

**PASTORAL PRACTICE AND HERDERS'
ATTITUDE TOWARDS WILDLIFE IN SOUTH GOBI
MONGOLIA**

A Dissertation Submitted to

Saurashtra University, Rajkot in partial

fulfillment of Masters Degree in

Wildlife Science

by

**Tserennadmid Mijiddorj
(Nadia)**

Under Supervision of

Dr. Ruchi Badola

&

Prof. G.S. Rawat



**भारतीय वन्यजीव संस्थान
Wildlife Institute of India**

June 2011



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Certificate

This is to certify that Mrs. Tserennadmid Mijiddorj (Nadia) has carried out an original piece of research in partial fulfilment of Master's Degree in Wildlife Science of the Saurashtra University, Rajkot. The topic of her dissertation is "Pastoral practice change and herders' attitude towards wildlife in South Gobi Mongolia"

The study was carried out under our supervision from December 2010 to June 2011. We hereby certify that this work has not been submitted for any degree to any university.

Dr. Ruchi Badola
Scientist- F
Supervisor

Dr. Rawat.G.S
Scientist- G
Co-supervisor

Date: June 17, 2011

Place: Dehradun

TABLE OF CONTENTS

List of tables	i
List of figures	ii
List of plates	iii
Acknowledgements	iv
Summary	v
1. Introduction	1
1.1 Literature review	3
1.1.1 Pastoral practices and drivers of change in Mongolia	3
1.1.2 Human-wildlife conflict intensity	5
1.1.3 People attitude towards wildlife	7
1.2 Aims and Objectives	8
2. Study area	10
2.1. General	10
2.2 Location	11
2.3 Climate	13
2.3.1 Frequency of drought and heavy winter occurrence	13
2.4 Vegetation	15
2.5 People and land use practices	16
3. Methodology	18
3.1 Survey structure and content	18
3.2. Data analysis	20
3.2.1. Changes in pastoral practice	20
3.2.2. Human-wildlife conflict intensity and possible correlations with changes in pastoral patterns	20
3.2.3. Assessing attitudes towards wildlife	21

4. Results	24
4.1. Respondent characteristics	24
4.2. Changes in pastoral practices	25
4.3. Human-wildlife conflicts	30
4.3.1. Encounter rate of carnivores	32
4.3.2. Economic value of livestock losses	35
4.3.3. Seasonality and behavior	35
4.3.4. Livestock preventive measures from carnivore depredation	36
4.4. Herders' attitude towards wildlife	36
4.4.1. Herders' tolerance levels towards carnivores.	37
4.4.2. Herders' overall perspective about wildlife	37
4.5. What influences people attitude towards carnivores?	39
4.6. Herders' media awareness preference	41
5. Discussion	42
5.1 Changing pastoral practices and drivers of change	42
5.1.1. Livestock composition:	42
5.1.2. Seasonal Movement pattern	43
5.1.3. Changes in herding techniques	43
5.1.4. Livestock stocking density	43
5.1.5. Livelihoods	44
5.1.6. Land tenure	45
5.1.7. Mining issue	45
5.1.8. Urban settlements	46

5.2. Human-wildlife conflict	46
5.2.1 Livestock mortality	47
5.2.2 Carnivore depredation.	47
5.2.3. Preventive measures for livestock depredation from carnivores	47
5.2.4. Herders' tolerance level to predators	49
5.2.5. Livestock depredation cause model	49
5.3. Herders' attitude towards wildlife	49
5.3.1. Herders' attitude towards carnivores' model	49
Conclusion	51
Glossary	52
Plates	53
Appendix	56
References	59

List of Tables

Table 2.1 Pasture area (million hectares) and livestock distribution in five different ecological zones, Mongolia.	10
Table 2.2: Livestock loss through drought and harsh winter from 1944-2001	14
Table 3.1: Variables used for data analysis	24
Table 4.1: Gender, age and education details of the pastoralists surveyed	25
Table 4.2: Reason behind lifestyle and seasonal movement change gradient	29
Table 4.3. Livestock mortalities Pair wise Rank table.	31
Table 4.4: Total livestock mortality due to the winter disaster, disease and carnivore depredation from 2010-2011 in Tost and Bayasah bag	32
Table 4.5 Livestock depredation patterns by Snow Leopard and Wolf in both intensive study sites	33
Table 4.6 Factors determining vulnerability of livestock to carnivore depredation	35
Table;4.7 .Significance of factors that livestock depredation by carnivores	35
Table 4.8: Economic losses incurred by herders during the past one year due to livestock depredation by snow leopard and wolf in the intensive study areas	36
Table 4.9: Potential factors influencing people's attitudes towards carnivores	39
Table 4.10. GLM potential models for carnivore attitude..	39
Table 4.11: Significance of factors that affect peoples' attitudes towards carnivores	40
Table 4.12 Peoples' preference of media sources.	41

List of Graphs

Figure 4.1: Frequency of annual movement by pastoral families	26
Figure 4.2: Comparison of livestock diversity and composition between current (2010 and past (1985) scenario	27
Figure 4.3: Intensity of change in pastoral practice change	28
Figure4.4: Reasons cited by respondents for changing their pastoral lifestyle	30
Figure4.5: Causes of Livestock mortality in 2010-2011 Southern Gobi area, Mongolia	31
Figure 4.6: Graph of numbers depredated versus livestock holding	34
Figure 4.7: Comparison of attitudes of people from the two intensive study sites towards wildlife	38
Figure 5.1: Livestock population trends in Mongolia	42

List of Plates

Plate 1. Location of Study Area in Mongolia	11
Plate 2. Study area families visited during interview in Gurvantes <i>soum</i> .	12
Plate 3 A. Panoramic view of study area	53
Plate 3 B. Unattended livestock is often prone to depredate by carnivores	53
Plate 4 A. Traditional pastoral practice	54
Plate 4 B. Modern pastoral practice	54
Plate 5 A. During the harsh winter (dzud) many livestock suffer from starvation and hypothermia	55
Plate 5 B. Gold mining in the pastures: recent cause of degradation and changes in pastoral practices	55

Acknowledgements

Firstly, I would like to acknowledge and thank my two supervisors for their guidance and supervision my supervisor, Prof. Ruchi Badola, G.S. Rawat. Their courage to take on a foreign student and efforts to make this project reach a satisfactory end were much appreciated. I would deeply appreciate WII Director, Dean and Faculty members to supports entire two years of my MSc course to complete successfully.

This research would not have been possible without the Snow leopard long term ecological project by Mongolian program, ISLT and Panthera. My gratitude also goes to Snow leopard Conservation Fund in Mongolia director Bayarjargal.Agvaantseren her humble advice and support. I truly appreciated my field assistant and driver Mijee his punctual and honesty in his work and ready to help me out anytime.

I could not express the magnitude of appreciation that I owe to Sutthirtu Dutta for his tireless support, discussion and analytical help throughout the dissertation.

For many suggestions and support during this research I want to thank to Charudutt Mishra to give different angle of view of research and I owe special thanks to Koustubh Sharma always available for his critical comments, advice and help. I would truly appreciate Rodney Jackson do his valuable comments and being mentorship.

I could not have completed my Master degree without financial support from WCN Sidney Byers scholarship and, Eve Schaeffer her kind encouragement.

I would like to thank all the people who have been there for me and helped me throughout my time at the Wildlife Institute of India especially my classmates and faculty members.

Special thanks to Kerry Nicholson, Rhea, Supriya and Divya for being such wonderful friends for me. I truly hope our friendship will last for many years to come. For all those who helped me with this project and whose names are not mentioned here please know your contributions are not forgotten and want to thank you sincerely.

I thank my parents and all my family members for their tremendous amount of support during the long road towards completing my MSc. Their love and help have encouraged me to move forward despite all the difficulties. I will be eternally grateful to my husband Khatanbaatar and my son Toogii who waited for me, encouraged me, and who has shown incredible love and patience during my entire Master course always being on hand with support.

I feel deeply privileged for having been granted with the chance to work with such magnificent cats in one of the most incredible landscapes of the world.

Summary

This study deals with analysis of traditional and current pastoral practices in south Gobi areas of Mongolia with emphasis on herders' attitude towards wildlife. The study was conducted during December 2010 to May 2011. The major objectives of the study were to study: (i) Nomadic herders' pastoral practices and drives of changes. (ii) Influence of pastoral practices on human-wildlife conflict and (iii) nomadic herders' attitude towards wildlife. I used questionnaire surveys in two villages in Gurvantes *soum* to find out the past and current patterns of herding, herders' attitudes and major drivers of changes. The villages were selected based on the fact that in one village (Tost), Snow Leopard Conservation initiatives are going along with livestock insurance and research programs, while in another village (Baysah) no conservation initiatives have been undertaken. However the range use patterns by the local herders and the level of conflict with wild carnivores is the same in both areas. A total of 144 individuals from different age, gender and educational background were interviewed, 74 in Baysah (non-conservation) area and 70 from Tost area where snow leopard conservation activities are taking place. The data were analyzed using SPSS Statistical Package for Social Sciences (SPSS) PC version 16.0 for Generalized linear model GLM linear and negative binomial with log linear model.

The study reveals that the pastoral practices among the herders in the study area is largely influenced by land tenure, mining disorder, school kids' admissions and development factors. Assessment of pastoral practice changes revealed that 84.7% herders had highly altered their seasonal movement pattern which can affect pasture degradation and regeneration of grass growth. Owing to changes in pastoral practices, the herders have become more prone to lose more livestock to carnivores. Using GLM models it is proven (Wald chi-square =4.55, df=1, P=0.033) that recent faulty pastoral practice change (e.g. nuclear family, vulnerable for natural disaster and herding techniques) explains livestock losses due to the carnivores. It requires implementing livestock husbandry management in better ways.

Gurvantes *soum*'s two different villages offered ideal condition to compare carnivore conservation efficiency and way to forward to mitigate such human-wildlife conflict. Study indicated that in generally herders positive perception towards ungulates whereas carnivores Tost (conservation area) area herders' tolerance level was higher than those of Baysah area (non-conservation area) ($t=5.23$, $df=89$, $P<0.00$) which is attributed to intervention in the form of conservation activities. Herders' carnivore attitude shapes by conservation activities and middle age people are more negative towards carnivores to comparing with youths. Last, number of livestock loss by carnivore negatively correlated with positive attitude towards carnivores.

