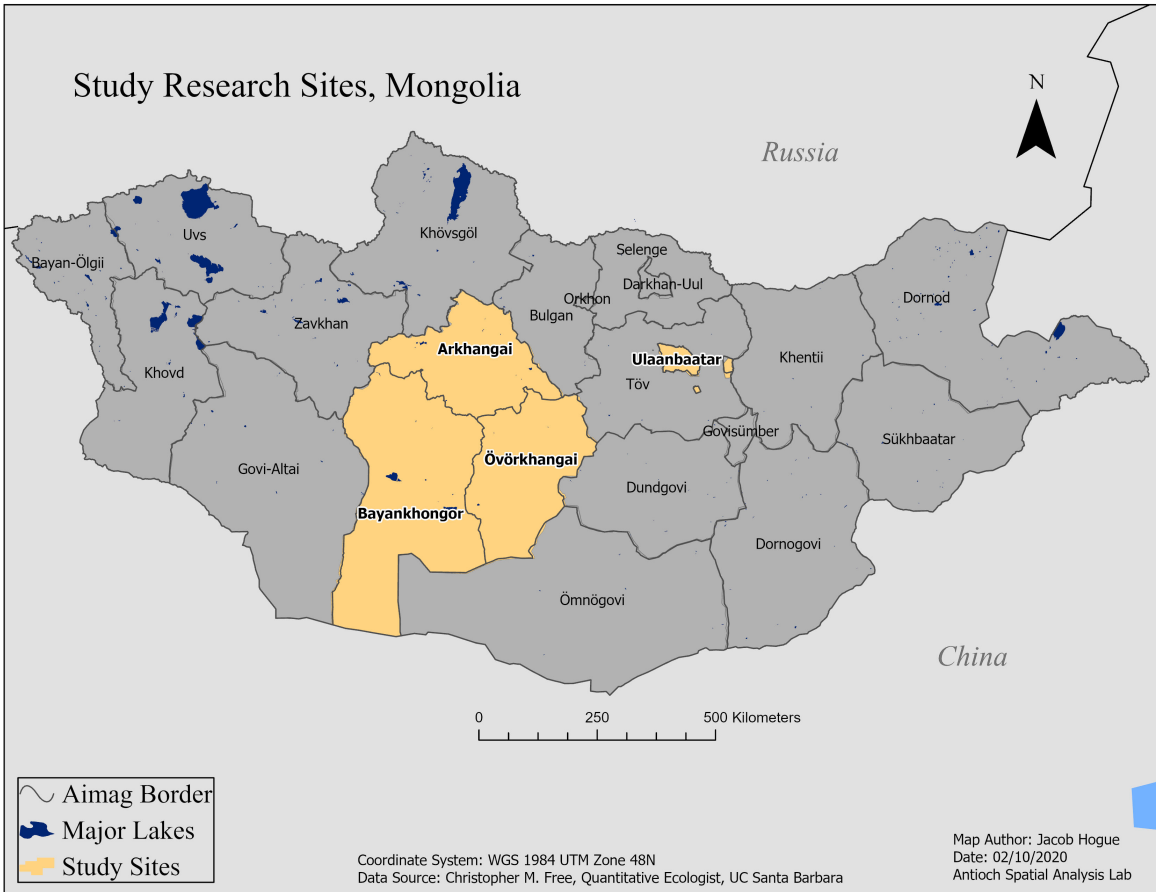

Figure 1. Map of the research sites for data collection. Areas included Ulaanbaatar city and parts of Arkhangai, Bayankhongor, and Uvurkhangai provinces (aimags).

I considered several rationales for these sites:

a. Ulaanbaatar city is the most densely populated area of the country, home to nearly half of all Mongolian citizens (National Statistics Office of Mongolia 2018). The city's population has increased dramatically due to internal migration from other parts of the country to Ulaanbaatar in recent decades (National Statistics Office of Mongolia 2018). The main factors that attract rural Mongolians are employment opportunities, businesses, better schools, improved hospitals and more (Solongo 2007). This location also allowed me to locate and meet people with different knowledge, backgrounds, occupations, educations, and living conditions;

b. Arkhangai, Bayankhongor, and Uvurkhangai provinces lie in the Khangai region that is part of the forest-steppe zone of Mongolia. This region's ecosystem is a blend of grassland, mixed coniferous forests, mountain peaks, rugged terrains, and meadows (Ministry of Environment and Tourism 2015). Wolves appear to favor the conditions of this landscape and wolf density is probably higher here than in other parts of the country (Davie et al. 2014a; Kaczensky et al. 2008). In fact, others have suggested that the Khangai region has one of the highest wolf populations in Mongolia (Bannikov, 1954, as cited in Enkhsaikhan, 2004; Clark et al., 2006);

c. Due to the Khangai region's natural characteristics, people of this region live on different landscapes such as open steppe, wooded areas, or mountainous terrain, which could affect their experiences with wolves; and

d. The Khangai region has the highest number of livestock in the country (approximately 24.3 million). Each of the three provinces stands in the forefront of the list of provinces with

the most livestock (National Statistics Office of Mongolia 2019). I anticipated that people in the Khangai region had extensive traditional knowledge and experience in managing wolves.

2.3. Participant selection

A total of 128 individuals participated in this study. Representatives of four stakeholder groups (n=50 herders, n=20 hunters, n=52 urban residents, and n=6 environmental officials) were selected based on the following basic criteria shown in Table 1.

Table 17
Criteria used for selecting stakeholder groups.

Herders	Individuals who currently owned livestock and lived in the countryside full time engaging in pastoral nomadic lifestyle. Herders who hunted wolves were considered as hunters. People who did not own any livestock and yet still lived in the countryside were not counted as herders in this research;
Hunters	Individuals who hunted for both recreational and subsistence purposes. In other words, despite their residency and occupation, anyone who regularly went hunting was considered as a hunter in this research. Hunters were not limited to people who only hunted wolves;
Urban residents	Individuals who had permanent residency in a city or a province center and who did not hunt. If they did any form of hunting, they were counted as hunters. People who seasonally moved between urban areas and the countryside were not considered as urban residents.
Environmental officials	Individuals who worked on behalf of the national or local government to enforce environmental laws and regulations and/or participate in governmental decision-making processes.

I chose the random sampling (n=39), snowball-sampling (n=27), and convenience sampling methods (n=62) to select participants (Evans and Rooney 2013; Goodman 1961; Lyon et al. 2018).

To select herders, a combination of the random sampling and snowball-sampling was an appropriate approach. In a few cases, the convenience sampling method was used. To randomly sample herders, we stopped at one in every five yurts (n=39). Sometimes, randomly selected participants indicated other individuals who could be valuable for the research, such as someone who had extensive experience with wolves (n=7). Only four herders were selected by the convenience sampling method, while we were stuck in a soum center due to a flood. We did not include anyone from the soum center, because soum center residents did not meet the criteria for herders.

The snowball sampling was helpful to find hunters, not only in the countryside but also in provincial centers and Ulaanbaatar city. All hunters (n=20) who participated in this research were found by the snowball-sampling method. The random sampling did lead us to two households that had people who hunted. However, we did not count these individuals as hunters, because they did not go hunting regularly (at least once a year) as shown in the criteria for hunters.

To select urban residents, we used the convenience sampling method (n=52). Urban residents were selected by personally approaching in public places and offices (n=28), via Facebook (n=24). Our intention was to select one in every five individuals; however, many people we approached did not agree to participated in the study. Because of this challenge, we stopped trying to use the random sampling method and needed to switch to the convenience sampling method.

The convenience sampling method was suitable to find environmental officials (n=6). I chose the most convenient and reachable environmental workers as participants due to the

difficulty of locating the officials' contact information and the fact that many government officials were unavailable within the planned period for data collection. This method is considered as one of the least-satisfactory methods because it is difficult to expect as to whether research findings can be representative (Evans and Rooney 2013; Robson 2011). However, it was an effective method in this case, stopping at offices without pre-contacting environmental officials. Despite the convenience of this method, I sought to involve at least one environmental official from each of the research sites.

2.4. Data collection

The data were collected from late July 2018 until early October 2018. I had seven assistants for the process of data collection (3 females and 4 males). These seven individuals were between 24-32 years of age. The field assistants were all residents of Ulaanbaatar. One local guide was hired from Arkhangai, Bayankhongor, and Uvurkhangai provinces. In these provinces, I had one of the four assistants for the entire data collection period. His two main responsibilities included conducting interviews when needed and driving. He was trained by shadowing me during the initial interviews. During his first three interviews, I observed his interviewing process and corrected him when needed. Therefore, I did not need to exclude any initial interviews by the assistant. The other three assistants aided me to collect data in Ulaanbaatar, by distributing questionnaires.

Mongolia's country roads are usually unpaved and poorly signed and it was important to have a local person who was familiar with local roads. Therefore, I hired one local guide from each of the three provinces. I found the local guides through previously built relationships in those provinces. The other three assistants played a strong role in the participant selection in

Ulaanbaatar city. Their responsibilities were distributing and collecting printed questionnaires. I thoroughly explained to them that they had to present the purpose of the study and a consent form to every participant.

Every participant was informed about the purpose of the research. They were also informed that participation in the research was entirely voluntary and that they could skip any question without answering and/or discontinue participation anytime. All participants of this research were native Mongolians. The questionnaires were completed in various places (Table 2), using three different approaches: in-person interview; online survey; and printed survey.

Table18

Locations of participants who participated in completion of questionnaires.

Locations	Number of participants	
In-person interviews		**82**
Home	61	
Outside in nature	7	
Office	5	
Store	4	
Factory	4	
Restaurant	1	
Online questionnaire		**17**
Printed questionnaire		**29**
Coffee shop	9	
Bank	8	
Home	7	
Office	3	
Store	2	
Total		**128**

2.4.1. In-person interviews. All herders (n=50) and hunters (n=20), a few urban residents (n=9), and several officials (n=3) completed the questionnaires in the in-person interview style. I refer to these as 'interviews'. Many people, especially country people, did not want to fill out the questionnaire by themselves, instead they preferred for me or my assistant to ask the questions and record their answers. The advantage was that I was able to have

conversations and ask additional questions and also ask for clarification if an answer was unclear.

Before an interview, I asked every interviewee for permission to use a voice recorder. Every interviewee accepted my request to record of his/her interview. However, some interviewees (n=4 herders) did not look comfortable being recorded, therefore I continued their interviews without a recorder. Another four interviews were not recorded with adequate quality due to ambient noises (e.g., wind, children playing, people talking, etc.). The length of interviews was usually 15 minutes to an hour. In a few cases, it exceeded an hour.

Most interviews were conducted at participants' homes, some outside in nature, some in offices and one in a restaurant. In the countryside, at every household, we were offered tea or *airag* (fermented mare's milk). During the greeting time, we introduced ourselves and talked about simple subjects such as the weather, livestock, and health. We also asked each participant if he/she was comfortable to give an interview. Fortunately, people were kind and did not refuse to participate. Some families fed us with a freshly cooked meal and we had to stay at a yurt for hours in some cases. Several families let us sleep overnight in their yurts. Several workers of a wool processing factory in Uvurkhangai province also participated.