1. Introduction

Nomadic pastoralism originated about 9,000 years ago with the domestication of goats and sheep in the mountains of southwest Asia in what is now northeast Iraq and northwest Iran (Miller 1998). This type of animal husbandry quickly dispersed from this Centre of origin into Central Asia. During the long period of time, pastoral societies have fluctuated, pastoral practices have changed and been modified to become what we see today. All across the Central Asia and Himalaya integrating socioeconomic development of the herder communities with nature conservation goals has been a major challenge (Chatty et al. 2010; Fox et al. 2002; Schmidt 2006). In the Central Asian mountains there are several types of nomadic pastoralism practices: transhumance, nomadism and agro pastoralism. The main livelihood resource based on their animal husbandry with has mixed herds. Sheep are valued for meat and wool, goats for meat but predominantly cashmere, and cattle and yak for milk and other products. Camels, horses and donkeys are mainly for transport of tents and household items (Kreutzmann 2004). Nomads seasonally migrate covering great distances between low and high land to reach suitable and accessible pastures. These mobile communities have strong kinship relations (Kreutzmann 2004).

With the changing times and drastic demands of socio-economic development many pastoral communities in Central Asia are facing conflicts. Studies on alpine rangelands in Central Asia have shown that the carnivores such as snow leopard and wolf that end up in more conflicts with herders are more prone to decline compared to other species. Particularly, large carnivores play important role in ecological function for regulating prey populations, controlling numbers of meso-predators through competition, and maintaining a functional balance of biodiversity in local communities (Krebs et al. 1995). Across all the geographical ranges, large carnivores have been facing antagonism with herders even if they may not be causing severe problems due to an innate fear and deep-seated cultural hostility from past experiences (Berg 2001). Because of the lack of social acceptance for wildlife especially carnivores it is worth exploring what drives them to change their attitude.

Mongolians have a proud history regarding nature conservation as industrial development has been kept in balance with the country's ecological capacity, resulting in unspoiled natural environment. Traditionally, people have been interacting with nature very carefully because they believe that if natural balance is not preserved, wild nature will take revenge one day. They are well aware that nature is an interactive system (Humphrey et al. 1993) and societies are responsible for conserving and managing resources sustainably. Recent phenomenon of socio-economic changes has influenced nomadic herders' lifestyle and pastoral practices a lot (Fernandez-Gimenez 2000) mainly in negative ways. Understanding of 'modernization' is not only industrialization and urbanization. It includes political transformation, social and traditional destruction (Ginat & Khazanov 1998).

Like all arid and semiarid rangelands the pastures of Mongolia are often unpredictable in terms of productivity and sustainability making them difficult to manage for long-term sustainability (Knapp & Fernandez-Gimenez 2009). Since Mongolia has one of the highest accelerated rate of climate change (Batima et al. 2005), it makes pastoralists lifestyle more vulnerable and need for modification of their pastoral practices. All process of changes and land use has altered the patterns of interaction between pastoralist and wildlife and is leading to increased human-wildlife conflict for various reasons.

This study attempts to examine the recent changes in pastoral practices, herder-wildlife interaction and herders' perception towards wildlife in southern Mongolia. Such information is lacking from the study area. Main focus of study is to find out which group/section of the society are vulnerable and require more awareness towards wildlife conservation. It is hoped that this study will help to strengthen long term conservation of wildlife and rangelands in the region.

1.1 Literature review

1.1.1 Pastoral practices and drivers of change in Mongolia

Nomadic pastoralists, according to (Dyson-Hudson & Dyson-Hudson 1980), are people who are primarily dependent on livestock for their livelihood, live in environments with marked seasonality, and choose movement of their herds rather than bring forage to the herds as their basic strategy for providing year-round forage for their livestock. In Mongolia, where livestock husbandry contributes 20 percent to the GDP and is the main source subsistence for rural Mongolians (constituting 40 percent of the total population), over 80 percent of the country, or about 126 million ha, are used by pastoralists for extensive livestock grazing (Reading et al. 2004), and these extensive grazing lands represent the largest remaining contiguous area of common grazing in the world (Olson et al. 2009).

There is a strong trend toward urbanization of the population, and the country has undergone rapid economic development and industrialization in the past few decades. Owing to socio-political changes in the region, shrinkage of pastures and excessive usage or 'tragedy of common' phenomenon the pastoral way of life is at the cross roads and management of pastureland poses is a major challenge for the natural resource managers (Hardin 1998). Nomadic herders moved with their livestock according to the seasonal pastoral schedule (Fernandez-Gimenez 2001). The main guidelines were ethical norms such as friendship and mutual assistance (Cooper 1993; Fernandez-Gimenez 2000). Nowadays, the whole scenario has changed because of socio-economic development, modern lifestyles and perspectives. Such drastic changes can cause severe problems for the environment as well as traditional lifestyles of herder communities. This phenomenon is most pronounced in Asian and African continent.

In 1990, Mongolia changed political practices from communism to a free-market democratic economy (Okayasu et al. 2007). During the transition livestock was privatized and subsequently numbers have increased dramatically (Mearns 2004). The land remained state property and private ownership of pastures was explicitly not allowed. During this regime of transition all connections with Russia were severed and social services, veterinary and transport services broke down (Mearns 1996). Moreover, the trade of livestock products was impeded due to fuel

scarcity, deterioration of roads, lack of maintenance and parts for primary mode of transportation which was Russian vehicles. Herding regulations did not exist and the herding economy was thrown back to subsistence level (Retzer 2004). During period of socialism of over 70 years, the size of goat population was stable at around 4- 5 million. After Democracy and livestock privatization, goat number increased at the rate of about 1 million per year (Banzragch.B & Ochirbat.B 2003) though there was some sharp decline in between due to the harsh winter (dzud). The vast growth of goat was due to an increase in cashmere production. Overgrazing by pastoralist livestock is often attributed to the “common property problem” whereby land is owned communally (Hardin 1968). The carrying capacity for livestock and the impact of potential pests on forage availability therefore are of immediate interest (Neupert 1996; Sternberg 2008).

Herding on open pasture in Mongolia is very risky and always follows uncertainty like drought, strong windstorm and harsh winter. According to (Batima et al. 2008), pasturelands are getting more vulnerable to climate change. It's known that Mongolia is the highest global warming zone and that the 1.9°C temperature increase since 1940 has led to short, rapid warming and melting of snow covers during winters. As the ground is then still frozen, the melted water creates ice sheets on the ground surface impeding animals from grazing (Schulze 2009). Adaptation and disaster risk management options for pastoralists will become more and more crucial.

The high altitude rangelands are particularly harsh with extremely erratic precipitation and very low primary productivity making the pastoral communities more vulnerable. With slight intervention and external inputs pastoral communities in such areas can change their lifestyles rapidly (Johnson et al. 2006). Nomadic livestock herding has often been blamed for land degradation and threatening biodiversity due to overstocking which leads to overgrazing and land and biodiversity degradation (Schmidt 2006) but environmental fluctuations also impact range lands, (Homewood & Rodgers 1987; Retzer 2007) in the northern hemisphere. Due to the harsh weather conditions and economic transition (Midgley & Mitsuhiro 2011) many nomadic herders abandon traditional way of life, intensively seeking alternative income and destination to poverty.

1.1.2 Human-wildlife conflict intensity

The 21st-century global landscape is increasingly human-dominated, with reports that every ecosystem on the Earth's surface has now been influenced by human activities (Vitousek et al. 1997) and due to this interference human-wildlife conflict getting more intense day by day worldwide (Woodroffe et al. 2005). For example, lion attack to humans in Tanzania (William D. Newmark 1994), livestock depredation by spotted hyena in Ethiopia (Yirga & Bauer 2010) and wolf attack in North America (Francis 2004; Mech & Boitani 2003) and elsewhere. Human-wildlife conflict defined as any action by humans or wildlife that has an adverse impact upon the others (Woodroffe & Ginsberg 1998), it is an issue of increasing conservation concern. Such human-wildlife conflicts are common worldwide and experienced by many diverse communities, ranging from big carnivores to rodents. Overall, nomadic herders have always been confronting with wildlife be it ungulates or carnivores. Ungulates are known to compete with livestock for forage, at least from the herders' perception (Bhatnagar & Wanchuk.R 2006) whereas carnivores are often prone to depredate their livestock. Despite the large taxonomic diversity in species conflicting with humans, a variety of factors mean that large carnivores tend to generate particularly intense conflict. Especially livestock depredation upon large carnivore is most common reason for human-wildlife conflict worldwide (Woodroffe & Ginsberg 1998). This review will focus on livestock depredation, with a particular upon large carnivores.

The livestock depredation is one of the most important sources of carnivore-human conflict in this region. Since spatial organization of carnivore species has been intrinsically related to the availability of resources (Azevedo 2006; Packer et al. 2005) conflict always exists. In Mongolia, the Southwestern area is inhabited by various carnivore species like wolf (*Canis lupus*), lynx (*Lynx lynx*), corsac fox (*Vulpes corsac*), red fox (*Vulpes vulpes*) and snow leopard (*Panthera uncia*). Among these carnivores, snow leopard and wolf are most resource competitive and more often face human conflict for livestock depredation.

The reasons for wildlife preying on livestock vary and are not fully understood. Several reasons have been given by scientists as to why carnivores prey on livestock. First, livestock replaces wild ungulates in these rangelands as a food for the carnivores (Mishra et al. 2004), and individual animals learn that livestock are easier to catch as compared to the wild ungulates (Linnell et al. 1999). In others, predation may occur simply because there are not many preventive measures taking place. The herders tends to leave livestock unattended (Jackson et al.

1996) or do not have proper livestock shelter, corrals etc. (Jackson & Wanchuk.R 2004; Namgail et al. 2007).

Pastoralists are often have strong negative attitudes towards the carnivore species (Mishra et al. 2003), across the world. Problems appear to be especially Trans-Himalaya, with losses to wolves and snow leopard accounting for an average of 18% of livestock depredation, the equivalent of about half the annual income (Mishra 1997). Snow leopards in Nepal were responsible for 63% of all livestock mortality (Jackson et al. 1996). However, such examples of very high livestock losses appear to be in the minority, with some studies admitting that there is a tendency for exaggeration (Lindsey et al. 2005; Namgail et al. 2007). In Mongolia carnivore depredation appears to be second highest cause of livestock mortality after harsh winter (*dzud*) (Reading et al. 2004). Though carnivore depredation is an important cause of livestock mortality, people's perception towards these animals differs by the level of destruction caused by different species (Woodroffe et al. 2005) as well as the status of species whether common or endangered carnivores. Under the category of common species wolf considered pest in most part of Mongolia. For herders, livestock is the main source of income. Particularly surplus killing, where the predator kills multiple animals in one attack, can result in severe financial hardship (Mech & Boitani 2003) to stock owners and are often the cause of intense hostile attitude towards wildlife (Jackson & Wangchuk 2000; Oli et al. 1994).

1.1.3 Herders' attitude towards wildlife

In recent years there has been a proliferation of projects aiming to integrate human development needs with conservation objectives, and to establish mutually beneficial relationships for the management of natural resources between rural communities and the state (Gillingham & Lee 1999). Consequently many modern conservation activities realized how important to working with local people (grass-root) who are sharing habitat with wildlife and start paying attention for their attitude, perception towards wildlife and nature.