2.4.2. Online questionnaire and printed questionnaire. I generated an online questionnaire with the same questions for urban residents on Google Forms and shared it through Facebook. I do not have a personal Facebook account; therefore, the distribution of the online survey was through the assistants' accounts. I observed three disadvantages from the online distribution of questionnaire: a) it was not possible to know how many people accessed the questionnaire; b) the online questionnaire was shared via my assistants' accounts;

therefore, only younger people might have accessed the questionnaire; and c) online questionnaire respondents answered numerous questions with 'I do not know' or left them without answering.

One of the three assistants in Ulaanbaatar joined me to distribute printed questionnaires in public locations such as a grocery store, a coffee shop, and a bank. All printed questionnaires were completed by participants. To get the responses back from participants, we waited for them to complete questionnaires. Originally, the assistant and I intended to use a lottery like approach, choosing one from every five individuals. Unfortunately, most people refused to complete a survey and we ended up accepting everyone who agreed to complete the survey.

The other two assistants took a few more printed questionnaires were taken at people's homes without me. They distributed questionnaires to participants in an apartment building (with 288 apartments) that was located in 'Unur' district of Ulaanbaatar. The assistants chose this location because of the close proximity. They collected data by knocking on one of every five apartment doors. According to the assistants, only a few people were home, probably because most people were at work when they distributed the questionnaires.

2.5. Data analysis

Following data collection, I compiled and organized all questionnaires and digitized them. First, the quantitative data part, or Likert-scale answers, was sorted and logged into a spreadsheet. Then, the qualitative data or interview transcripts were added into the worksheet.

2.5.1. Quantitative data analysis. Stata/IC 15.1 (StataCorp, Texas, USA) was used to analyze quantitative data. The quantitative data consisted of participants' ratings to three six-point Likert scale questions. These ratings were sorted by the stakeholder groups. To evaluate the relationship between stakeholders' ratings, I created two-way contingency tables. Descriptive statistics (i.e., means, medians, standard deviations, and interquartile ranges) and test statistics, degrees of freedom, and *p*-values were calculated by Stata. The Pearson's Chi square test was used to obtain *p*-values. Results that showed less than a five percent probability ($p \leq 0.05$) of a false positive were considered significant.

2.5.2. Qualitative data analysis. MAXQDA Analytics Pro18 (VERBI GmbH, Berlin, Germany) was used to process and analyze qualitative data. The qualitative data mainly consisted of participants' responses to open-ended questions that were included in the questionnaire. Additional information from stories that participants shared during interviews was also used in the qualitative data analysis. All recorded interviews were transcribed and translated by myself (a native Mongolian). My intention was to recognize patterns emerging from the qualitative data. To understand the patterns, I created codes from the participants' responses and grouped the codes into general themes using MAXQDA.

3. Results

The following four themes were discerned from the data collected: participants' opinions on problems caused by wolves; participants' opinions on threats towards wolves; historical and current wolf management practices; and participants' recommendations on effective wolf management in Mongolia.

3.1. Problems caused by wolves

All respondents were asked "*What problems do wolves cause?*" I grouped the respondents' answers into six categories: A) wolf predation on livestock; B) disease transmission; C) attacks on humans; D) wolves do not cause any problems; E) wolf predation on wild animals; and F) not sure. A total of 102 individuals provided specific answers, but the remaining 26 individuals were not sure how to answer the question. As shown in Table 3, the most frequently identified problem was that wolves preyed on herders' livestock.

Table19

Problems caused by wolves (described by stakeholder groups).

Stakeholders groups	**Livestock predation**	**Disease transmission**	**Attack on humans**	**Wolves do not cause problems**	**Predation of wild animals**	**Not sure**	**Total**
Herders	39	3	1	0	1	6	50
Urban residents	22	1	5	6	2	16	52
Hunters	12	3	0	0	1	4	20
Environmental officials	4	1	0	0	1	0	6
Total	77 60%	8 6%	6 5%	6 5%	5 4%	26 20%	128 100%

Wolf predation on livestock. Most respondents of all stakeholder groups agreed that the main problem that wolves cause to humans is predation of livestock. An older herder stated:

> During the totalitarian regime, the authorities and governors used to come to this area to hunt wolves. After that era, everyone was attempting to raise private livestock and tried to kill wolves. But wolves are not such animals that are easily killed by anyone who wants to kill them… …Because this area has many wolves, it is generally challenging for herders to get foals. Several summers ago, wolves were vicious towards foals, even

when rabbits and marmots were still out. When there are too many wolves, a few hunters hunt wolves to lower their numbers. And I think that is a right thing to do.

An urban resident stated, “Wolves attack livestock and impact herders’ livestock population. This is probably the reason to hunt wolves.” Another urban resident said, “If the wolf population increases too much, they become dangerous to livestock.” According to a hunter, “Sheep and horses are wolves’ favorite. It’s probably because of what they are used to hunt. Gobi wolves like camels. Khangai wolves love [to eat] horses.” An environmental official stated, “The negative side of wolves is that they are hostile to the livestock industry.”

Disease transmission. Some respondents expressed their concerns about diseases of the wolf. Most of these respondents mentioned the danger of rabid wolves; fortunately, none of them personally experienced any rabid wolves. In a herder’s words, “Wolf’s rabies is a serious thing. [Rabid wolves] should be immediately eliminated.” Another herder stated, “When there are too many wolves, they attack and bite animals. There’s a high probable that a disease might spread from the animal that was bitten by a wolf.” According to a hunter, “It is hard when a wolf gets rabies. It will attack people and animals. I've heard that wolves can't resist rabies and mange well.” An urban resident mentioned, “Infectious diseases such as rabies can be dangerous to humans.” An environmental official indicated, “Wolves can spread the cowpox.”

Attack on humans. In general, the risk of wolf attack on humans seemed to be low. However, stories that were shared by some interviewees suggested that there were a few incidents that even non-rabid wolves attacked humans. According to a herder:

> My neighbor's wife 'O' was tethering calves before milking her cows. A wolf came running. Although she yelled to scare the wolf away, the wolf attacked her directly… She had thick clothing on, therefore she only got scratched a little bit… We sent the wolf's brain to the province center later to check if it was a rabid one. The result was not positive.

An urban resident stated, "If there is too little food, wolves may attack humans and livestock." And another urban resident pointed out, "Wolves are enemies. They are enemies of humans and domestic animals. I heard that they attack humans, when there are too many wolves."

Wolves do not cause problems. A few urban residents claimed that wolves did not cause any problems to humans. According to an urban resident, "I don't think that wolves have any bad side." Another one stated, "Wolves don't have bad sides. If their population is too high, then maybe they are harmful." Another one said, "It is just fine that humans and wolves co-exist together."

Wolf predation on wild animals. A few individuals indicated that wolves negatively impacted the growth of rare wild animals, such as elk (*Cervus elaphus*), wild camel (*Camelus ferus*), and marmots (*Marmota sibirica*). For instance, an elderly herder stated, "Besides livestock, wolves predate on wild animals too. Therefore, wolves cause a lot of losses… They eat everything, such as marmots, the elk, and the deer. Wolves are real predators, so they eat everything to feed themselves." An urban resident indicated, "Wolves prey on rare mammals and ungulates." According to an elderly hunter, "Wolves are also destructive. They don't let

the elk grow. In the Gobi, they don't let the wild camel grow. Wolves ruthlessly eat little young animals."

3.2. Threats to wolves

One survey statement was used to assess respondents' agreement on the following statement: "*Too many people hunt wolves.*" Six-point Likert-scale categories were given to respondents to choose one for each statement (1 = strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5 = strongly disagree; and 6 = not sure). Results did not indicate a significant difference between stakeholders' groups ($X^2(15) = 19.7$, $p > 0.05$). Overall, more than half the respondents strongly agreed or agreed that too many people hunt wolves (Table 4). On the other hand, 10 percent of all respondents disagreed or strongly disagreed with the statement. It is worth noticing that more herders (16% of all herders participated) disagreed that too many people hunted wolves. In other words, the herders' disagreement rate is comparatively higher than the other stakeholder groups' disagreement rates. Compared to the other stakeholder groups, more urban residents (25% of all urban residents participated) held a 'neutral' position towards this statement. I did not ask respondents a direct follow-up question to explain their responses.

Table20

Stakeholder groups' responses to a six-point Likert-scale statement "Too many people hunt wolves."

Stakeholder groups	**1** Strongly agree	**2** Agree	**3** Neutral	**4** Disagree	**5** Strongly disagree	**6** Not sure	**N**	**Median***	**IQR***
Herders	14	12	5	6	2	11	50	2.0	2
Urban residents	13	15	13	2	1	8	52	2.0	2
Hunters	7	2	2	0	2	7	20	1.0	2

Environmental officials	2	3	1	0	0	0	6	2.0	1
Total	36 28%	32 25%	21 17%	8 6%	5 4%	26 20%	128 100%	2.0	2

Note: ** The median and interquartile range (IQR) were calculated for Likert scale 1 to 5 only.*

During interviews, I also asked participants about what potential threats wolves faced in Mongolia. Respondents had different opinions on this subject. Most of them stated that overhunting was the biggest threat to wolves. Other threats that were named by respondents included diseases, food scarcity, and habitat loss. Only a few people stated that wolves were not facing any threats.

One common point brought up by interviewees was that people hunted wolves using "powerful rifles and strong vehicles." Interviewees clearly expressed their dislike of this specific hunting method. They found this method "unfair" and defined it as "wealthy people's amusement." Table 5 shows some examples of words expressed by interviewees about current wolf hunting in Mongolia.

Table21

Example quotes about "unfair" or inappropriate wolf hunting in Mongolia from interviews.

Herder	"I think that [wolf hunting] has basically become people's amusement. Wealthy rich people show up with their big vehicles… …In my observation, they kill wolves only by the power of strong vehicles and guns..."
Herder	"Lately, jeeps and guns are really advanced."
Herder	"Nowadays, when people see a wolf, they try to kill it at all costs. Guns and communication devices are so improved. When someone sees a wolf, he would call everywhere…"
Hunter	"Those people, who chase a wolf by a vehicle and kill after it's exhausted, post their pictures and call themselves hunters. That is not hunting. It equals torture…"
Hunter	"The number of cars and motorcycles has become so high and guns are so advanced. Wolves are getting defeated."
Hunter	"I don't consider someone, who kills an animal with technical advance, as a hunter. He is a killer. Mongolian [hunting] traditions are on the verge of being forgotten."

Hunter	"Nowadays, there is hardly anyone who hunts wolves using old traditional methods. People kill [wolves] only by fast vehicle and fast guns. This is unfair. One or two times could be acceptable. But it wouldn't be any good, if everyone kills that way."
Urban resident	"Hunters with strong vehicles are the threat to wolves."
Environmental worker	"I can't say that contemporary hunters are sharp shooters. They chase [wolves] by strong vehicles and shoot them with machine rifles.

The most commonly stated wolf diseases were rabies and mange. It seemed that most individuals were more familiar with rabies than mange. Those individuals who talked about mange were all from Arkhangai province. For example, a herder stated, "I heard that wolves die from rabies and mange a lot." Another herder said, "Elders used to say that when there is mange breakout among wolves, many of them die. That is how nature controls the wolf population." According to a hunter:

> It seems like wolves die from mange. I've seen two wolves dying from mange. A mangy wolf's body itches unbearably, so it doesn't care about the surroundings. A wolf came to the winter camp's shed of a family. Another time, a mangy wolf came to the well. We couldn't identify it at first and all thought that it was a dog. It didn't attack to any humans though.

A few urban residents mentioned that lack of food and habitat loss were threats to wolves. These individuals stressed that "the wild prey populations of the wolf declined due to human activities" as well as the "desertification occurring in the country."

3.3. Wolf management practices

Based on the respondents' interview answers, the following sub-themes were created: official wolf management practices; non-official wolf management practices; hunters' contribution to wolf management; and wolf management practices in the past.

3.3.1. Official wolf management practices. I asked environmental officials (n=6) about "*What kind of wolf management practices are currently being implemented?*" All of the officials responded that there was currently no work towards wolf management being done, but two of them gave a few more insights. A ranger from Bayankhongor pointed out:

> The local government sometimes organizes wolf hunting by herders' requests… An annual wolf hunting quota is actually set by the [Ministry of Environment and Tourism] for each province. But there is no way to determine the wolf population. It is very hard to determine their dispersion and population. Our ranger takes notes how many wolves and wolf tracks or feces he's seen and gives his report to us and we send it further the province government.

He continued:

> People hunt wolves only for profit these days. And herders like [when people kill wolves], because wolves eat their livestock. But those people refuse to pay the wolf hunting license fee. But they would sell their hunted wolf for 200-300 thousand tugrugs (approximately 75-110 USD). The economic value for a male wolf is 510 thousand tugrugs, and for a female 600 thousand tugrugs. Because everybody views wolves as enemy, the wolf is not valued highly by environmental assessment.

An environmental specialist from Arkhangai responded, "According to the law on special protected area (SPA), the SPA administrations are responsible for controlling the wolf populations inside the protected areas. Currently, primary wolf monitoring data is being collected."

I asked 122 participants (n=50 herders, n=20 hunters, and n=52 urban residents) about the current wolf management practices in Mongolia (i.e. *What do you know about current wolf management practices in Mongolia?*). My intention was to ascertain whether people knew about wolf management at all and, if so, how much they knew. Several people (n=5 hunters and n=1 urban resident) said that they "heard about the wolf hunting ban in the eastern provinces" of Mongolia. And the rest of the respondents claimed that they did not have any information and/or knowledge about any activity that was related to wolf management. Three herders from Bayankhongor pointed out that the local government organized wolf hunting once a year in the area. No hunter claimed that he purchased a license to hunt a wolf. One hunter from Ulaanbaatar complained:

> Getting a hunting license is complicated. When I go to a soum center to buy a license, there is never anyone. It seems like rangers intentionally hide from hunters to not give licenses and penalize later for not having a license.

3.3.2. Non-official wolf management practices. According to most herders, they never had any support from the local government to mitigate wolf related problems. They usually took actions as a community to reduce wolf risks. When wolves come to herders' campsites regularly and kill livestock, usually a group of local male herders go together for wolf hunting or scaring wolves away (Table 6).

Table22

Example quotes of herders about wolf hunting.

"People go together to scare wolves away. They don't kill wolves. Hunters probably kill wolves. Herders usually don't hunt wolves."
"When wolves eat from different households' livestock, a group of people go to scare wolves."
"When wolves tend to become a little harsh to livestock, we all together decide to go hunting."

"When wolves become too many, they are dangerous to livestock. During the collectivist time and in the present time, people go for wolf hunting in summer and winter, when they come to the campsite."
"People don't hunt wolves in summer, only those ones that attacked livestock.

Some herders closely observe wolves where they travel and rest. For instance, a younger herder said, "Around here, wolves usually come out of this southern wood, run by the north side of the river, and maybe hunt something. Herders talk to each other about where wolves have been travelling." More details about herders' observation of wolves are included in the case "Understanding of traditional ecological knowledge as it applies to wolves in the Khangai region of Mongolia" by Sukhbaatar et al. (2020a).

In some cases, they use the *beltreg suilah*[21] *method*. A female herder stated, "People hunt wolves when there are too many wolves and eat livestock. In spring, people also dig wolf dens and take cubs." A young herder shared his experience of *beltreg suilah*:

> About four to five years ago, a wolf killed multiple lambs of mine. It was snowy. I followed wolf tracks on the snow and found a den. There were 11 cubs, five small and six larger. Perhaps, they belonged to two mothers. I got rid of all of them. I almost became a celebrity around here.

As reported in a case study by Sukhbaatar et al. (2020a), this method was no longer a popular method compared to the collectivist period. Also, it seemed that some herders did not appreciate using this method, because they found it inhumane. A female herder said:

[21] Take cubs from den

> I would say that *beltreg suilah* is wrong. Separating cubs and a mother is wrong. People who hate wolves perhaps take cubs from den. Wolves are really smart animals. There is a story that a woman gave birth to her baby in the middle of nowhere and was struggling to cut the cord. A female wolf helped her and was feeding the baby along with her cubs.

A hunter explained himself for being against *beltreg suilah*, comparing his children to wolf cubs. According to him:

> I am not eager about *beltreg suilah*, because I have cubs too. Therefore, I think that it is inappropriate. People use [this method], but I don't blame them either. Because I have several cubs of my own, I don't want to lose mine. I've never tried this method. But I could if I want.

Herders also reported that they took hunters' help. When the wolf risk increased, they would send requests to hunters to hunt wolves. For example, a male herder stated, "We would reach hunters we know. Otherwise, we wouldn't contact the local government to ask for help." Another male herder shared a story about himself after losing two lambs. He first tried to kill the wolf himself and then called hunters from the city:

> I'll tell you an interesting story. One year, a female wolf in heat came to our campsite and lead our two male dogs with her to the woods… In the afternoon, our dogs came back without her. And then in the evening, our dogs started barking and growling, when they saw her coming down from the mountain ridge. She would stay near our campsite and leave in the morning. The dogs didn't follow her again. But she came to the campsite for several days in a row. One day when I was gone to the province center,

> she killed two lambs from our herd. That evening I tied up my dog on the wolf's way and waited for her with my rifle at close range… She came to my dog, and they were sniffing and licking their mouths. And then when I tried to shoot her, my rifle wouldn't kindle. The wolf heard that little clicking noise and ran away. So, I called young people from the center. Two guys came with a large spotlight. They watched her a little bit and were sitting inside, just chatting. I was wondering when they would do something… …When it became dark, they got outside and one of them shined the spotlight on the wolf and the other one shot her…

3.3.3. Hunters' participation in non-official wolf management. Thirteen out of 20 hunters said that they received requests from herders. However, hunters would not come to every request of herders. A hunter said, "People call me and say that wolves are destroying our herd. Of course, the wolf wouldn't be waiting for me there. People don't have to kill wolves for every incidence. Shooting in the air would still keep wolves away for a while." Another one also stated:

> Every situation is different. Sometimes, families call me and complain that wolves are not leaving their livestock in peace. In that case, I would go there for wolf hunting. I also go for wolf hunting where wolves are abundant. If only one wolf is causing minor problem, I don't go there. It's better to let it just be.

From interviews, it seemed that most of the hunters who participated in this research considered themselves as conservationists. Table 7. shows some hunters' responses to a question "*Who is a hunter?*"

Table23

Examples of hunters' definitions of a hunter.

"A hunter is an individual who cares and protect the nature and environment… Being a hunter doesn't mean to kill everything that he sees…
"A hunter shouldn't kill juvenile animals. Most importantly a hunter has to shoot without injuring an animal.
"A hunter hunts to subsist and to feed his family. It is hard to call someone, who kills animals for fun, a hunter."
"People misunderstand hunters as killers. Hunters are not killers. Hunters are close to nature and knowledgeable about animals and plants. However, contemporary hunters are not aware hunters' traditions and hunting ethics. They think that riding a big vehicle and carrying a big gun is hunting. And they shoot anything, big or small. That is not hunting. Hunting has a long history. There are plenty of things to consider when hunting, such as what animal I should hunt, when I should hunt, and what animal I shouldn't hunt. When hunters go for hunting together, they respect each other, respect the elders, and follow hunters' traditions."
"A hunter is an individual who loves nature. A hunter doesn't kill everything he sees, he hunts only what he needs. People get to know each other through hunting. People reveal their true characters during hunting, for example, some people turn angry when they get hungry, and some people compete with others to a better spot."
"A hunter has to love and protect the environment. If a species' population decreases, a hunter works towards to increase its population. A hunter doesn't hunt every animal he spots. It's been taught that way and I do hunt the way I was taught."

The hunters claimed that they used traditional methods to hunt wolves, including ambushing, following, waiting for wolves to fall asleep, howling, and driving wolves out from the woods. A couple of individuals mentioned that they saw some urban hunters using a spotlight to hunt wolves in night time. According to the country hunters, they used ambushing, following, and howling methods when they went for wolf hunting alone. Usually they would combine different methods depending on the situation. For example, a young hunter told me a story about how he combined following and waiting for wolves to fall asleep:

> Following means that to follow wolves without being seen. If I spot a wolf early in the morning, I would secretly follow them. Wolves usually sleep at a higher elevated location. Every 20 to 30 minutes, one of them would wake up and watch around and go

> back to sleep… If wolves sleep on a pretty high hill, they wouldn't wake up for 2 to 3 hours because they feel safe. That is my chance to approach… It's actually scary to get close… It feels like all my hair is standing. My back feels cold and my eyes water. If I can't shoot well, then I will be killed.

A couple of elder hunters said that they used the howling method. They used this method to detect wolves' approximate locations or to bring wolves come closer to themselves:

> Hunters use the howling method quite often. But howling is tricky. Some wolves will come after howling and some won't. Generally, wolves come in three occasions. First, when they are in heat; second, if there is a carrion from their kill; and third, to gather together again after being separated by a hunter.

Driving wolves out of the woods seemed to be the most common method used by both country and urban hunters. This method is not for a solo hunter. A hunter explained, "A group of people are needed to participate. They go on feet or on horses through the woods making loud noise and drive wolves to an open area, where shooters would be waiting."

3.3.4. Wolf management practices in the past. It was evident that respondents were more aware of wolf management practices that were used in the past. Many respondents recalled assignments from the state government that were directed to citizens to battle with wolves. Herders and hunters, who personally witnessed and took part in those actions, shared stories about their experiences. An older herder said:

> During the collectivist era, large numbers of wolves were killed. Trade and prepare units had strict plans. [People who hunted wolves] were awarded a female sheep for killing one wolf and a horse was given as an award for four to five wolves. These awards were

> in addition to the wolf price. The *beltreg suilah* campaign was organized every spring. Hunters were called up for this task. In order to take cubs, a hunter had to exterminate the mother first… …Also residents of *soum*[22] centers were given duties to participate in wolf hunting twice a year. We would go after wolves until January. We would be distributed in different areas to hunt wolves. Back in those years, the law enforcement was strict and people realized their civil duties well too. In general, all kinds of furs and hides from fox to wolf, even ground squirrel skins were prepared…

In addition to awarding herders and other citizens for hunting wolves, hunters were given awards and 'hunter of the state' title. Receiving the title was great honor for hunters. Even in present days, hunters who received the title in the past still show pride:

> The ministry of agriculture made a stipulation that a hunter who hunted 35 wolves in the Khangai region in a year would receive the title 'hunter of the state' and a Czech rifle, the second place hunter would be awarded with a tent and a sleeping bag. The number of wolves to be hunted in the Gobi region was twofold lower, in other words 17 wolves in a year. I hunted 38 wolves in 1989 and became a state hunter. And I finally got the rare Czech rifle.