Public attitudes play a major role in acceptance of environmental policies or management actions and conservationists in particular (Karanth et al. 2008; Winter et al. 2005). Examining people's attitudes is important for formulating policies and management actions, and generating public awareness (Gillingham & Lee 1999). It is very important to understand local people perception towards wildlife where they are sharing same habitat with wildlife. Especially for researchers who are working on big carnivore species it has been always challenge (Andersone & Ozoliņš 2004; Jackson et al. 2010; Mishra & Madhusudan 2003; Webster 2007) but both the problem and the magnitude of the possible response have increased greatly over recent generations (Bagchi & Mishra 2006; Kellert et al. 1996). However, positive attitudes are less common in response to questions about carnivores, which frequently reveal very negative attitudes (Andersone & Ozoliņš 2004; Bruskotter et al. 2007; Saberwal et al. 1994; Teel et al. 2002).

Overall various reason affect people attitudes towards carnivore like animal i) level of destructiveness-wolf are known for killing multiple livestock in one attack- surplus killing (Bruskotter et al. 2007; Mech & Boitani 2003; Van Duyne et al. 2009), whereas snow leopard usually takes one or two livestock (Linnell et al. 1999) except in a few occasion and incidences. ii) cultural and religious beliefs related to particular animals and iii) conservation activities play major role (Gillingham & Lee 1999) for forming attitude towards wildlife. Another reason is carnivores' frequency of visit to the corrals also leads to conflicts with herders even though they may not kill livestock. Therefore wolves may be blamed for far more predation than they actually commit (Kellert et al. 1996). This perception of severe conflict is an important factor, as negative attitudes are strongly linked to removal of the species concerned (Gittleman 2001a).

Last option for increasing human tolerance towards carnivores is incentive and mitigation measures in order to reduce the risk of carnivore depredation on livestock (Allen & McCarthy 1999; Mishra & Madhusudan 2003), is very time consuming and requires more intensive engagement with local people.

1.2 Aims and Objectives

This study aimed to investigate nomadic herders pastoral practice and the various changes that have taken place in these that may increase conflict level between herders and wildlife in South Gobi Mongolia where the herders share habitat with endangered species of snow leopard (*Panthera uncia*), wolf (*Canus lupus*), ibex (*Capra sibirica*) and argali (*Ovis ammon*). It allows to examine possible contributing factor for pastoralists' attitudes towards wildlife.

A traditional pastoral practice changing towards developmental phases is more prone livestock depredation by carnivores because livestock were left unattended for several reasons. It may leads to nomadic peoples having negative attitudes towards wildlife. It requires understanding of the pastoral practices and also of the main drivers of change in these, the level of livestock depredation and herders attitude towards wildlife. To understand herders' attitude these have been compared in two different areas, one which for last ten years has ongoing efforts for snow leopard conservation; whereas the other area has similar level of human-wildlife conflict but there is no conservation initiative till today.

A framework identifies a broad set of variables and their linkages. Priority of this work is to focus on the issues that when social system changes how it affects wildlife conservation and their interaction with humans.

Main objectives are:

- Understand nomadic herders' lifestyle and drivers that have led to changes in their recent pastoral practice. And to compare the traditional and current herding practices vis-à-vis drivers of change various among various age and socio-economic classes of the herders. It includes seasonal movement patterns, livestock composition, herding techniques, frequency of going to city and other alternative jobs that leave livestock unattended.
- Hypothesis testing that pastoral practice change has affects to carnivore depredation and two areas human-wildlife conflict intensity. To collect information about livestock depredation events, carnivores encounter rates.
- Determine nomadic herders' attitude towards wildlife and their tolerance level. To attempt to find out which group/section of the society are vulnerable and require more awareness towards wildlife conservation and which factor contributes more in changing their perceptions.
- To compare pastoralists attitudes towards wildlife in two different areas one with and another without conservation initiatives, in order to measure the efficacy of such measures. Those two areas are same in terms of wildlife conflicts and issues and only differ in conservation activities undertaken.

2. Study area

2.1. General

Mongolia (41° 35' - 52° 09'N and 87° 44'E-119° 56'E) is located in Northeast Asia covering an area of 1,564,000 km². It borders with the Russian Federation and the People's Republic of China, and stretches for 2,392 km from west to east and 1,259 km from north to south. Mongolia is one of the largest land-locked countries in the world and with a population of 2.5 million people is one of the least densely populated countries in the world (UNDP 2004). Agriculture contributes nearly one-third of the national GDP and herding accounts for over 80 percent of agriculture (Mahul & Skees 2007). Almost 98% of the area used for livestock grazing (Johnson, 2006). Every fabric of the Mongolian society has been influenced by the nomadic pastoralism, an ecological adaptation that makes it possible to support more people in the Mongolian environment.

Table 2.1 Pasture area (million hectares) and livestock distribution in five different ecological zones, Mongolia.

Ecological zones	Pasture Area million ha (%)	Distribution livestock, %	Number of livestock (AUE)per 100 ha
Forest steppe	24.9 (22.2)	42.7	111
High mountain	14.0 (12.5)	14	62
Steppe	30.2 (26.9)	24.6	77
Desert Steppe	26.8 (23.9)	13.5	32
Desert	16.4 (14.6)	5.2	20

AUE-animal unit equivalent

(Source: Mongolian Society of Range Management, 2009; (Chantsallkam 2009)

2.2 Location

The study was carried out in two areas within South Gobi province of Mongolia in Gurbantes *soum* (medium administrative unit):

1. Tost Village: Tost village that has higher human-wildlife conflict and where snow leopard conservation activities are being implemented since 1992 by Snow leopard Enterprises

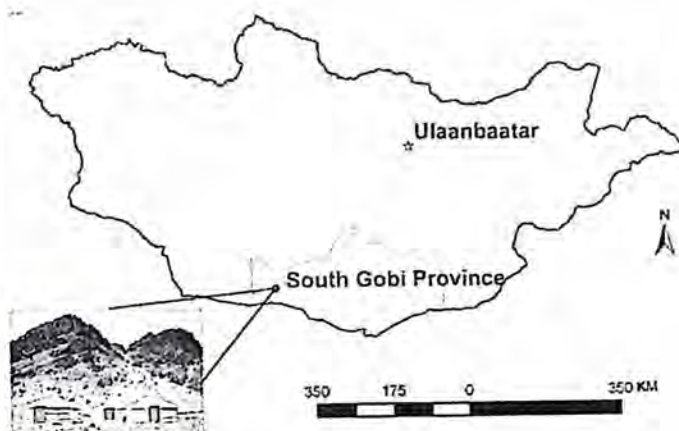


Plate 1 Location of Study Area in Mongolia

program of the Snow Leopard Trust (ISLT). This area i.e., Tost-Tosonbumba mountain range lies in the South Gobi desert. Here Snow Leopard Enterprise program (SLE) has been operational for the last 10 years; whereas the livestock insurance program was initiated in the year 2009, long-term research on snow leopards was also initiated in the same area in 2008. The program tries to increase herders' tolerance toward carnivore species particularly one of the endangered species, snow leopard, by enhancing the income of the herders. (Allen & Macray 2000).

2. Baysah village: The second study area, Baysah village is located in adjacent Noyon mountain range. It provides crucial snow leopard corridor to sustain viable population in South Gobi. Snow leopards are known for their requirements of large areas for their home ranges, especially sub-adults who travel more for exploratory movements (McCarthy et al. 2010). Therefore conservation activities are required to expand their areas and efforts constantly.

Baysah area represents the site where similar extent of human-wildlife conflict is present as in Tost area, but no specific conservation activities have been initiated till date. This area i.e., Baysah village is c. 120 km towards East of Tost mountain range. It has snow leopard, wolf, ibex and argali populations.



Plate 2 Study area families visited during interview in Gurvantes soum.

Both the areas form part of south-eastern Altai landscape. In addition to being suitable habitats for snow leopard and associated prey species, there are various similarities between the two sites, making them ideal candidates for such a comparative study. Both areas can best be defined as cold Montane drylands (Wesche 2007). Altitude ranges between 1450m and 2550m, temperature varies between 0 to -35°C in winter and goes up to +35°C in summer. Precipitation is low and winters are usually dry though some parts receive snow which varies between years. These areas are different only in terms of conservation activities particularly those involving the Snow Leopard Trust (ISLT), otherwise herders lifestyles and conflicts are the same.

South Gobi province is identified one of the areas with the highest density of snow leopards and prey species in Mongolia (Amgalanbaatar and Munkhtsog1999; (McCarthy 2000) where local herders have been living with charismatic species such as the wolf and the snow leopard through centuries. Wolf distribution is spread across the entire Mongolia (Red list of Mongolia 2006; (Wingard & Zahler 2006), even then we do not have actual estimation of wolf population and

distribution. The snow leopard is confined in along the Altai mountain range which is approximately estimates 103.000km² (McCarthy 2000)

2.3 Climate

Mongolia is exposed to polar air masses and semi-arid continental climate that leads to extremely low temperatures in the northern part of the country where daily winter means can be as low as -40°C, while winter mean temperatures in the Gobi generally remain above -20°C. Cold air accumulates in the extensive basins while mountain sites are less affected, leading to stable temperature inversions on a local scale. In spring, the anticyclone collapses and the planetary west-wind drift gains control of the climate. Temperatures rise steeply, but inflow of cold northern air masses can result in occasional frosts up to May. Moreover, strong winds, especially in the Gobi Altay, make living conditions unpleasant (Wesche 2007).

There are four distinct seasons: windy spring with variable weather, hot sunny summer with rain, cool autumn and a long cold winter. Precipitation is low, most of the precipitation returns to the atmosphere through evapotranspiration. Strong winds (with velocities in excess of 20 metres/second) are common in spring and early summer and then dust storms can cause disaster to people and livestock (Batima et al. 2008; Fernandez-Gimenez & Allen-Diaz 1999).

Snow covers are extremely uneven depending on area. In some northern states snow cover averages have been quoted as 13 centimeters, but sometimes, some parts of the steppe, semi-desert and desert zones are without any snow at all during winter (Shiirevdamba.Ts 1998). Basically climatic conditions fluctuate greatly from one ecological zone to another. In my intensive study sites annual precipitation is <139 mm a year and temperature range from -35°C to 38°C (McCarthy et al. 2010).