A few elders mentioned that poison was used to kill wolves as well. But this method was used prior to the period of collectivism. According to a senior herder:

> Poison was used since the 30s. Poison really reduced the wolf population. Many wolf carcasses would be lying around. The Russian poison was very strong. Some people

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[22] A second level administrative subdivision of Mongolia, similar to county

used to say that oxcart full of wolf carcasses would be brought in mornings and afternoons. From the late 40s and early 50s, poison was no longer in use.

3.4. Wolf management recommendations by participants

One Likert-scale item was used to assess respondents' viewpoints on wolf population control (i.e., *The wolf population should be controlled*). Results indicated a significant difference between stakeholders' groups ($X^2(12) = 23.9$, $p < 0.05$). Nearly 50 percent of the respondents strongly agreed and more than 20 percent agreed that the wolf population needs to be controlled (Table 8).

Table24

Stakeholder groups' responses to a six-point Likert-scale statement "The wolf population should be controlled."

Stakeholder groups	1 Strongly agree	2 Agree	3 Neutral	4 Disagree	5 Strongly disagree	6 Not sure	N	Median*	IQR*
Herders	14	12	5	6	2	11	50	1.0	1
Urban residents	13	15	13	2	1	8	52	2.0	1
Hunters	7	2	2	0	2	7	20	1.0	0
Environmental officials	2	3	1	0	0	0	6	1.5	1
Total	63 49%	30 24%	3 2%	8 6%	2 2%	22 17%	128 100%	1.0	1

Note: * *The median and interquartile range (IQR) were calculated for Likert scale 1 to 5 only.*

Most respondents pointed out that a higher number of wolves would cause much damage to herders, therefore controlling the wolf population was considered important. However, wolf population control should be done carefully based on reliable research. For example, according to a herder, "… If the wolf population is not controlled, it will be a disaster. They wouldn't leave livestock alone. It's good to hunt some wolves to prevent their population

from growing…" Another herder stated, "…the wolf population should be controlled at a level that is not too high and not too low." An urban resident said, "I am not against organized wolf hunting to control the wolf population." A hunter pointed out, "Balanced hunting is important. Whatever game species, hunters need to hunt only for their need. One or two. Then wildlife populations can increase. When there is no hunting, wildlife populations don't increase as well, perhaps due to some infectious disease."

Participants were asked to share their opinions to improve the wolf management in Mongolia (i.e. "*What needs to be done to improve the wolf management in Mongolia?*") A total of 100 individuals answered the question and 28 people did not give any response or did not know how to answer. Based on the frequencies and similarities of people's answers, I grouped them into multiple subcategories, which fit under three main categories: governmental regulation, public participation, and research institution (Table 9). Some participants' responses could be included in multiple categories. In order to avoid complication, I included one participant's response in only one category that could best describe the answer.

Table25

Stakeholder groups' responses to an open-ended question "What needs to be done to improve the wolf management in Mongolia?"

	Respondents' recommendations	**Herders**	**Urban residents**	**Hunters**	**Officials**	**Total**
Governmental regulation	Hunting quota	10	15	1	-	26
	Population control	8	5		-	13
	Higher threshold for hunters	2	5	3	2	12
	General call for non-specified form of government regulation	3	4	1	1	9

	Actions against poachers	1	2	-	1	4
	Stricter regulation of wolf trading	-	1	1	-	2
	Capacity building of rangers	-	1	-	-	1
	Wolf habitat protection	-	1	-	-	1
Public participation	Local people's participation	6	1	4	-	11
	Traditional hunting	-	-	3	-	3
Research institution	Research		5	-	1	6
	Environmental people	1	2	-	-	3
	Education	-	-	1	-	1
Miscellaneous	Hunting tourism	-	1	-	-	1
	Develop shooting sport	-	-	1	-	1
No regulation	No regulation needed	5	1	-		6
Total		36	44	15	5	100

Governmental regulation. Most individuals recommended an action that required governmental participation. The most frequent response was that "an annual hunting quota should be set for each region's characteristics." Also, participants pointed out that wolf hunting season dates should be determined. For example, an urban resident responded, "When the wolf population increases too much, there perhaps should be some permission given to hunt certain numbers of wolves in specific areas and in a specific season, based on wolf monitoring research." In addition to defining a hunting quota and a hunting season, multiple individuals highlighted that "killing female wolves", "pregnant and/or mother wolves with cubs", and "digging wolf dens and killing cubs should be banned" by the law. For instance, a female herder expressed, "Wolves are hunted way too much. Outrageous. It is good if environmental department officials and local people agree on not killing female wolves or mother wolves." As stated by several individuals, hunting sick and old wolves could be permitted. A male herder, for example, stated:

> People who are knowledgeable and experienced about hunting should hunt, otherwise, the pretentious ones shouldn't get involved in hunting at all. It is maybe beneficial to plant it in people's mind that it is better to hunt old and sick wolves… Even marmots put their weakest and smallest ones, that wouldn't survive the year, outside the burrow as gatekeepers…

Moreover, some participants thought that increasing the threshold of becoming a hunter would be better. They suggested "increasing hunting license fees", "better registration of hunters' guns", and "improve hunters' education and skills." A hunter said,

> It would good if there were higher requirements for people who want to hunt. They need to learn first how to shoot and how to hunt animals. And then maybe they can get a hunting license. Nowadays, guns are so abundant and gun sale is unrestrained. Whoever wants gets a gun. Some people own 2 or 3 guns.

A few individuals expressed that the government should work towards elimination of illegal wolf hunting. For instance, a herder pointed out, "… I think that there is a big network that kills wolves in a large number. Those people need to be controlled and regulated." An urban resident said, "We need to combat illegal wolf hunting." An environmental official stated, "Wolf hunting should be better monitored." These individuals suggested that it was necessary to take actions to combat with illegal hunters; however, no one specifically indicated how what actions should be taken to stop illegal hunters.

Several participants brought up different notions. Two individuals emphasized that wolf trading should be better regulated. One urban resident stated, "Whoever wants shouldn't hunt. We need a very good law that can combat illegal international trade." A hunter stated,

"People have the right to own firearms, so it is hard to restrict people's hobby. But it is good to control and regulate wolf trading." An urban resident brought up an insight about building rangers' capacity. He said, "There is a need to increase the number of local rangers, increase their capacity, and education." Another urban resident stressed about wolf habitat protection. She indicated, "It is probably important to take a wolf habitat under state protection wherever it is needed."

Public participation. One of the main recommendations was about local people's participation. Respondents emphasized the importance of local herders' and hunters' participation and of their collaboration with local governments. A male herder stated:

> If one wants to regulate wolf hunting, only local people can manage that. What could those big bosses who are driving around the countryside do! For every problem people tend to blame that it was because of the government. Normally, individuals and local people need to work cooperatively. Herders are the main characters in wolf management.

Another male herder stated, "I think that the local government should have meetings with local residents and summarize their opinions and suggestions, and then make a decision on how to manage wolves." According to a female herder:

> Wolf management will be improved if rangers collaborate with herders and gather information from them about where wolves have been seen more and where they travel. It is normal to see 7, 8, or 10 wolves in winter. They leave tracks on snow, …so clearly visible and howl.

Several hunters briefly discussed that Mongolian traditional hunting methods were being ignored or perhaps forgotten. They criticized the new generation of hunters, especially urban hunters, preferring convenient and easy ways of killing animals, instead of learning traditional hunting practices and tasting "real hunters' experience." An elderly hunter pointed out, "There is no young hunter, who goes around and stays in the wilderness for days, like us. Modern hunters kill wolves only by using technical power…" Another elder hunter stated:

> Wolves are like us trying to live and find food to feed themselves. There is no way that wolves would not eat from herders' livestock. Therefore, a certain level of hunting is important, when it is necessary. However, that doesn't mean that all wolves should be killed. In recent years, people hunt wolves only by using strong guns and big vehicles. That is not good. It is never a good thing to kill an animal by chasing until it's exhausted. It is more appropriate to kill an animal using traditional methods, such as ambush or wait until it sleeps. Killing too many animals at once is not right as well.

Research institution. Compared to other three stakeholder groups, more urban residents brought up the importance of wolf research in wolf management. Respondents, in general, expressed that wolf hunting needs to be done based on research, such as studies on wolf population and dispersal. A female urban resident said, "I think that more studies should be conducted to estimate the wolf population and take appropriate wolf management measures. Research is number one priority." Another urban resident pointed out, "Currently, in Mongolia, wolf management is not sufficient. I think that wolf population is decreasing because there is no research on wolf population and wolves are killed in large numbers only based on herders' assumption."

There were a few individuals who said that it was not necessary to have wolf management. They were all from Bayankhongor province. A couple of them expressed that "wolves needed to be hunted and there was no need to regulate it." A hunter stated:

> I don't think that there is any need of [wolf management]. If you reduce hunting, we humans ourselves will be attacked. It is necessary to let wolves know who humans are. Wolves are not afraid of humans in dark. Last fall I shot two wolves outside my yurt. They attacked our cattle under the moonlight... I was watching them near the stream (that flows right next to his campsite) and saw multiple wolves. While watching them, they gathered together and decided to run to me. A cow that was standing next me ran away and I remained alone (laughed). I yelled at them, but they didn't care. I shot once running backwards and hit one. Another one came so close (a few steps away) and I shot it when it was jumping towards me.

Miscellaneous. Two individuals recommended developing hunting tourism and shooting sport in Mongolia. An urban resident stated, "Developing hunting tourism is a good way to control the wolf population. It also will have a positive impact to the Mongolia's economy." A hunter pointed out:

> I have been thinking to develop shooting sport instead of killing animals in Bayankhongor among young people. A few years ago, a group of us (hunters) organized a shooting event for young people. We invited a local elderly experienced hunter. He gave [young hunters] a lecture on what a hunter should do and not do…

A few participants stated that there was no need to have wolf managements in Mongolia. The majority of these individuals were herders. In a herder's words, "I don't think

that there is any need to regulate wolf hunting." Another one stated, "I disagree that many people kill wolves. It's good to hunt wolves." According to an urban resident, "The Khangai region has a lot of wolves, because people can't kill them that easily. Herders know it well and always say that there are many wolves around."

5. Discussion and conclusion

It appears that both livestock and the wolf are essential elements of Mongolian culture. Livestock is important to the country's economy (Batmunkh et al. 2019) and the wolf is important for healthy ecosystems (Clark et al. 2006; Mech and Boitani 2003; Ripple et al. 2014). A sufficient wolf management approach, therefore, is one that is beneficial for both the livestock industry and the wolf. This study had three aims, including understanding the knowledge of stakeholder groups on current wolf management practices in Mongolia; recognizing possibilities of Mongolian TEK's to improve current wolf management in Mongolia; and identifying stakeholder groups' opinions and recommendations towards improving wolf management in Mongolia.

Research results suggest that people of Mongolia generally have very little knowledge about current wolf management practices. It was discouraging that even most of environmental officials who participated in this research did not express much knowledge on wolf management. This could be a result of a lack of the governmental effort to inform the public about wolf related laws and regulations and/or lack of people's interest to know about this subject. Moreover, this could be a disadvantage of not having a formal wildlife management agency or authority in Mongolia.

According to one environmental official, local rangers collect data based on the number of wolves that have been seen and field signs (e.g., track and feces) that have been spotted in the area wherein, they are in charge. Besides visual observation of wolves and wolf signs, rangers do not use any specific methods to collect wolf population related data. Based on the numbers reported by rangers, the Ministry of Environment and Tourism set an annual hunting quota (Secretariat of the State Parliament of Mongolia 2012). However, this method appears to be impractical and unreliable, because there is a high chance that one wolf could be redetected multiple times by a ranger.

In other countries (e.g., the United States, Canada, and Finland), wolf density has been estimated mostly using marked animals (Burch et al. 2005; Fuller and Snow 1988; Kojola et al. 2006). In the last decade, hair snaring and spatially explicit capture-recapture approaches have been introduced (Roffler et al. 2019). In Mongolia, since the 1980s, wolf population density has not been officially evaluated (Clark et al. 2006; Fritts et al. 2006; Wingard and Zahler 2006). Although it might be a long overdue to conduct a research on estimation of wolf density, it is a challenging task, which could be very costly to complete (Fuller, Mech, and Cochrane 2007).

Findings also indicate that hunting has been the most popular method to manage wolves and reduce their threats. Especially during the socialist era, the propaganda against the wolf was strong and the government appealed to people for help fighting the wolf (Sukhbat and Shagdarjav 1990; Wingard and Zahler 2006). In present days, Mongolians mostly solve wolf-related issues using non-official wolf management practices. These practices include both non-lethal or lethal methods to protect livestock and lessen wolf-caused problems (Sukhbaatar et al.

2020a); however, lethal actions are widely used to reduce wolf numbers (Gittleman et al. 2001; Reading et al. 1998).

Herders prefer getting assistance from hunters, instead of letting the local government know about the issue. I recognize that I should have asked herders follow-up questions for clarification of their preference for hunters' assistance over the local government. I only posit that one reason is related to herders' traditional relationships with hunters. Historically, hunting for subsistence was a common action among nomads; yet, not every hunter hunted wolves, because wolf hunting required more skills. Therefore, skilled wolf hunters were highly respected by local folks. In the modern time, herders and hunters still keep close relationships with each other, and wolf hunters are still admired. However, the number of people who hunt wolves is significantly higher, which raises concerns. A common complaint about hunting is that urban people kill wolves unfairly using vehicles and other technical advantages. Legally, any individual who wants to hunt a wolf is required to purchase a hunting license from a local government. However, a wolf hunting license can be waived in case of hunting wolves to protect livestock or rare herbivores (Secretariat of the State Parliament of Mongolia 2012). While conducting this research, I never came across any evidence that any hunter who was interviewed purchased a hunting license. On one hand, it shows that the laws are easily manipulated to illegally hunt wolves under the umbrella of hunting wolves to protect livestock. On the other hand, this could be related to the impractical system of hunting license issuance. A hunter has to travel to a soum or province center to get a hunting license. Also, it appears that there is poor serve by governmental workers, causing difficulties for hunters to purchase a license.

Results suggest that local people, including herders and hunters, play an important part in the current wolf management. Previous studies reported that herders obtained TEK of co-existing with wolves (Sukhbaatar et al. 2020a, 2020b). Interestingly, herders and hunters manage wolves in their lives using TEK; yet, it seems as they do not necessarily acknowledge and/or recognize their knowledge as a powerful tool that could contribute to develop wolf management strategies. Instead, herders and hunters strongly endorse governmental involvement in wolf management. It perhaps shows that there is still a residue of the socialist era in people's mind that all wolf management actions should be taken by the national government. Also, it can be an indication that there is a need to establish a wildlife management authority in the national government.

Continuing to practice traditional ways to manage and co-exist with wolves could be a significant contribution to help preserve Mongolians' TEK, especially in this period of time when this generational knowledge is being lost among Mongolians (Fernandez-Gimenez 2000; Soma and Schlecht 2018). Traditional hunters still follow their own personal customary laws and taboos, such as to not hunt pregnant and mother animals, to not kill more than needed, to not hunt during mating seasons, and to not shoot every animal that is spotted. These taboos match with some of Mongolian customary hunting norms (Kaczensky 2007). This indicates that traditional hunters could have positive influence to younger generations of hunters and educate them about being respectful to animals.

According to stakeholders' recommendations, the government needs to pass comprehensive and balanced laws and regulations that are not biased against the wolf. The current relevant laws appear, perhaps, too discriminative against the wolf (Kaczensky et al.

2008). Participants' recommendations include: setting an annual wolf quota for each region based on wolf monitoring and research; clearly establishing wolf hunting season dates; and prohibiting of inappropriate methods that are currently used (e.g., chasing wolves by motored vehicle). Additionally, the government should be responsible for providing the public with timely information about management practices.

The recommended approaches also suggest that wolf management requires the participation of multiple parties, including the government, public, and research institutions. For example, herders and hunters have a wide range of knowledge about wolf behaviors, distribution of wolves, incidents of diseases, and more (Davie et al. 2014b; Sukhbaatar et al. 2020b). Research institutions could closely work with herders and hunters and include them in research, not only limited to wolves but also other wildlife species. Different stakeholder groups could bring more creative approaches to problem solving and result in higher quality decisions (Reed 2008; Vogler, Sigouin, and Macey 2017). However, due to differences in values, norms, knowledge, and experience of different stakeholders, strong disagreement and conflicts can grow among stakeholder groups (Clark and Rutherford 2014; Mitchell et al. 2018). To avoid these potential conflicts and clarify roles of stakeholder groups, especially policy makers and scientists, some countries (e.g., U.S., Canada, and Australia) have been incorporating structured decision making (SDM) into wildlife management and conservation (Martin et al. 2009; Runge and Converse 2017).

SDM is a value-based PrOACT approach in decision analysis: Problem, Objectives, Alternatives, Consequences, and Trade-offs (Keeney 1992; Runge, Grand, and Mitchell 2013). The advantage of this approach is that it incorporates science with values and objectives of

stakeholders, and transparently produces a common understanding among stakeholders (Gregory et al. 2012). For example, in Canada, different indigenous communities have adopted SDM to develop initiatives towards environmental management and ecosystem restoration (Gregory et al. 2012). In the U.S.A, wildlife researchers used SDM to set harvest quotas for mountain lions (*Puma concolor*) in the state of Montana (Mitchell et al. 2018). Also, in Montana, the SDM process was effectively used to proactively manage potential risks of pneumonia epizootics in bighorn sheep (*Ovis canadensis*). Mongolia could adopt SDM in improving wolf management. SDM has potentials to help build better communication and cooperation among stakeholder groups, and explore wider opportunities to improve wolf management in Mongolia with an objective to minimize human-wolf conflicts and maintain the wolf population at sustainable rates.

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Appendix 1: Excerpt of the questionnaire for herders

Date:
Name:
Age:
Sex:
Education:
Address:

Since when have you been herding?
What kinds of livestock do you have? (number of each kind of livestock)
How many generations of your family have been herders?
Do you children who want to be or have become herders?
How many times do you move in a year?

Please indicate how strongly agree or disagree with the following statements about wolves. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
Too many people hunt wolves.						
Wolf population should be controlled.						
Wolf hunting should be regulated better.						

How should wolf hunting be regulated?
What problems do wolves cause?
What do you know about current wolf management practices in Mongolia?
What threats do wolves face?
What needs to be done to improve the wolf management in Mongolia?

Appendix 2: Excerpt of the questionnaire for urban residents

Date:
Name:
Age:
Sex:
Education:
Address:

Are you originally from the place you live now?

Please indicate how strongly agree or disagree with the following statements about wolves. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
Too many people hunt wolves.						
Wolf population should be controlled.						
Wolf hunting should be regulated better.						

How should wolf hunting be regulated?
What problems do wolves cause?
What do you know about current wolf management practices in Mongolia?
What threats do wolves face?
What needs to be done to improve the wolf management in Mongolia?

Appendix 3: Excerpt of the questionnaire for hunters

Date:
Name:
Age:
Sex:
Education:
Address:

Since when have you been hunting?
In your opinion, who is a hunter?
Do you any customary laws that you follow?
What do you mostly hunt?

Please indicate how strongly agree or disagree with the following statements about wolves. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
Too many people hunt wolves.						
Wolf population should be controlled.						
Wolf hunting should be regulated better.						

How should wolf hunting be regulated?
What problems do wolves cause?
Why do you hunt wolves?
How many wolves do you hunt a year?
What methods do you use for wolf hunting?
What threats do wolves face?
What do you know about current wolf management practices in Mongolia?
What needs to be done to improve the wolf management in Mongolia?

Appendix 4: Excerpt of the questionnaire for environmental officials

Date:
Name:
Age:
Sex:
Education:
Address:
Position:

How long have you been working this position?
What is your background profession?

Please indicate how strongly agree or disagree with the following statements about wolves. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
Too many people hunt wolves.						
Wolf population should be controlled.						
Wolf hunting should be regulated better.						

How should wolf hunting be regulated?
What problems do wolves cause?
What kind of wolf management practices are currently being implemented?
What measures have been successfully implemented?
What needs to be done to improve the wolf management in Mongolia?
Based on what criteria do you define wolf numbers to be hunted?
What is the current wolf population?
How do you cooperate with herders in terms of wolf management?
How do you cooperate with hunters in terms of wolf management?

Appendix 5: IRB approval

Dear Tuul Sukhbaatar,

As Chair of the Institutional Review Board (IRB) for 'Antioch University New England, I am letting you know that the committee has reviewed your Ethics Application. Based on the information presented in your Ethics Application, your study has been approved.
Your data collection is approved from 07/20/2018 to 07/19/2019. If your data collection should extend beyond this time period, you are required to submit a Request for Extension Application to the IRB. Any changes in the protocol(s) for this study must be formally requested by submitting a request for amendment from the IRB committee. Any adverse event, should one occur during this study, must be reported immediately to the IRB committee. Please review the IRB forms available for these exceptional circumstances.

Sincerely,

…

Chapter Seven. Conclusion

In recent decades, countries started acknowledging TEK and have been applying this knowledge for sustainable resource management, wildlife behavioral studies, and environmental conservation (Berkes, Colding, and Folke 2000; Brown 2006; Fernandez-Gimenez 2000; Langdon 2006). Exploring Mongolians' TEK and its potential contribution to improve the relationships between humans and wolves in Mongolia can be of significant value in developing effective wolf management policies. In addition, it will be a contribution to the conservation of TEK of Mongolian people, especially in this critical time that traditional knowledge is being lost among Mongolians (Fernandez-Gimenez 2000; Soma and Schlecht 2018). TEK can also contribute to the achievement of Mongolia's national strategies and targets linked to Aichi Biodiversity Targets of the Convention on Biological Diversity (Batbold et al. 2015; CBD 2018).

This dissertation involved multiple stakeholder groups of Mongolians and aimed to answer an overall question "*How can Mongolian nomadic TEK help inform and potentially improve the existing relationships between humans and wolves in Mongolia?*" To further explore this over-arching question, the following sub-questions were developed for this research:

- What is the local understanding of TEK as it applies to wolves in the Khangai region of Mongolia?
- What are the perceptions of different stakeholder groups on the wolves of Mongolia?
- What opportunities are there to draw upon TEK to reduce human-wolf conflicts in Mongolia?