2.3.1 Frequency of drought and heavy winter occurrence

Mongolian climate is harsh and extreme such as summer drought, severe winter, spring and autumn frost, blizzard and strong dust storm. Mongolia shows gradually increasing trend in air temperature in the last 60 years temperature increased by 1.8C⁰ (Batima et al. 2008), and a slight decreasing trend in precipitation. Though Mongolians have a long history of being well adapted

and resilient to harsh climatic conditions, in recent years Mongolian pastoralist are getting more vulnerable to climatic hazards. The rising temperature and uncertainties in rainfall associated with global warming are likely to increase the frequency and magnitude of climate variability and extremes (Batima et al. 2005). Most of those climate hazard cause extensive livestock mortality due to reduced access to forage and water, weakening livestock and limiting their weight gain (Batima et al. 2008). The last harsh winter (dzud) occurred in 2009-2010. According to Local government documentation, the herders lost about 17% of their livestock which is 7.8 million heads during the peak of the winter season (not in chart). Since harsh winter (dzud) and drought are one of the highest reasons for causing livestock mortalities it's worth exploring frequency of stochastic event occurrence in Mongolia generally.

Table 2.2: Livestock loss through drought and harsh winter from 1944-2001.

<i>Year</i>	<i>Type of disaster</i>	<i>Losses of adult stock</i>	<i>Losses of young stock</i>
1944-45	Drought+dzud	8.100.000	1.100.000
1954-55	Dzud	1.900.000	300.000
1956-57	Dzud	1.500.000	900.000
1967-68	Drought+dzud	2.700.000	1.700.000
1976-77	Dzud	2.000.000	1.600.000
1986-87	Dzud	800.000	900.000
1993-94	Dzud	1.600.000	1.200.000
1996-97	Dzud	600.000	500.000
1999-00	Drought+dzud	3.000.000	1.200.000
2000-01	Drought+dzud	3.400.000	n.a

Source: Adopted from: (Reading et al. 2004)

According to the herders, high snowfall and low temperature was the main problem, but too warm winters would lead to less snow falling in the mountains and problems of drought during the following summer.

Drought, from the herders' viewpoint, is a lack of rain during the warmer part of the year. Drought in late spring and early summer is the most serious since during this time the pasture is starting to grow and the animals are in greatest need of good forage to rebuild body conditions and provide milk for their young. Drought over a wide area leads to concentration of livestock around water-points and better grazing and thus causes damage to the vegetation (Stumpp et al. 2005).

2.4 Vegetation

The Gurvantes *soum* in South Gobi province lies in the vegetation zone dominated by desert steppe vegetation (Tsegmid & Vorobiev 1990). The zonation of vegetation belt is largely dependent on precipitation (Pyankov et al. 2000). Generally growing season is limited to three months in Mongolia. Temperatures permit plant growth usually from the beginning of May onwards (Wesche 2007). But as the rains do not set in until June, soil moisture is not sufficiently available.

Characteristic vegetation of the area are grasses, above all the small species of the genus *Stipa* from the series *Barbatae*, especially *S. gobica*, and *S. glareosa*. The desert-steppes (or semi-deserts) can be subdivided into the main subtypes shrub-semi-deserts with *Caragana leucophloea*, and *Eurotia ceratoides*, and *Stipa-Allium*-steppes with *S. glareosa*, *Allium polyrrhizum*, *A. mongolicum*, and *Anabasis brevifolia* (von Wehrden et al. 2006). The most important components of the vegetation are shrubs and semi-shrubs (Fernandez-Gimenez & Swift 2003) from the families *Chenopodiaceae* (such as *Anabasis*, *Haloxylon*, *Iljinia*, *Kochia*, *Salsola*), *Asteraceae* (*Ajania*, *Artemisia*), *Polygonaceae* (*Calligonum*, *Atraphaxis*), *Zygophyllaceae* (*Zygophyllum*, *Nitraria*), *Tamaricaceae*, *Fabaceae*, and *Convolvulaceae* (Hilbig, 1990). A prominent vegetation type is that of saxaul *Haloxylon ammodendron* shrublands. Saxaul is a leafless tree or shrub with green shoots and extremely hard wood. Camels graze saxaul, and generally are the kind of livestock best suited for the desert zone (Thiel, 1985)

2.5 People and land use practices

Administratively Mongolia is divided into twenty-one provinces, each province further sub-divided into *soums* (medium administrative unit), the *soums* are sub-divided into *bags* (smallest administrative unit). My study area belongs to South Gobi province and I worked two different areas-village (*bag*) which are located in *Gurvantes soum*. The people lifestyle and culture is relatively homogeneous in the central and Southern regions of Mongolia. Majority of people are Buddhist and relatively religious.

I interviewed a total of 144 herders in both the villages- 70 in Tost and 74 in Baysah. Every sites has approximately 24,000-25,000 mixed (goat, sheep, horse, camels) group of livestock. Average household livestock is 240-250. Both the villages (*bag*) have approximately 200 households but many of them are settled in *soum* center for taking care of their school going kids and also because they want to live in a developed area. There is term called "absentee herding" in Mongolia which means that some herders herd another's livestock who themselves live in urban. It's slightly different than contract herder or hired herder. Herders tend their own livestock in addition to absentee owners' livestock (Fernandez-Gimenez 1999). It's mainly based on kinship and friendship. The absentee herder system is getting more popular those days due to urbanization.

In terms of the land use traditionally, herding groups followed customary pasture-use patterns that were considered unwritten law (Fernandez-Gimenez & Batbuyan 2004; Mearns 2004). Mongolian pastureland is owned by the state and operated under a common tenure system which refers to undivided land that is available for joint use by residents of the community (Fernandez-Gimenez & Batbuyan 2004). In 2007 there a new Pastureland Law was introduced (draft version of law) for regulating pastureland to allocate to respective herder's pastureland .But it's still under the process due to various criticism and experts predicting that this form of legal framework will take 10-15 years to be functional and operational. Basically there is no standardized national pastureland monitoring system for land resource use. Currently pasture management law goes under General Land law.

The existing land law has three categories of land tenure – ownership, possession, and use –in Mongolia:

Land ownership. Ownership rights are limited to Mongolian citizens and include the right to manage and sell the land. As of November 2004, forestland, pastureland, water basins, and special needs/protected areas could not be owned. Mongolian citizens can own plots of land for family residential and/or commercial purposes, and privatization of cropland is expected in the near future.

Land possession. Licenses for possession of land are granted to Mongolian citizens for periods of 15–60 years with an option to renew for up to 40 years. The right of possession includes the right to manage the land. A right of possession can be transferred by inheritance or by consent of the legal body that originally granted the possession rights, but cannot be sold.

Land use. A right of land use provides for the right to make use of a particular land feature, with no right to alienate the land. Land-use contracts are granted for terms of five years with one extension. Foreign entities can obtain use-rights but cannot use the land for agriculture or livestock (GOM 2002) Land Law 2002 (Fernandez-Gimenez & Batbuyan 2004). According to the Land Law, *soum* governments have the power to control and regulate *soum* land, to allocate possession to herder households for seasonal campsites and user rights to citizens and to impose land fees on land possessors (Fernandez-Gimenez & Batbuyan 2004). But because of incomplete political, and almost no financial decentralization (Mearns 2004), combined with lack of manpower, skills and sharing of some responsibilities with civil society institutions, the implementation of the Land Law is very weak and unclear at the local government level (Ojima & Chuluun 2008). Most of the herders are confused with legal terminology due to lack of awareness and implementation. There is potential future conflict include competing claims to water and pasture use, the expansion of protected areas to further include customary grazing areas, and conflict over property rights in areas undergoing mining exploration and mineral extraction.

3. Methodology

3.1 Survey structure and content

In order to understand recent changes in pastoral practices and changing lifestyle, I used an open ended questionnaire. This is one of the commonly used tool for such a study (White et al. 2005). It allows in-depth analysis of people's feeling and their perspectives and since the idea is to get an understanding of a boarder scenario, it is important not to confine responses to pre-determined answers. Good communication and the free exchange of information lies at the heart of all questionnaire surveys (Pretty 1995).

Prior to conducting the survey, a questionnaire was tested using 12 randomly selected herders representing different backgrounds and gender, and modified as necessary to ensure the respondent comprehension of each question posed, while also allowing for free thought on selected topics. The interviews were partly structured though mostly unstructured, depending on the initial response of the interviewee. All interviews were conducted in an informal manner within a relaxed setting with an initiative being taken by the researcher and followed by a discussion between the local people present and the researcher. The interviews provided the researcher with the flexibility of adding more questions to the discussion as the merited or the need arose.

Changes affecting traditional pastoral practices and the use of the natural resources were discussed with the herders, government officials and other local people from Gurvantes *soum* (county) center. Additional data from secondary sources and government records were collected to compare past herding practices with current practices.

The questionnaire was broadly divided into four parts that provided information on the following aspects: a) Basic demographic and socio economic information of the herders interviewed; b) Current and past pastoral practices and changes that have taken place since soviet occupation to present. This included local and regional changes which affect herding practices, herd size and composition, frequency of movement between pastures, frequency of visits to permanent settlements, number of family members involved in herding; c) Intensity of human-wildlife conflicts, including livestock depredation and their encounter rates acquired from during the

interview; and d) Local herders' attitude towards wildlife (see following section) I chose two different areas having comparable wildlife abundance, pastoral practices and wildlife conflict issues but with one area currently having no conservation activities or initiatives, such as compensation for communities suffering from losses incurred due to wildlife. The other area had a conservation program consisting of Snow leopard Enterprises program, livestock insurance and snow leopard long term ecological research going on. This research was done to assess the impact of conservation activities on the attitude of herders towards wildlife. In each area 70 and 74 herders were interviewed. When initiating each informal conversation with the households, the dominant family member was recognized and the interview initiated with this individual. All interviewees were adults (i.e., above 18 years of age). All surveys were conducted with the help of a local field assistant well known to most of the families. This helped facilitate cross-checking of each respondent's answers following completion of the interview as well as in clarifying doubts or inconsistencies that may have arisen during the particular interview. I also crosschecked livestock mortality information with the nearest neighbor(s) of the interviewee. If conflict occurs I averaged between information.

Last I asked herders' willingness to get more information about wildlife and nature conservation, and through which media source they would prefer to obtain such information. I measured the frequency of occurrence of people mentioning various feasible and possible ways to acquire knowledge. I conducted 144 independent interviews including both genders, across age groups, educational levels and family sizes in approximately equal proportion to their occurrence in order to obtain a representative sample.

3.2. Data analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) PC version 16.0. The statistical tests employed in this study were the Spearman correlation, Mann Whitney U test and Generalized Linear model and negative binomial Log Linear model. In some cases I used the Chi Square test and Cronbach's alpha method.

3.2.1. Changes in pastoral practice: In order to document changes in pastoral practices, I selected 5 variables:

Frequency of livestock grazing movement (shift between seasonal pastures) – Seasonal movement pattern and frequency of camp shifts are the key parameters to detect the changes in pastoral practices. Since one of the highly changed parameter is movement pattern and frequency, I used benchmark of movement frequency to be four times a year for a perfectly nomadic family. Traditionally, the herder families used to shift places at least once each season on a rotational basis (spring, summer, fall, winter).