In Chapter 4, I focused on the understanding of TEK as it applies to wolves in the Khangai Region of Mongolia. This chapter explored the lifestyle of pastoral herders of the Khangai region, their relationships with wolves, and their traditional ecological knowledge that

is applied to co-existence with wolves. My findings are that most herders live in a type of balance, both harmony and rivalry, with wolves. I also found that there was a broad acceptance among herders that wolves can actually help them become more responsible and accountable in their practices. Potential conservation practices were identified that can benefit both herders and wolves. These include: the promoting of conservation activities towards wolves' natural prey species; the encouragement of herders to raise less livestock with better quality; the promotion of livestock herding based on traditional knowledge; and the importance of careful management of wolf hunting.

Chapter 5 describes differences and similarities of how herders, urban residents, hunters, and environmental officials perceive wolves. My findings indicate that all four stakeholder groups consider the wolf as both an ecologically and culturally iconic species. The wolf is broadly perceived as a keystone species that plays a significant role in keeping the ecological balance. Even though herders of the Khangai region showed a significant tolerance towards wolf existence and predation, they expressed a preference to keep the wolf population low (but did not wish for their total elimination). This is probably due to financial losses caused by wolf attacks. Women herders, specifically, expressed appreciation that there were fewer wolves in their areas in the last two years, even though they stated wolf predation is not very common in their area. However, there was a wide variation in cultural perceptions of wolves based upon the residency of an interviewee. For example, urban participants frequently focused on the wolf and the heroic history of Mongolian ancestors; however, those living rurally did not give much weight to the wolf in the history of Mongolia. I provide in this chapter a few of the major drivers that influence the stakeholder groups' perceptions of wolves.

Chapter 6 findings include recommendations from across all four stakeholder groups for the government to pass comprehensive laws and regulations for managing the wolf population in an ecologically balanced manner. It was perceived that current laws are too excessive and biased against the wolf. Results also suggested that traditional hunters, drawing upon their own TEK, followed their customary practices and taboos, such as to not hunt pregnant and mother animals, to not kill more than needed, to not hunt during mating seasons, and to not shoot every animal that is spotted. I posit that hunters' taboos and beliefs about wolves and general wildlife may increase positive attitudes in younger generations of hunters to respect animals and the environment and recognize hunters' responsibilities in wildlife conservation. In addition, acknowledging structured decision making (SDM) in wolf management could be an important move towards better wolf management policy. SDM encourages having clearly defined objectives, developing alternative management approaches, and evaluating alternative approaches to choose the most effective ones (Clark and Rutherford 2014).

While conducting this research, there were a few limitations. The limitations were related to the participant selection, data collection, data analysis, and time. First, due of unforeseen issues, many participants were selected through the convenience sampling method. As a result, participants might not be randomized well enough. Second, I hired multiple individuals as my assistants. However, the assistants who aided me in Ulaanbaatar could not get comprehensive training in collecting data. Therefore, questionnaires that were distributed by them did not receive detailed answers to open-ended questions. Third, while analyzing data, it was observed that Likert-scale questions did not have direct follow-up questions. Follow-up questions would have been helpful to better interpret participants' responses. And

fourth, the time was too short. Most of the time was spent to collect data in the countryside and a very limited time was used to collect data in urban areas. As a consequence, I could not to get more robust and detailed information from most of participants in urban areas.

Several implications derive from this research. The current wolf management in Mongolia appears to be directly influenced by the wolf management policy that was used during the communist/socialist era, when wolves were viewed as bad or destructive animals. According to the Ministry of Environment and Tourism of Mongolia that sets the annual hunting quota of wolves (Secretariat of the State Parliament of Mongolia 2012), the law permits hunting wolves anytime and anywhere for livestock protection. The same law indicates that actions such as destroying animals' dens and taking the life of baby animals are prohibited. However, taking wolf cubs from dens still exist in some areas of my research sites without any legal consequences. In other words, wolves are still legally viewed as destructive animals and there are limited laws and regulations to protect them in Mongolia. This research suggests that amendments to the current laws related to wolves need to be made through adding more clarifications about wolf hunting season, quotas, locations, and methods.

Second, findings of this research are consistent with the previous researchers' reports that TEK is getting lost among Mongolians. However, this research shows that there is a potential that this trend can be reversed. In spite of various political shifts over the last few decades in Mongolia which have influenced Mongolian culture, a significant part of traditional knowledge has survived and is still being shared among Mongolian people. Through conducting more research on TEK and promoting its application to younger generations, it may be possible to slow down the TEK loss and preserve this valuable knowledge.

The third implication stems from the findings on the knowledge of herders to raise livestock with less risk of wolf predation. Results of this research suggest that the TEK of herders (e.g., wisely choosing pastures based on careful observation of wolf travel routes, denning areas, and estimation of wolf population in order to avoid conflicts from wolves) may set apart knowledgeable herders from others. The TEK of experienced herders and their roles in communities could be most valuable to locally reducing human-wolf conflicts. Using pasture and water resources responsibly, using natural resources wisely, keeping the livestock population suitable for the pasture capacity, maintaining the herd composition at a proper level, maintaining and/or improving livestock breeds, and raising livestock with good quality are all significant parts of reducing adverse impacts human-wolf conflicts. Involvement of the national government could be essential to develop incentives that support improving livestock quality and maintaining livestock population that is sustainable for the current pasture and water capacities.

Four, results of this research indicate the significance of collaboration of herders and hunters. Good hunters who follow traditional customary laws are respected by herders in their homelands and herders are willing to listen to hunters' advice and decisions on wolf hunting. In other words, local hunters can act as wildlife conservationists and advocates for wolf management.

Lastly, improvement of the relationships between humans and wolves in Mongolia needs the participation of multiple stakeholder groups and collaboration of different parties and organizations in decision making. Adaptive wolf management practices that embrace both TEK and scientific knowledge can play an essential part in reducing human-wolf conflicts.

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Complete List of Appendices

Appendix A. Complete questionnaire for herders (English)

Date:

A. Demographic questions

Name:	Age:	Sex: female/male	Education:
Address:			

Since when have you been herding?
What kinds of livestock do you have? (number of each kind of livestock)
How many generations of your family have been herders?
Do you have children who want to be or have become herders?
How many times do you move in a year?

B. Questions about wolves

How do you describe 'the wolf' with one word: ……..

Please indicate how strongly agree or disagree with the following statements about wolves. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
The wolf is an important species.						
The wolf is an important part of Mongolia's culture.						
The wolf is a spirited animal.						
Mongolians respect the wolf.						
Too many people hunt wolves.						
Wolf population should be controlled.						
Wolf hunting should be regulated better.						

How would you rate your attitude towards wolves?

- Very good
- Good
- Average

- Bad
- Very bad
- Not sure

What roles do wolves play in nature?
What roles do wolves play in the history and culture of Mongolia?
What is "*hiimori* of wolf" to you?
Why do Mongolians respect wolves?
How do Mongolians control the wolf population?
In your opinion, how should wolf hunting be regulated and controlled?
How does it feel to you if Mongolia does not have any wolves?

C. Questions about potential threats of wolves?

How is the wolf population in your area?

- Very abundant
- Abundant
- They exist, but not abundant
- Rare
- Very rare
- Not sure

How do you think the wolf population in your area has changed over the last five years?

- Increased
- Has not changed
- Decreased
- Not sure

Because of what do you think this change is happening?
How many times do you see wolves? …. In a month/week
What advantages do wolves have?
What disadvantages do wolves have?
When do wolves become the most aggressive?
How often do wolves predate on livestock?
How much loss of livestock in a year is an acceptable amount to you?
What methods do you use to protect your livestock from wolf predation?
Where from have you learned these methods?

Please indicate how strongly agree or disagree with the following statements. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
Wolf predation increases when the wolf population increases.						
Wolf predation increases because populations of natural preys of wolves decrease.						
Wolf predation increases because the livestock populations have increased.						
Wolf predation increases due to lack of herder's herding experience.						
Wolf predation increases due to lack of caution of a herder.						

D. Questions about wolf management

What measurements does your local government take in the framework of wolf management?
What measurements do you want to be taken by your local government in the framework of wolf management?
What problems do humans cause to wolves?
In your opinion, what should be done to decrease these problems?

Thank you

Appendix B. Complete questionnaire for urban residents (English)

Date:

A. Demographic questions

Name:	Age:	Sex: female/male	Education:

Where do you live now?
Are you originally from the place you live now?

B. Questions about wolves

How do you describe 'the wolf' with one word: ……..

Please indicate how strongly agree or disagree with the following statements about wolves. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
The wolf is an important species.						
The wolf is an important part of Mongolia's culture.						
The wolf is a spirited animal.						
Mongolians respect the wolf.						
Too many people hunt wolves.						
Wolf population should be controlled.						
Wolf hunting should be regulated better.						

How would you rate your attitude towards wolves?

- Very good
- Good
- Average
- Bad
- Very bad
- Not sure

What roles do wolves play in nature?
What roles do wolves play in the history and culture of Mongolia?
What is "*hiimori* of wolf" to you?

Why do Mongolians respect wolves?
How do Mongolians control the wolf population?
In your opinion, how should wolf hunting be regulated and controlled?
How does it feel to you if Mongolia does not have any wolves?

C. Open-ended interview questions

Do you have any experience with wolves? (For example, have you seen a wolf?)
What do you know about wolves?
What advantages do wolves have?
What disadvantages do wolves have?
What do you know about wolf management implemented in Mongolia?
What problems do humans cause to wolves?
In your opinion, what should be done to decrease these problems?

Thank you

Appendix C. Complete questionnaire for hunters (English)

Date:

A. Demographic questions

Name:	Age:	Sex: female/male	Education:
Address:			

Since when have you been hunting?
Who is a hunter?
What hunters' customary laws do you follow?
What game animals do you mostly hunt?

B. Questions about wolves

How do you describe 'the wolf' with one word: ……..

Please indicate how strongly agree or disagree with the following statements about wolves. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
The wolf is an important species.						
The wolf is an important part of Mongolia's culture.						
The wolf is a spirited animal.						
Mongolians respect the wolf.						
Too many people hunt wolves.						
Wolf population should be controlled.						
Wolf hunting should be regulated better.						

How would you rate your attitude towards wolves?

- Very good
- Good
- Average
- Bad
- Very bad
- Not sure

What roles do wolves play in nature?
What roles do wolves play in the history and culture of Mongolia?
What is "*hiimori* of wolf" to you?
Why do Mongolians respect wolves?
How do Mongolians control the wolf population?
In your opinion, how should wolf hunting be regulated and controlled?
How does it feel to you if Mongolia does not have any wolves?

C. Questions about wolf hunting

Since when have you been hunting wolves?
Who influenced you to become a wolf hunter?
Why do you hunt wolves?
How many wolves do you hunt a year?
What methods do you use for wolf hunting?
When do you hunt wolves?
Why do you choose this period to hunt wolves?
Where do you usually go to hunt wolves?
Why do you go there to hunt wolves?
When go hunting wolves, which wolf do you intend to hunt?
How do you think the wolf population in your hunting areas has changed over the past five years?

- Increased
- Remained the same
- Decreased
- Not sure

Why do you think this change has happened?
What advantages do wolves have?
What disadvantages do wolves have?

D. Questions about wolf management

What problems do humans cause to wolves?
In your opinion, what should be done to decrease these problems?
What do you know about wolf management practices in Mongolia?
What needs to be done to improve wolf management?

Thank you

Appendix D. Complete questionnaire for environmental officials (English)

Date:

A. Demographic questions

Name:	Age:	Sex: female/male	Education:
Address:			

How long have you been working in your position?
What is your profession?

B. Questions about wolves

How do you describe 'the wolf' with one word: ……..

Please indicate how strongly agree or disagree with the following statements about wolves. Select one choice per statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not sure
The wolf is an important species.						
The wolf is an important part of Mongolia's culture.						
The wolf is a spirited animal.						
Mongolians respect the wolf.						
Too many people hunt wolves.						
Wolf population should be controlled.						
Wolf hunting should be regulated better.						

How would you rate your attitude towards wolves?

- Very good
- Good
- Average
- Bad
- Very bad
- Not sure

What roles do wolves play in nature?
What roles do wolves play in the history and culture of Mongolia?

What is "*hiimori* of wolf" to you?
Why do Mongolians respect wolves?
How do Mongolians control the wolf population?
In your opinion, how should wolf hunting be regulated and controlled?
How does it feel to you if Mongolia does not have any wolves?

C. Open-ended interview questions

What measures are implemented in the framework of wolf management in Mongolia?
Which measures are successfully implemented?
By what criteria do you measure your success?
What needs to be improved?
Based on what criteria do you define quota for wolf hunting?
What is the current wolf population?
How do you cooperate with herders in terms of wolf management?
How do you cooperate with hunters in terms of wolf management?

Thank you

Appendix E. Complete questionnaire for herders (Mongolian)

Огноо:

Малчдад зориулсан асуулга

А. Ерөнхий асуултууд

Нэр:	Нас:	Хүйс:	Боловсрол:
Хаяг:			

Та хэзээнээс эхэлж мал хариулж байна вэ?
Танайх хичнээн тооны ямар төрлийн малтай вэ?

Та хэд дахь үеийн малчин бэ?
Танай хүүхдүүдээс малчин болох сонирхолтой эсвэл малчин болсон хүн бий юу?
Та жилдээ хэдэн удаа нутаг сэлгэн нүүдэг вэ?

В. Чонын тухай ерөнхий асуултууд

Та чоныг нэг үгээр юу гэж тодорхойлох вэ?: ……..

Та дараах асуулга тус бүрт нэг хариулт сонгоно уу?

	Санал маш их нийлж байна.	Санал нийлж байна.	Дунд зэрэг	Санал нийлэхгүй талдаа.	Санал огт нийлэхгүй байна.	Мэдэхгүй
Чоно чухал байгальд чухал амьтан.						
Чоно Монголын соёлд чухал байр суурь эзэлдэг.						
Чоно хийморьтой амьтан.						
Монголчууд чоныг хүндэтгэдэг.						
Хэт олон хүн чоно агнаж байна.						
Чонын тоо толгойг хянах нь зүйтэй.						
Чонын анг илүү зохицуулалттай болгох нь зөв.						

Таны чононд хандах хандлага ямар вэ?

- Маш сайн
- Сайн
- Дунд
- Муу
- Маш муу
- Мэдэхгүй

Чоно байгальд ямар үүрэг гүйцэтгэдэг вэ?

Чоно Монголын түүх соёлд ямар үүрэг гүйцэтгэдэг вэ?

Чонын хийморийг та өөрийн үгээр тайлбарлана уу.

Монголчууд чоныг яагаад хүндэтгэдэг вэ?

Монголчууд чонын тоо толгойг хэрхэн зохицуулж ирсэн бэ?

Чонын анг хэрхэн зохицуулалт, хяналттай болгох вэ?

Монгол орон ямар ч чоногүй болчихвол танд ямар санагдах вэ?

С. Чонын аюулын тухай асуултууд

Танай нутаг хэр их чонотой вэ?

- Маш элбэг
- Элбэг
- Байдаг, гэхдээ элбэг биш
- Ховор
- Маш ховор
- Мэдэхгүй

Сүүлийн 5 жилд чонын тоо толгой танай нутагт хэр өөрчлөгдсөн бэ?

- Өссөн
- Өөрчлөгдөөгүй
- Буурсан
- Мэдэхгүй

Чонын тоо толгой юунаас болж өөрчлөгдөж байна вэ?

Та чонотой таарах тохиолдол хэр олон бэ? Сард/долоо хоногт .... удаа

Чонын ашиг тус юу вэ?

Чонын муу тал юу вэ?

Чоно хэдий үед хамгийн аюултай болдог вэ?

Чононд малаа алдах тохиолдол хэр олон гардаг вэ?

Малын хорогдол хэдий хэмжээнд хүрсэн тохиолдолд чоно агнах арга хэмжээ авдаг вэ?

Чонын аюулаас урьдчилан сэргийлэх ямар арга хэрэглэдэг вэ?

Та энэ аргуудыг хаанаас, хэнээс мэдэж авсан бэ?

Та дараах асуулга бүрт нэг хариулт сонгоно уу.

	Санал маш их нийлж байна.	Санал нийлж байна.	Дунд зэрэг	Санал нийлэхгүй талдаа.	Санал огт нийлэхгүй байна.	Мэдэхгүй
Чонын тоо толгой ихэссэнээс чоно малд орох нь элбэгшдэг.						
Байгаль дээрх чонын иддэг амьтад цөөрснөөс чоно малд орох нь элбэгшдэг.						
Малын тоо толгой их болсноос чоно малд орох нь элбэгшдэг.						
Малчин хүний туршлага багаас чоно малд орох нь их байдаг.						
Малчин хүний анхаарал муугаас чоно малд орох нь их байдаг.						

D. Чонын менежментийн тухай асуултууд

Нутгийн захиргаанаас чонотой холбоотой ямар арга хэмжээ авдаг вэ?

Нутгийн захиргаанаас чонотой холбоотой ямар арга хэмжээ авахыг хүсдэг вэ?

Хүний зүгээс чононд ямар аюул учруулдаг гэж та бодож байна?

Энэ хүндрэлүүдийг хэрхэн багасгах вэ?

БАЯРЛАЛАА

Appendix F. Complete questionnaire for urban residents (Mongolian)

Огноо:

Суурин газрын иргэдээс авах судалгааны асуулт

Нэр:	Нас:	Хүйс: эр/эм	Боловсрол:
Хаяг:			

А. Ерөнхий хэсэг

Та хаана оршин суудаг вэ?

Та одоо амьдарч байгаа газрын уугуул иргэн үү?

В. Чонын тухай хэсэг

Та чоныг нэг үгээр юу гэж тодорхойлох вэ?: ……..

Та дараах асуулга тус бүрт нэг хариулт сонгоно уу?

	Санал маш их нийлж байна.	Санал нийлж байна.	Дунд зэрэг	Санал нийлэхгүй талдаа.	Санал огт нийлэхгүй байна.	Мэдэхгүй
Чоно чухал байгальд чухал амьтан.						
Чоно Монголын соёлд чухал байр суурь эзэлдэг.						
Чоно хийморьтой амьтан.						
Монголчууд чоныг хүндэтгэдэг.						
Хэт олон хүн чоно агнаж байна.						
Чонын тоо толгойг хянах нь зүйтэй.						
Чонын анг илүү зохицуулалттай болгох нь зөв.						

Таны чононд хандах хандлага ямар вэ?

- Маш сайн
- Сайн
- Дунд
- Муу
- Маш муу
- Мэдэхгүй

Чоно байгальд ямар үүрэг гүйцэтгэдэг вэ?

Чоно Монголын түүх соёлд ямар үүрэг гүйцэтгэдэг вэ?

Чонын хийморийг та өөрийн үгээр тайлбарлана уу.

Монголчууд чоныг яагаад хүндэтгэдэг вэ?

Монголчууд чонын тоо толгойг хэрхэн зохицуулж ирсэн бэ?

Чонын анг хэрхэн зохицуулалт, хяналттай болгох вэ?

Монгол орон ямар ч чоногүй болчихвол танд ямар санагдах вэ?

С. Чонын аюулын тухай асуултууд

Танай нутаг хэр их чонотой вэ?

- Маш элбэг
- Элбэг
- Байдаг, гэхдээ элбэг биш
- Ховор
- Маш ховор
- Мэдэхгүй

Чоно байгальд ямар үүрэг гүйцэтгэдэг вэ?

Таны бодлоор чоно Монголын түүх соёлд ямар үүрэг гүйцэтгэдэг вэ?

B6. Чонын хийморийг та өөрийн үгээр тайлбарлаж өгнө үү?

B7. Монголчууд чоныг яагаад хүндэтгэн үздэг вэ?

B8. Монголчууд чонын тоо толгойг хэрхэн зохицуулж ирсэн бэ?

B9. Таны бодлоор чонын анг хэрхэн зохицуулалт, хяналттай болгох вэ?

B10. Монгол орон чоногүй болчихвол танд ямар санагдах вэ?

С. Ярилцлагын хэсэг

Танд чонотой холбоотой ямар нэг туршлага бий юу? Жишээ нь: Та чоно харж байсан уу, чонотой таарсан тохиолдлууд бий юу?

Чонын тухай та мэддэг зүйлээсээ хуваалцана уу?

Чонын ашиг тус юу вэ?

Чонын муу тал юу вэ?

Монгол улсад хэрэгжүүлж буй чонын менежментийн тухай та юу мэдэх вэ?

Чононд тулгарч байгаа хамгийн хүндрэлтэй асуудлууд юу вэ?

Энэ хүндрэлүүдийг багасгах боломжит арга замууд

БАЯРЛАЛАА

Appendix G. Complete questionnaire for hunters (Mongolian)

Огноо:

Анчдад зориулсан асуулга

А. Ерөнхий асуултууд

Нэр:	Нас:	Хүйс:	Боловсрол:
Хаяг:			

Та хэзээнээс эхэлж ан хийж байгаа вэ?

Анчин хүн гэж хэнийг хэлэх вэ?

Анчин хүнд дагадаг бичигдээгүй хууль гэж байдаг уу? Түүнээс нэрлэнэ үү.

Та ихэвчлэн ямар төрлийн ан агнадаг вэ?

В. Чоныг тухай ерөнхий асуултууд

Та чоныг нэг үгээр юу гэж тодорхойлох вэ?: ……..

Та дараах асуулга тус бүрт нэг хариулт сонгоно уу?

	Санал маш их нийлж байна.	Санал нийлж байна.	Дунд зэрэг	Санал нийлэхгүй талдаа.	Санал огт нийлэхгүй байна.	Мэдэхгүй
Чоно чухал байгальд чухал амьтан.						
Чоно Монголын соёлд чухал байр суурь эзэлдэг.						
Чоно хийморьтой амьтан.						
Монголчууд чоныг хүндэтгэдэг.						
Хэт олон хүн чоно агнаж байна.						
Чонын тоо толгойг хянах нь зүйтэй.						
Чонын анг илүү зохицуулалттай болгох нь зөв.						

Таны чононд хандах хандлага ямар вэ?

- Маш сайн
- Сайн
- Дунд
- Муу

- Маш муу
- Мэдэхгүй

Чоно байгальд ямар үүрэг гүйцэтгэдэг вэ?

Чоно Монголын түүх соёлд ямар үүрэг гүйцэтгэдэг вэ?

Чонын хийморийг та өөрийн үгээр тайлбарлана уу.

Монголчууд чоныг яагаад хүндэтгэдэг вэ?

Монголчууд чонын тоо толгойг хэрхэн зохицуулж ирсэн бэ?

Чонын анг хэрхэн зохицуулалт, хяналттай болгох вэ?

Монгол орон ямар ч чоногүй болчихвол танд ямар санагдах вэ?