Livestock diversity – Historically, the herders used to keep five different species of livestock (goat, sheep, cow/yak, horse and camels) for capable of responding to climate change (Damiran & Darambazar 2002) to avoid various types of risks. For calculating species diversity, I used the Shannon diversity index (Peet 1974).

$$H' = -\sum p_i \ln(p_i)$$

H' = The Shannon-Weaver Diversity Index

p_i = the relative abundance of each group of organisms

Herding techniques- Nomadic herders are well known for their eco-friendly lifestyle that enables them to adapt to the harsh climatic and physical conditions. In the past, they used to herd their livestock on foot and travel by horse or camel. Now the livestock herding method is changing rapidly, with herders preferring to use motorbikes and other methods that can potentially damage pastures (Okayasu et al. 2007) and also leads to reduction in the number of hours herds attend to livestock on daily basis.

Frequency of going to the village (soum) center- Since 2008 the Mongolian school entrance age has been reduced from 8 years to 6 years of age. One of the parents, usually the mother, has to

stay with the young children. Since the family is centered in the village center, herder men visit frequently, causing sedentarisation (fig 4.4). Also it included other reasons such as bank and some official works. The situation becomes potentially more dangerous for livestock which are more prone to depredation by carnivores when left unattended.

Family numbers present in the each household- I assumed that if all family members are present in herding, it would potentially offer increased vigilance for livestock thereby making them less prone to depredation.

All those variables can play a role in herders' lifestyle and measured them using Ordinal scores (Zar 1999). Each variable was scored by rank order method (Dawis 1987) as 0 (prefer traditional method), 1 (somewhat changed) or 2 (highly changed) based on their current practices. In order to assess the congruence of information between the variables, I used Cronbach's alpha method.

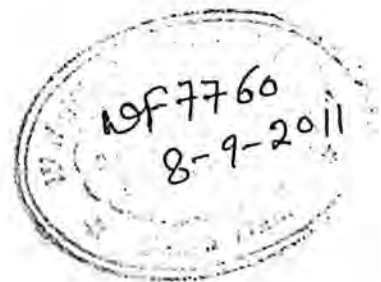
$$\alpha = \frac{N \cdot \bar{r}}{1 + (N - 1) \cdot \bar{r}}$$

N -equal to the number of items

r-bar is the average inter-item correlation among the items.

It estimates how closely related a set of variables are as a group and their relationships (Bland & Altman 1997). In this method reliability is measured as the ratio of true score variance versus observed score variance. At the end I summed up all ranked variables and acquired 1-10 different gradients of pastoral practice lifestyle changes in the study area.

In assessing the main drivers of change, I asked herders to state why they were interested in settling in an urban area; they responded with several answers, including the need for schooling, taking a mining job, problems of harsh winters and development. I cross-tabulated the frequency of respondents mentioning each of these reasons for changing lifestyle against the less (0-3 summed lifestyle change score), moderate (4-6) and high (7-10) intensities of change.



3.2.2. Human-wildlife conflict intensity and possible correlations with changes in pastoral patterns

The most obvious measure of human-wildlife conflict is how much livestock a herder has lost due to carnivore depredation and how often they sighted a carnivore of interest (encounter rate). To compare the human-wildlife conflict intensity between the two study sites (conservation vs., non-conservation areas), I used t-test on livestock mortality from carnivores and herders' carnivore sighting frequency (based on questionnaire survey).

Carnivore encounter rate was judged by the frequency of herders' sightings over the course of the 12 months. It was difficult to establish encounter rates based on herder memory, especially for the snow leopard which is largely nocturnal and rarely sighted, *albeit*, pugmarks may often be seen. Many herders claimed that, although wild predators eat their livestock, they usually only see the tracks. Thus, even-indirect evidences were enough to create anger and hatred towards carnivores among the herders and thus I deemed it acceptable to include indirect evidence as the basis for establishing encounter rates (Hill et al. 1997). To test *a-priori* hypotheses regarding causes of livestock depredation, I used Generalized Linear Regression (log link and negative binomial error distribution) to model livestock depredation with three predictor-combinations: i) number of livestock holding, ii) number of livestock holding+ area (conservation vs., non conservation), or iii) number of livestock holding+ area+ pastoral practice change.

I selected the model with smallest AIC value to interpret drivers of livestock depredation. I employed current market value of particular domestic species to calculating economic value of per head losses to convert depredation into US monetary value.

3.2.3. Assessing attitudes towards wildlife:

I attempted to evaluate local herders' attitudes towards wildlife in two different areas that differed with respect to presence (or absence) of conservation initiatives. Questions relating to attitude were framed in the Likert scale method, which is a five point rating system embracing positive to negative feelings (i.e. strongly disagree, disagree, neutral, agree, disagree). These were scored as follows: strongly disagree (-2 points), disagree (-1 point), neutral (0 points), agree (1 point), strongly agree (2 points) Strongly disagree(-2 points) (Albaum 1997; Likert 1932).

Generally, two attitude questions were asked first: (i) what each respondent thought about having wild animals present in their pastoral area (the perception question) and (ii) whether it is important to conserve these animals in their natural environment (the knowledge based question) for each of the focal wildlife species – Ibex, Argali, Wolf and Snow Leopard. In all cases, each respondent was probed for his or her reasoning. In reality, the interviewer can evaluate responses both as verbal expressions and from the body language the respondent may present in response to a particular questions (Oppenheim 1998).

Each respondent's item scores were summed to constitute the respondent's total wildlife perception score. I used Non-Metric Dimensional Scaling (NMDS) to extract two synthetic variables (NMS axes) from eight item scores that represented the wildlife perception of respondents in reduced dimensions. The analysis was conducted in Program PC-ORD (multivariate analysis for ecological data <http://home.centurytel.net/~mjm/pcordwin.htm>) using the Sorenson (Bray-Curtis) method for rank-order relationship between dissimilarity and the distances between points in the ordination (Kenkel & Orlóci 1986). The NMS scores of respondents were plotted on the NMS (X-Y) axes to investigate differences in the attitudes of people towards wildlife between the conservation vs., non-conservation areas.

My special interest was in understanding drivers of herders' attitude towards carnivores (wolf and snow leopard). For this I tested a suite of *a*-priori hypotheses by constructing Generalized Linear Models (Gaussian error distribution) to model the summed perception score of wolf and snow leopard with potential alternative combinations of predictor variables. The predictors of interest were respondent's age, gender, education, number of depredation, when last depredation happened, number of livestock owns, annual income derived from actual number of livestock productivity, and pastoral practice change, and conservation vs. non-conservation area. (Myers et al. 2002). The maximal GLM of biologically meaningful parameters were initially fitted to the response variable. Only predictors with significant *P* values (< 0.1) were considered as indicative of trends that might be worthy of future investigation to create the most plausible set of scenarios. Alternative models of parameters and their interactions based on these significant variables were constructed and compared using AIC values and the smallest AIC model was selected (Burnham & Anderson 2002) to interpret drivers of carnivore-perception.

Table 3.1: Variables used for data analysis

<i>Predictor</i>	<i>Explanations</i>	<i>Variable type</i>
Age	Respondents age-group	3 nominal categories: young, middle and old
Gender	Respondents gender	2 categories: male and female
Area	Respondents location whether from conservation or non conservation area	2 categories: conservation area and non conservation area
Recent depredation	Livestock depredation recent incidences	2 categories: old(12-6 month ago depredation occurred) or recently happened(within in last 6 months)
Education	Respondents education	4categories:no-education,scool-level,pass10th, college
Herd number	# of livestock currently owned	Continues variable: (11-620 livestock)
Depredation	# of livestock depredation	Continues variable: (0-163.4 livestock)
Change	Summarized pastoral practice change	Ordinal variable: (0-10)
Annual income	Production yields per livestock	Continues monetary value by \$

4. Results

4.1 Respondent characteristics

Respondents' age ranged between 18 and 80 years and the young, middle-aged and old age classes had nearly equal representation (30-36%) in the questionnaire survey. The interviews were slightly biased towards male interviewees (59.7%) as many times males started responding first (table 4.1). Interviewees owned between 11 and 620 heads of livestock with an average of 194.5 livestock per household. Domestic goat comprised of the majority of domestic livestock (91.5%). Although herders still mainly rely on livestock products such as goat cashmere for their income, recent developments such as individual gold mining (84.7%, n=102 of respondents) has been directly and indirectly providing alternate income to many herder families. Among the respondents, 11% (n=16) were involved in varying degrees with conservation programs such as Snow leopard Enterprise, livestock insurance and as assistants in research projects to supplement their income.

Table 4.1: Gender, age and education details of the pastoralists surveyed (N = 144).

Description	Frequency	Percentage
No. male interviewees	86	59.7%
No. female interviewees	58	40.3%
No. young adult (18-35)	52	36.0%
No. middle age adult (35-50)	49	34.0%
No. elder adult (more than 50)	43	30.0%
No. non educated people	5	3.5%
No. educated people 1-4 th grade	44	30.6%
No. educated people 4-10 th grade	81	56.2%
No. educated people some college	14	9.7%
No. family member per house (less than 3)	54	37.5%
No. family member per house (3-6)	85	59.0%
No. family member per house (more than 6)	5	3.5%

4.2. Changes in pastoral practices

In this part I examined the extent to which herders' lifestyle and pastoral practices have changed and how much change happened overall. I choose five key variables that could be considered as the indicators of this change in the pastoral lifestyle of Mongolian South Gobi. Above mentioned (3.2.1.) indicators results are:

Frequency of movement: The study revealed that 50% of the families now move only twice a year at an interval of six months (winter and summer), and 26% of them are sedentary (Fig 4.1). Only 15% (n=22) of the families move more than four times a year especially during the summer time herders needs to move frequently to fatten livestock before cold winter comes. The herders stated that in case of longer periods of drought they have to move more often in search of better pastures. This was evident during 2009-10, which was particularly drought year.

Most herders have changed their movement patterns (84.7% n=122) from their traditional way of life.