С. Чонын ангийн тухай асуултууд

Та хэзээнээс эхэлж чоно агнах болсон бэ?

Таныг чоно агнадаг болоход хэн хамгийн их нөлөөлсөн бэ?

Та яагаад чоно агнад вэ?

Та жилд хэдэн чоно агнадаг вэ?

Чоно агнахдаа ямар арга хэрэглэдэг вэ?

Хэзээ чонын авд гардаг вэ?

Яагаад энэ үеийг сонгодог вэ?

Та хаашаа явж чонын ан хийдэг вэ?

Та яагаад энэ газрыг сонгодог вэ?

Та ямар чоныг сонгож агнадаг вэ?

Сүүлийн 5 жилд таны чоно агнадаг газрын чонын тоо толгой хэрхэн өөрчлөгдсөн гэж та бодож байна?

- Өссөн
- Хэвээрээ
- Багассан
- Мэдэхгүй

Чонын тоо толгой ямар шалтгааны улмаас өөрчлөгдсөн гэж бодож байна?

Чонын ашиг тус юу вэ?

Чонын муу тал юу вэ?

D. Чонын менежментийн тухай асуултууд

Хүний зүгээс чононд ямар аюул, хүндрэл учруулдаг вэ?

Таны бодлоор энэ хүндрэлүүдийг багасгах вэ?

Монгол улсад хэрэгжүүлж буй чонын менежментийн тухай та юу мэдэх вэ?

Таны бодлоор чонын талаар авч буй арга хэмжээг хэрхэн сайжруулж болох вэ?

Баярлалаа

Appendix H. Complete questionnaire for environmental officials (Mongolian)

Огноо:

Байгаль орчны албаны хүмүүсээс авах судалгааны асуултууд

А. Ерөнхий асуултууд

Нэр:	Нас:	Хүйс:	Боловсрол:
Албан тушаал:			

Та энэ тушаалыг хэр удаан хашиж байна вэ?

Таны эзэмшсэн мэргэжил юу вэ?

В. Чонын тухай ерөнхий асуултууд

Та чоныг нэг үгээр юу гэж тодорхойлох вэ?: ……..

Та дараах асуулга тус бүрт нэг хариулт сонгоно уу?

	Санал маш их нийлж байна.	Санал нийлж байна.	Дунд зэрэг	Санал нийлэхгүй талдаа.	Санал огт нийлэхгүй байна.	Мэдэхгүй
Чоно чухал байгальд чухал амьтан.						
Чоно Монголын соёлд чухал байр суурь эзэлдэг.						
Чоно хийморьтой амьтан.						
Монголчууд чоныг хүндэтгэдэг.						
Хэт олон хүн чоно агнаж байна.						
Чонын тоо толгойг хянах нь зүйтэй.						
Чонын анг илүү зохицуулалттай болгох нь зөв.						

Таны чононд хандах хандлага ямар вэ?

- Маш сайн
- Сайн
- Дунд
- Муу
- Маш муу
- Мэдэхгүй

Чоно байгальд ямар үүрэг гүйцэтгэдэг вэ?

Чоно Монголын түүх соёлд ямар үүрэг гүйцэтгэдэг вэ?

Чонын хийморийг та өөрийн үгээр тайлбарлана уу.

Монголчууд чоныг яагаад хүндэтгэдэг вэ?

Монголчууд чонын тоо толгойг хэрхэн зохицуулж ирсэн бэ?

Чонын анг хэрхэн зохицуулалт, хяналттай болгох вэ?

Монгол орон ямар ч чоногүй болчихвол танд ямар санагдах вэ?

С. Чонын менежментийн тухай асуултууд

С1. Чонын менежментийн хүрээнд ямар арга хэмжээнүүд авдаг вэ?

С2. Эдгээр арга хэмжээнүүдээс аль нь амжилттай хэрэгжсэн гэж та бодож байна?

С3. Ямар шалгуураар гаргасан амжилтыг хэмжсэн бэ?

C4. Сайжруулах шаардлагатай арга хэмжээнүүд юу вэ?

C5. Агнах чонын тоо толгойг юун дээр үндэслэж тогтоодог вэ?

C6. Одоогийн байдлаар чонын тоо толгой ямар хэмжээтэй байгаа вэ?

C7. Чонын менежментийн арга хэмжээг авахдаа малчид, иргэдтэй хэрхэн хамтран ажилладаг вэ?

C8. Чонын менежментийн арга хэмжээг авахдаа анчидтай хэрхэн хамтран ажилладаг вэ?

БАЯРЛАЛАА

Appendix I. Informed Consent Form (English)

Study title: Nomadic Traditional Ecological Knowledge (TEK) and Opportunities for Improving Relationships Between Humans and Wolves in Mongolia

Researcher: Tuul Sukhbaatar, Antioch University New England

PURPOSE

The purpose of this project is to investigate nomadic TEK and explore potentials to reduce conflicts between humans and wolves in Mongolia.

PROCEDURES

If you agree to participate in the study, you will take a survey. The survey will take approximately 10-15 minutes. You may be asked to give an additional 30-minute interview after taking the survey.

RISKS

The risk of participating in this study is very low. You will be asked questions about nomadic traditional knowledge, wolf-related issues, wolf management, and your opinions on potential approaches to improve the relationship between people and wolves. If there is a question that you are not willing to answer, you can skip it without answering. If you feel uncomfortable participating in the study, you can stop your participation at any time.

BENEFITS

This study could bring the following benefits: to document nomadic TEK from the Khangai Region which could be used passed down to younger generations as well as other Mongolian communities that lack TEK; and to explore opportunities to improve the current wolf management through drawing upon.

EXTENT OF CONFIDENTIALITY

Your name will not be used in any written reports or publications. Data will be kept for three years after the study is finished and then will be destroyed.

PARTICIPATION IS VOLUNTARY

Your participation in this study is entirely voluntary. You can end your participation at any time.

QUESTIONS

If you have any questions about this study, please contact me, Tuul Sukhbaatar, via email: xxxxxxxx

If you have any questions about your rights as a research participant, you may contact …., Chair of the Antioch University New England IRB, +x xxx-xxx-xxxx or …, Provost and Campus CEO for Antioch University New England, +x xxx-xxx-xxxx.

DOCUMENTATION OF CONSENT

I have read this form and decided that I will participate in this project. I understand that I can withdraw at any time.

Printed Name of Study Participant	Signature/Fingerprint of Study Participant	Date

Signature of Person Obtaining Consent	Date

Appendix J. Informed Consent Form (Mongolian)

Судалгаа Авах Зөвшөөрөл

Судалгааны ажлын нэр: Нүүдэлчдийн уламжлалт экологийн мэдлэг ба хүн-чоно хоёрын хоорондын зөрчлийг бууруулах боломж

Судлаач: Сүхбаатарын Туул, Антиок Нью Ингланд Их Сургуулийн дэд докторын зэрэг горилогч

Судалгааны ажлын зорилго

Энэхүү ажлын зорилго нь нүүдэлчдийн уламжлалт экологийн мэдлэгийг цуглуулж, Монголчууд болон чоно хоёрын хооронд элбэг тохиолддог зөрчлийг бууруулах боломжийг эрэлхийлэхэд оршино.

Явц

Хэрэв зөвшөөрвөл та тусгай бэлтгэсэн асуулганд хариулах байдлаар судалгаанд оролцох юм. Асуулганд хариулахад ойролцоогоор 10-15 минут болох байх. Таныг асуулганд хариулж дууссаны дараа нэмэлт дэлгэрэнгүй ярилцлаганд орох хүсэлт тавьж магадгүй. Нэмэлт ярилцлага 30 минут хавьцаа үргэлжилнэ.

Эрсдэл

Энэ судалгаанд оролцсоноор тохиолдож болох эрсдэл маш бага. Та дараах сэдвүүдийг талаар асуултанд хариулна. Үүнд: нүүдэлчдийн уламжлалт мэдлэг, чоно ба түүнтэй холбоотой тохиолддог асуудлууд, чонын менежмент, хүн-чонын хоорондын зөрчлийг бууруулах чиглэлээр хэрэгжүүлж болох арга замын тухай таны бодол, санал. Хүсэхгүй байгаа асуултууданд та хариулалгүй орхих боломжтой. Мөн судалгаанд оролцох нь танд тааламжгүй байвал та хүссэн үедээ судалгаанаас татгалзаж болно.

Ашиг тус

Энэ судалгааны ашиг тус нь чонотой газар нүүдэлчид хэрхэн малаа адгуулан маллаж, өсгөж ирсэн уламжлалт мэдлэгийг баримтжуулан авахаас гадна, өнөөгийн Монгол оронд энэхүү уламжлалт мэдлэгийг шингээн чонын менежментийг хэрхэн сайжруулах боломжуудыг олоход оршино. Түүнээс гадна залуу үеүдэд мартагдаж буй мэдлэгийг хүргэснээр Монголын соёл, уламжлалын дархлаа сайжрах боломжтой юм.

Нууцлал

Таны нэрийг энэ судалгааны бүхий л үед нууцална. Таниас авсан мэдээллийг судалгаа дууссанаас хойш 3 жилийн дараа бүрэн устгах болно.

Сайн дурын оролцоо

Судалгаанд та өөрийн сайн дурын хүслээр оролцоно. Та судалгаанаас хэдий үед ч татгалзан гарч болно.

Асуулт

Танд энэхүү судалгааны ажилтай холбоотой асуулт байвал Сүхбаатарын Туул миний биетэй дараах имэйл хаягаар холбогдох боломжтой: хххххххххх

Судалгаанд оролцогчийн хувиар өөрийн эрхийн талаар ямар нэгэн асуулт байвал Антиок Нью Ингланд их сургуулийн ёс зүйн хяналтын хорооны дарга … эсвэл Антиок Нью Ингланд их сургуулийн захирал ….тай дараах утасны дугаараар холбогдоно уу.

хххх: +х ххх-ххх-хххх

хххх: +х ххх-ххх-хххх

Баримтжуулалт

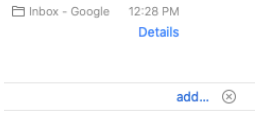
Би энэхүү судалгаа авах зөвшөөрлийг уншиж танилцсны үндсэн дээр судалгаанд орохыг зөвшөөрөв. Судалгаанаас хэдийд ч татгалзан гарах боломжтой гэдгийг ойлгож байна.

Судалгаанд оролцогчийн нэр (дармал үсгээр):

Судалгаанд оролцогчийн гарын үсэг:
Он, сар, өдөр:

Судалгаа авагчийн гарын үсэг:
Он, сар, өдөр:

Appendix H. Permission to use maps



Hi Tuul,

The Antioch Spatial Analysis Lab at Antioch University New England gives you permission to use the two maps the Lab created for you for the purposes you request as defined below.

Permission is given to reproduce and use two maps created in February 2020 by Jacob Hogue, an Antioch student employee of the Antioch University Spatial Analysis Lab titled: 'Study Research Sites, Mongolia" and "Khangai Ecoregion, Mongolia," in your dissertation that will be published online on three sites, including Antioch University Repository and Archive (open access); OhioLINK Electronic Theses and Dissertations Center (open access); and Proquest Dissertations and Theses Database (a print-on-demand service). The maps would appear without any alteration in the dissertation.

Congratulations on completing your dissertation.

best regards,

Antioch University New England
40 Avon Street
Keene, New Hampshire 03431-3516