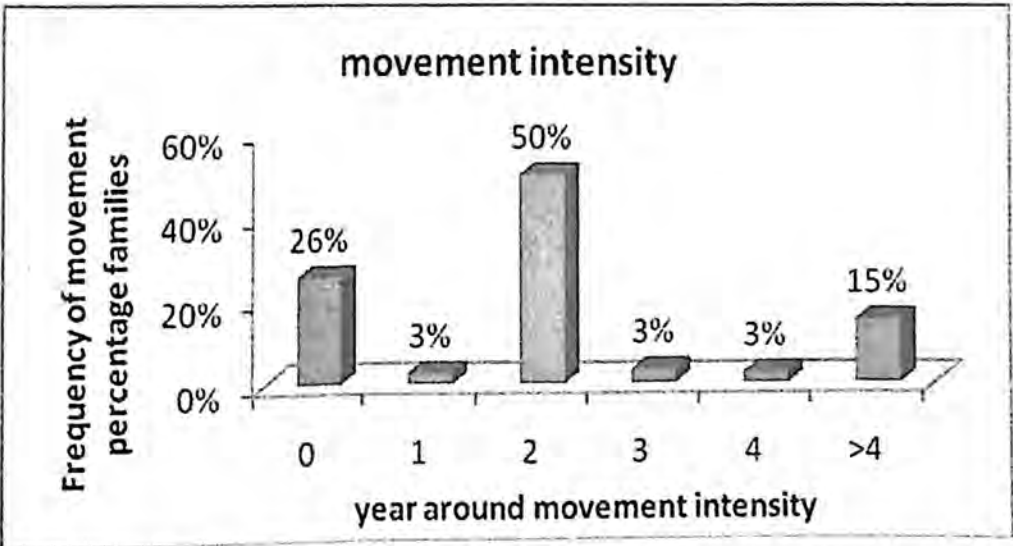


Figure 4.1: Frequency of annual movement by pastoral families

Species diversity: Analysis of the livestock holding pattern over the past 25 years reveals that in South Gobi, goat population increased by 21%, whereas rest of the livestock-species population decreased that included camels (11% decrease), cows (1% decrease), horse (1% decrease) and

sheep (7% decrease, see Fig 4.2) .This estimate does not consider periodic population fluctuations due to harsh winter (dzud) and drought. Overall changes in domestic species diversity (69.4% n=100) for interviewed families.

Using Shannon index to calculate current domestic species diversity $H' = 2.23$ in Gurvantes *soum*.

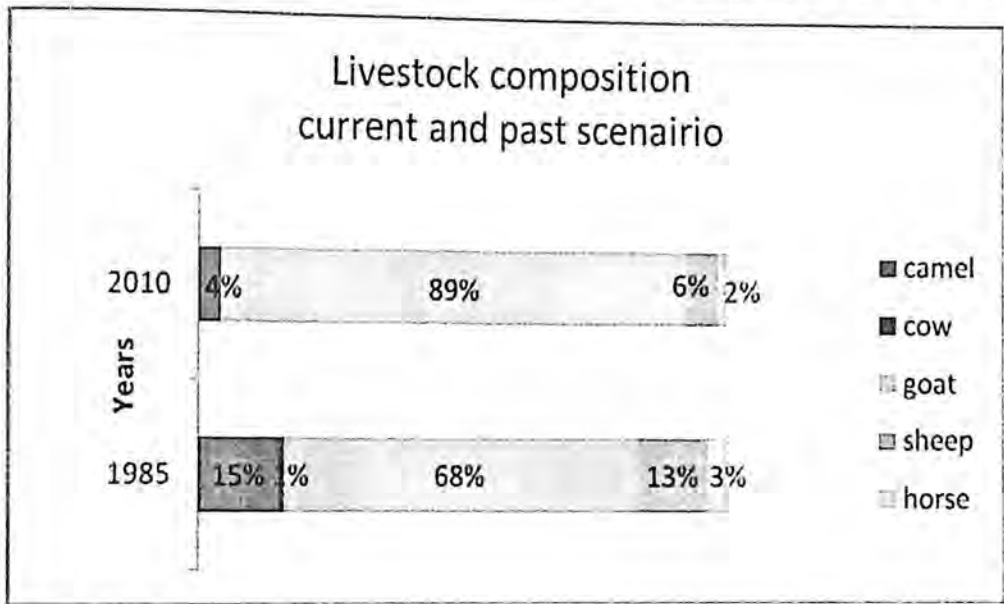


Figure 4.2: Comparison of livestock diversity and composition between current (2010 and past (1985) scenario

Herding technique: Only 43% of the interviewed herders tended their livestock by foot, whereas most of them (57%, n=82) use motorbikes to herd their livestock. herding techniques (56.9% n=82) altered from traditional herding techniques which is recent emerging changes comparatively other change variables.

Frequency of going to city: Out of total 144 respondents frequency of going to *soum* center is high with a majority of herders (70.8%, n=102) visiting the center up to 3-4 times in a month or more. About 20.8% (n=30) herders visit the centre once a month. A minority of them (8.3% n=12) visited the center less than once a month. Total 91.6% of them increased frequency of visiting settlement.

Family present in house: The recent scenario revealed that only 11.8% respondents live with their family. About 41% of the families do not have some of the members living together, and in these cases mainly the children have gone for schooling and only 2-3 family members have

stayed back. Most people are living alone, while rest (47.2% n=68) of their families live in the *soum* center. For summarizing (88.1% n=127) live in nuclear families.

The above variables used to synthesize the pastoral practice change showed substantial correlation between each other (Cronbach's $\alpha=0.62$) implying that the construct (pastoral practice change) did not suffer from internal inconsistency.

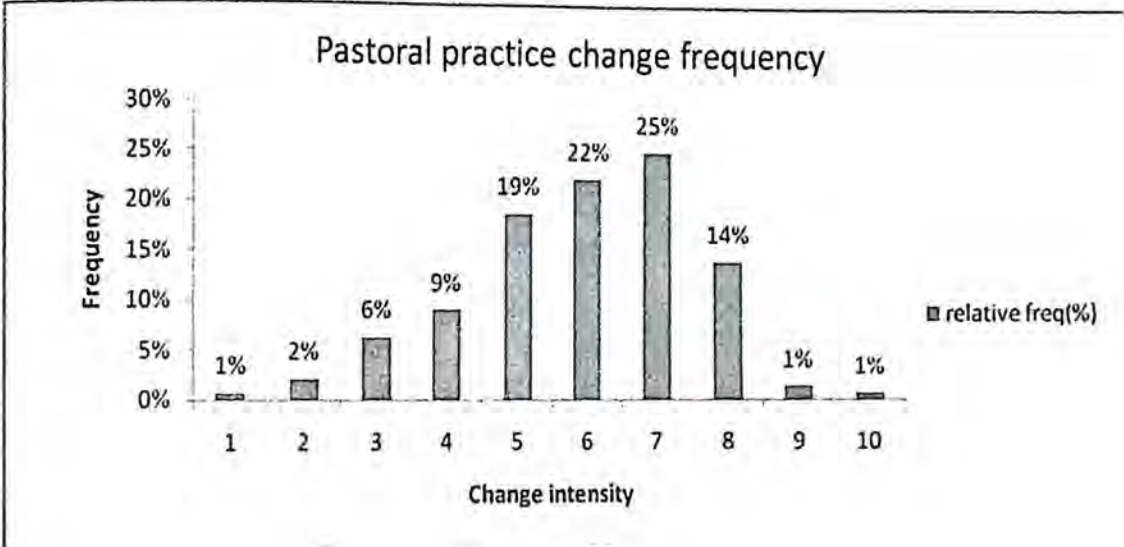


Figure 4.3: Intensity of change in pastoral practice change (intensity by gradients)

The study reveals that pastoral lifestyle has changed over the past two decades (fig 4.3). Only a small proportion of the interviewees (9%) seem to be following their traditional pastoral practices or have changed to lesser extent (change intensity: 1-3), while 91% have changed to moderate (50%) or higher (41%) degree.

The reasons behind these reduced movement patterns across the gradient of change intensity were also investigated (Table 4.2). It was found that the herders who have changed less (rank 1-3), seemed to have faced new emerging problems in the form of degradation of pastures due to mining. For moderately changed herders (rank 4-6) land ownership and resource scarcities are the main challenging issues. They claimed that since the quality of pastures has gone down everywhere, there is no incentive to move. Land ownership was the most frequently cited reasons for changing lifestyles across all groups.

Table 4.2: Reason behind lifestyle and seasonal movement change gradient

Gradient	Land ownership	Resource scarcity	Community competition	Mining exploitation	Other(man power, furniture)	Less number of livestock (no need)
1	1					
2			2		1	
3	1		3	5		
4	7	2	4			
5	11	2	6	2	4	2
6	13	13		4	2	
7	16	7		2	5	6
8	10	4	1	1	2	2
9	1	1				
10	1					
Grand Total	61	29	16	14	14	10
Percentage	42.4%	20.1%	11.1%	9.7%	9.7%	6.9%

- Land ownership- Although pasture land is still state owned, recent winter camp allotment has created a sense of legitimacy lands among herders. Respondents think if the winter camp site is registered as the current users' pasturelands, then others are barred to move nearby the registered area.
- Resource scarcity- Many herders felt that almost everywhere pasture quality is same and of relatively poor quality, and confinement of water sources are main reason behind sedentary lifestyle
- Community competition- Everywhere herders move, there is always pasture competition among the herders and some herders choose not to move to avoid such conflicts.
- Mining exploitation- Some mining companies already destroyed pasture where herders used to graze livestock previously.
- Other minor reasons such as some herders said that they don't have man power and logistically handicapped to move and few of them expressed they already have big furniture's cannot carry move them frequently. They are quite settled one place.
- Less number of livestock is another reason that they felt no need to move that frequently.

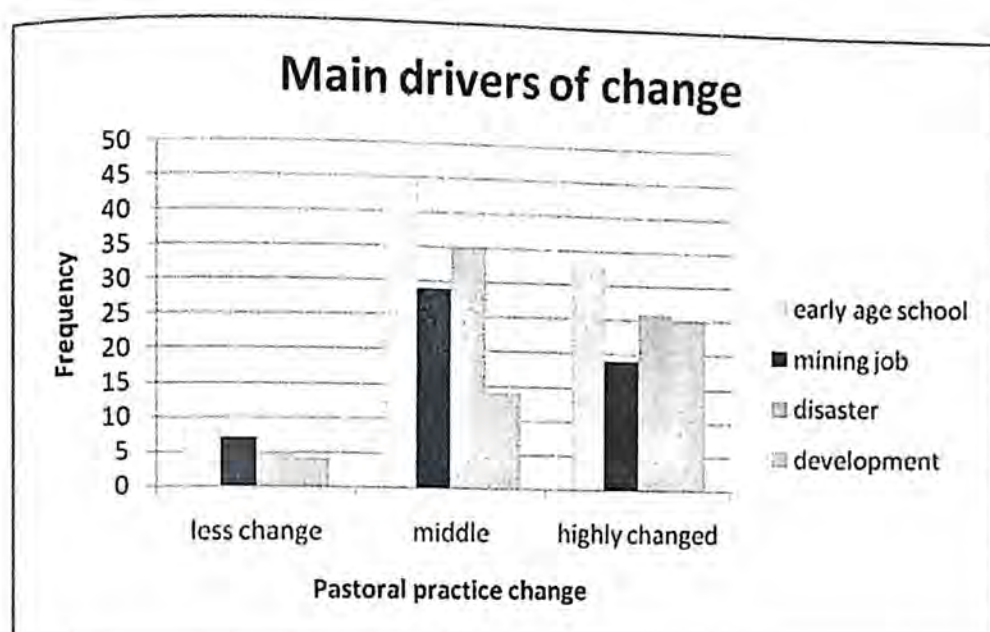


Figure4.4: Reasons cited by respondents for changing their pastoral lifestyle (Drivers of change)

Generally, the early admission need for school kids is the major reason (34.4% n=86) that herders need to settle in urban area and occasionally visit *soum* center. Secondly due to winter disaster (*dzud*- livestock starvation due to heavy snowfall) (26.4%) herders (n=66) who lost majority of livestock look for jobs in an urban area. The increase in job opportunities with gold and coal mining companies in both areas is another important driver of change is (22% n=55). Lastly, youths are more interested in living in *soum* centers or towns where the facilities are better (17.2% n=43) (Figure 4.4).

4.3. Human-wildlife conflicts

Herders in Mongolia suffer livestock loss from various factors, including, but are not limited to carnivore depredation. The main livestock loss occurs during drought years that are followed by the harsh winter which causes severe hardship for almost all pastoralists. According to Government documentation, during a harsh winter (*dzud*) livestock population decreased by 0.3% in South Gobi province. During year prior to this survey, both areas livestock mortality occurred as a result of a severe winter, amounting to a 73% decline in total livestock number (n=5091 among the 144 respondents. Wolf depredation is the second most important source of mortality (16%) followed by snow leopard (11% n=738) the as cited by herders. A small number of livestock (1% n=45) died of feeding on poisonous plants, accidents, disease and other unknown reasons. Causes of livestock mortality were similar in both areas (Figure 4.5), though

proportions of livestock lost to wolf vs., snow leopard was more similar in Bayash compared to Tost (where almost twice as many livestock were killed by wolf than snow leopard)

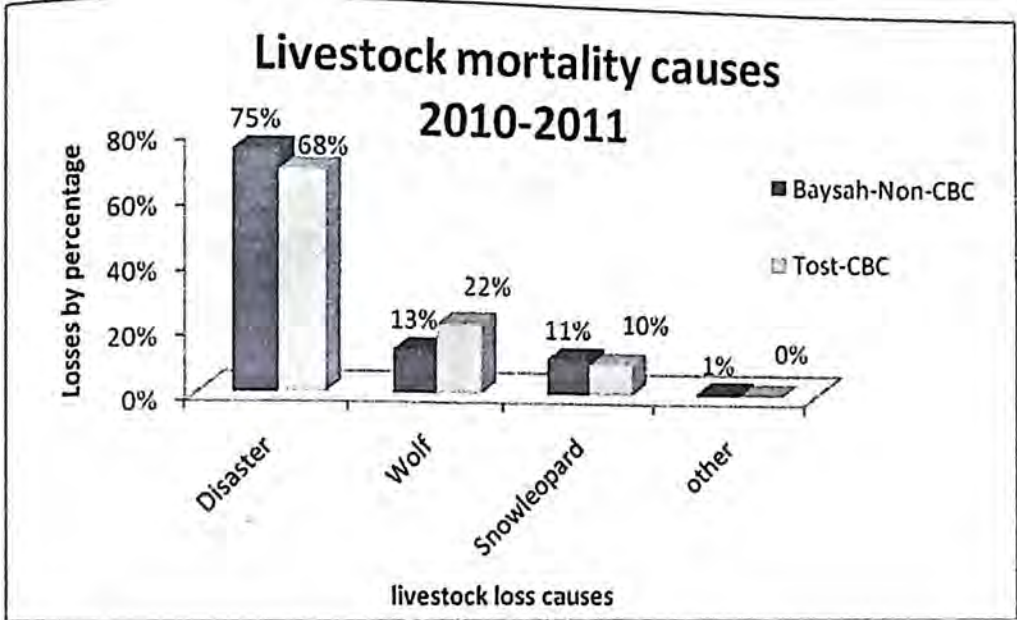


Figure 4.5: Causes of Livestock mortality in 2010-2011 Southern Gobi area, Mongolia

According to the one group (7 adults) of herders, severe winter is most harmful for livestock followed by drought. Interestingly wolves and snow leopards ranked third and fourth respectively, which can represent overall herders’ perception.

Table 4.3. Livestock mortalities Pair wise Rank table.

#	Severe winter	Disease	Wolf depredation	Snow leopard depredation	Drought
Severe winter					
Disease	Severe winter				
Wolf depredation	Severe winter	Wolf depredation			
Snow leopard depredation	Severe winter	Snow leopard	Wolf depredation		
Drought	Severe winter	Drought	Drought	Drought	
Total	4	0	2	1	3

The herders said many animals died during the winter due to cold and starvation. Heavy snowfall and blizzards could cover the grasslands and many animals often starved to death, due to the difficulties of finding grass. Also it exposes to the livestock to hypothermia. Many herders said that they don't want the sheep to breed as giving birth may weaken mother sheep and goat also offspring increasing livestock mortality during the harsh winter. Recent phenomenon shows that severe winter and drought leads to large internal migration of people to urban area, causing widespread un-employment and poverty.

Table 4.4: Total livestock mortality due to the winter disaster, disease and carnivore depredation from 2010-2011 in Tost and Bayasah bag (*Estimated from current total absolute number of each species*).

<i>Livestock losses</i>	Goat	sheep	Camel	Horse
Disaster	17%	24%	2%	6%
Disease/poison	0%	1%	0%	0%
Snow leopard	3%	3%	0%	1%
Wolf	3%	22%	7%	1%
Total	23%	50%	10%	8%

From table 4.4 it is evident that sheep are vulnerable to winter disaster and poisonous plants, goats and sheep are equally vulnerable to snow leopard predation. Sheep, followed by camel are more vulnerable to wolf depredation.

4.3.1 Encounter rate of carnivores

Three-quarters of the herders (n=108) reported seeing carnivores or their sign in the year preceding this survey. Snow leopards were sighted 28 times (5 respondents have seen this shy cat twice) and wolves were sighted 69 times (maximum one herder has seen five times). Sixteen percent of herders (N=23) have seen a snow leopard, while 18.1% (n=26) detected this species' tracks only. Out of total respondents 34% (n=49) herders have seen wolves more than once and 6.9% (n=10) of them saw wolf tracks last year 2010.

Contingency chi square test revealed that ($\chi^2=0.946$, $df=1$, $p=0.331$) there is no carnivore sighting difference between two areas.

120 respondents (83.3%) had experienced at least one attack on their livestock by carnivores in the past one year. In total 47.9% ($n=69$) respondents recall snow leopard attack and 63.2% ($n=91$) suffered wolf attacks to their livestock. Furthermore, 83.3% ($n=120$) of respondents experienced livestock loss ($min=1$; $max=53$) to carnivores within the last year in 2010.

Although there is hardly any report of carnivores attacking humans in South Gobi, in terms of livestock attacks and their monetary impact on livelihood resources they add significantly to the economic hardship of the herders.

Table 4.5 gives comparative account of livestock depredation by carnivores in two areas. It was found that livestock depredation by snow leopard and wolf was higher in Baysah area compared to Tost. Both the carnivores depredated goats more compared to other species which is most common in the study area. In Baysah area wolves also showed some preference for sheep. However, in Tost area wolves depredated more on camels compared to Baysah area (table 4.5). Mean livestock depredation per family was higher in Baysah ($6.8(\pm 3.4SE)$ livestock/family by snow leopard and $8.5(\pm 3.3SE)$ by wolves than Tost ($3.3(\pm 2.5SE)$ livestock/family by snow leopard and $3.3(\pm 3.2)$ by wolves).

Overall comparison of carnivore depredation of two areas was statistically not significant ($t=1.977$, $df=140$, $P=0.059$).

Table 4.5 Livestock depredation patterns by Snow Leopard and Wolf in both intensive study sites

	Respondents No. head depredation losses				% attacks on different stock types				% attacks on different stock types				Average No. stock killed	
	Tost		Baysah		Tost				Baysah				Tost	Baysah
	N	%	N	%	Goat	Sheep	Horse	Camel	Goat	Sheep	Horse	Camel		
SL	225	1.8%	513	3.3%	214	6	4	0	484	27	0	0	$3.3(\pm 2.5)$	$6.8(\pm 3.4)$
Wolf	509	4.1%	629	4.1%	408	44	3	45	439	187	0	5	$3.3(\pm 3.2)$	$8.5(\pm 3.3)$

4.3.2 Hypothesis testing of pastoral practice change influence of livestock depredation

I tested the alternate hypotheses of higher carnivore depredation under greater change in pastoral practices. For crosschecking purpose I applied Spearman rank correlation, showed substantial association between changes in carnivore depredation and pastoral practice change intensity ($\rho = 0.52$, $p < 0.00$). To understand the factors determining vulnerability of livestock to predators, I added pastoral practice change (Wald chi-square = 4.55, $df=1$, $P=0.033$), number of livestock holding (Wald chi-square = 1.809, $df=1$, $P=0.179$) and conservation and non-conservation area (Wald chi-square = 1.192, $df=1$, $P=0.275$) variables in GLM in negative binomial with log linear model (Table 4.6).

Table 4.6 Factors determining vulnerability of livestock to carnivore depredation

Model structure	Log likelihood	K	AIC	ΔAIC
carnivore depredation ~ no. livestock + area + practice change	-512.6	5	1033	0
carnivore depredation ~ no. livestock + practice change	-513.5	4	1033	0
carnivore depredation ~ no. livestock + area	-516.0	4	1038	5
carnivore depredation ~ no. livestock	-517.3	3	1039	6

Table:4.7 .Significance of factors that livestock depredation by carnivores

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Square	Chi-Df	Sig.
(Intercept)	1.161	.4234	.331	1.991	7.523	1	.006
Non-conservation area	.248	.1821	-.109	.605	1.856	1	.173
Conservation area	0 ^a	.	.	.	.	.	.
No. livestock holding	.001	.0007	.000	.003	2.819	1	.093
P. practice change	.167	.0628	.044	.290	7.097	1	.008
(Scale)	1 ^b						
(Negative binomial)	1						

Dependent Variable: carnivore depredation

Model: (Intercept), area, livestock, change

a. Set to zero because this parameter is redundant.

b. Fixed at the displayed value.

The model can be explained in a way that when livestock holding is increased by one unit, carnivore depredation will increase by $(0.001) \pm 0.007$ $P=0.093$ and non-conservation area is more prone to depredate to carnivores by $(0.248) \pm 0.1821$ $P=0.173$. Whereas if pastoral practice changes increased one unit depredation will increase by $(0.167) \pm 0.0628$ $P=0.008$

4.3.2. Economic value of livestock losses

Within the past one year, economic loss caused by livestock depredation by snow leopard was US\$36,180, whereas the loss due to wolf was US\$82,610 for a total loss of US\$ 118,790 by carnivores just for 144 individuals by current livestock economic value (Table 4.8). This represented an economic loss of 6.7% to the overall livestock holding, indicating that carnivores had a strong impact on herders' livelihoods.

Table 4.8: Economic losses incurred by herders during the past one year due to livestock depredation by snow leopard and wolf in the intensive study areas

#	Unit value (US\$)	Snow leopard(US\$)	Wolf (US\$)	Overall (US\$)
Goat	50	33 000	42 850	75 850
Sheep	60	1 980	13 860	15 840
Horse	300	1 200	900	2 100
Camel	500	0	25 000	25 000
		36 180 USD	82 610 USD	118 790 USD

In South Gobi the monetary value of reported losses, averaged over all households was equivalent to 37.1% *per capita*.

4.3.3. Seasonality and behavior

Livestock depredation varies seasonally, and from year to year for each carnivore. Maximum snow leopard depredation is known to occur in the winter (Bagchi & Mishra 2006; Jackson et al. 1996; Jackson & Wangchuk 2004; Schaller et al. 1988) but in the case of the wolf loss rates seems to vary more with respect to location than season varies by places (Musiani et al. 2005). Data on carnivore behavior collected from the surveyed families indicated that 23% of the attacks by snow leopards were in corrals as compared to 5% in case of wolves. Wolves mostly attacked in pastures (37% $n=35$). Many wolf depredation (24% $n=23$) occurred when livestock

were returning from the pastures. As told by herders, when they approach their homes, they tend to leave their livestock unattended and proceed ahead to their homes.

Snow leopard depredation was most frequent (41% ; n=29) in pastures when herders left some of their livestock in pasture overnight due to various reasons such as lack of herding practice and difficulty in managing large herds (mean herd size =194.5) by one person. Two carnivores preying technique is not statistically significance ($\chi^2=0.889$, $df=8$, $P=0.19$). It could be attributed because of not sufficient enough sample size for each preying techniques.

4.3.4. Livestock preventive measures from carnivore depredation

Livestock is the most important asset of herders' livelihood. I assessed the current preventive measures and recommended measures that can be implemented in future for the benefit of wildlife as well as communities living around it. According to herders, supervised livestock herding was most effective in preventing depredation (39.8%). Unfortunately, about 19.9% herders did not take any preventive measures. Besides, several people (9.5%) expressed that if depredation increases, they prefer to kill the predator. Other preventive measures such as better corral (7.5%), use of guard dogs (7.5%) and scare-crows were reported by (6.5%) respondents, followed by wire barriers around potential carnivore entrance to livestock area 3.5%. Certain number of respondents (6%) suggested use of gun to shoot in the air and use cracker to frighten the predator. One of the interesting responses from a small number (2 interviewees) of interviewees was to paste discarded CD on the back of domestic animals that reflect the sun, thereby deterring predators.

4.4. Herders' attitude towards wildlife

To evaluate local herders' attitudes towards wildlife, I chose two intensive study sites. In one of these areas, community based conservation (CBC) activities have been implemented since past 10 years in Tost whereas in the other area no conservation activity has taken place in Baysah area.

4.4.1. Herders' tolerance levels towards carnivores.

People's tolerance levels differed in the two study areas. In the site where conservation activities are ongoing Tost area, data suggested that their tolerance level was much higher than non-CBC site Baysah. The tolerance level to carnivore depredation was significantly higher ($t=5.23$, $df=89$, $P<0.00$) in Tost (4.6 ± 0.66) than Baysah (1.3 ± 0.2). Tolerance level of people in Tost was up to losses of 30 livestock as compared to Baysah where livestock losses to carnivores up to only 5 heads were acceptable. Considering their two areas average livestock holding is ($t=1.505$, $df=139$, $P<0.067$) not much differs.

4.4.2. Herders' overall perspective about wildlife

Using PC-ORD (multivariate analysis for ecological data) test, and using NMDS (non-metric dimensional scaling) I was able to extract dissimilarity of two areas in terms of herder perspectives towards carnivores. When I tested herders attitude towards general wildlife, from two areas, it didn't show significant differencece ($U=2.332$, $z=-1.024$, $P=0.306$). But carnivore attitude shows significant difference among two areas ($U=1.821$, $z=-3.072$, $P=0.002$). Therefore I tested herders' attitude for carnivores for comparing two different areas perspectives.

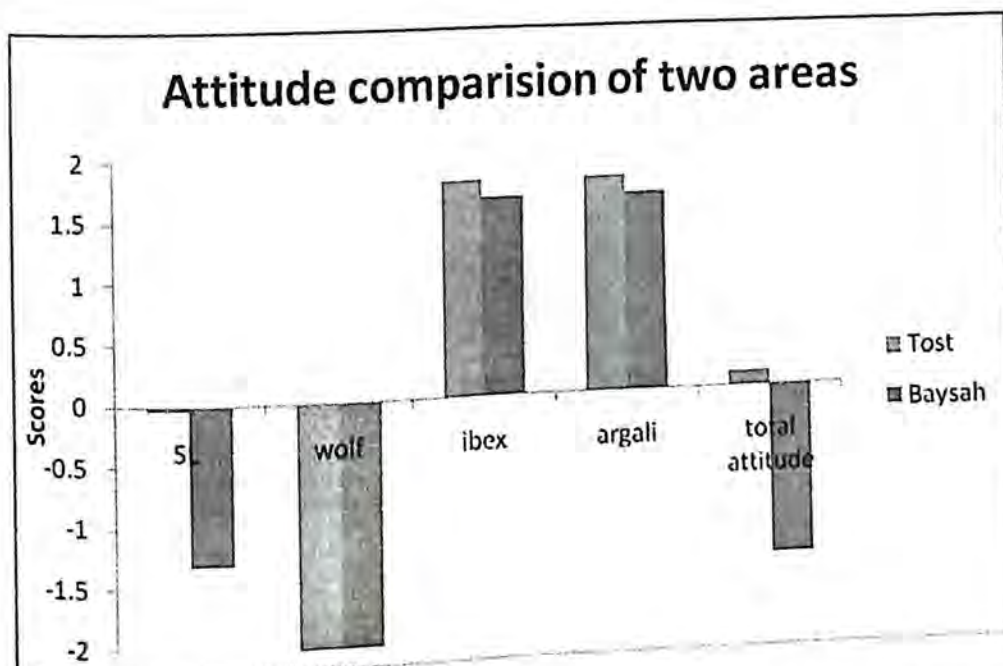


Figure 4.7: Comparison of attitudes of people from the two intensive study sites towards wildlife

Since herders did not regard wild ungulates as competitors, there was no desire to reduce their numbers. In fact herders wanted to increase wild ungulates populations to reduce depredation pressure on livestock. Positive attitude towards carnivores can be attributed to long term conservation activities being implemented for many tireless years. For example in Mongolia and the Himalaya the most sound conservation investment includes direct linkages between biodiversity conservation, economic assistance, large-scale local community participation, and incorporation of local values into conservation programs.(Jackson & Wanchuk.R 2001)

4.5. What influences people attitude towards carnivores?

Understanding herders' attitude towards carnivores is very crucial part of my dissertation work. Since overall wildlife perspective revealed no significant difference between two areas I emphasizing more on carnivore attitude issues here because it appeared different among the two areas. For that I had chosen nine important variables that can shape herders' carnivore perspective model. Subsequently, only three variables passed tests significantly. Based on significant variables I built herders' carnivore attitude model.

Table 4.9: potential factors influencing peoples' attitude towards carnivores

Source	Type III		
	Wald Chi-Square	Df	Sig.
(Intercept)	5.482	1	.019
Respondent age	3.939	2	.139
Conservation vs Non-conservation area	2.603	1	.107
Respondents education	2.376	3	.498
Respondents gender	.051	1	.821
Recent depredation (how recent incident happened)	.785	1	.376
No. Livestock owns	1.015	1	.314
No .livestock depredation killed by predator	2.814	1	.093
Respondents Annual income	.007	1	.932
Pastoral practice change	1.034	1	.309

Table 4.10. GLM potential models for carnivore attitude.

Model structure	Log likelihood	Kl	AIC	ΔI
carnivore attitude~area+age+no.depredation	-360.174	5	732.962	0
carnivore attitude~area+age	-363.138	5	736.71	3.748
carnivore attitude~area	-365.493	2	737.158	4.196

Table 4.11: Significance of factors that affect peoples' attitudes towards carnivores
Carnivore attitude = $a + b_1 \text{Area} + b_2 \text{Age} + b_3 \text{number of depredation}$

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Square	Chi-Df	Sig.
(Intercept)	-2.461	.5492	-3.538	-1.385	20.077	1	.000
[area=Baysah]	-.876	.5013	-1.859	.106	3.055	1	.080
[area=Tost]	0 ^a	.	.	.	.	.	.
[age=young]	-.530	.6123	-1.730	.670	.750	1	.387
[age=middle]	-1.316	.6167	-2.524	-.107	4.551	1	.033
[age=elder]	0 ^a	.	.	.	.	.	.
No. depredation	-.043	.0175	-.077	-.009	6.050	1	.014
(Scale)	8.711 ^b	1.0266	6.914	10.974			

According to my model conservation and non conservation area shapes peoples' attitudes towards carnivores more by $(-0.876) \pm 0.5013$ $P=0.080$ than non conservation area. Middle age people are more negative $(-1.316) \pm 0.6167$ $P=0.033$ towards carnivore comparatively young herders $(-0.530) \pm 0.6123$ $P=0.387$. When livestock depredation increase by one unit attitude will be negative by $(-0.043) \pm 0.01075$ $P=0.014$ (Table 4.11).

Univariate relationships of recentness of depredation shows ($\beta = -0.491 \pm 0.20$ Wald Chi-Square=5.92 $P=0.11$). Alone it shows play role for herders' carnivore attitude.

4.6. Herders' media outreach preference.

Generally people perception indicated that the public required conservation awareness. For investigating herders conservation media accessibility is revealed that many of them (37% n=54) suggested conservationists and researchers can visit families to initiate open informal conversation that host can ask any question and doubts regarding conservation issues he or she may hesitated to ask in public and meetings. Secondly, Television (TV) is one of the strong media tools (29.2% n=42) everywhere. Some people trust TV channel information more than any other source of information and almost most of them (73% n=105) have TV sets. Public meeting is another option (28.5% n=41) that can spread message to a mass audience at the same time. Others such as t radio and certain conservation events received lowest preferences.

Table 4.12 Peoples' preference of media sources.

	visit families	TV	Radio	Meeting	Newspaper	Events
young male	16	12	3	10	4	2
young female	6	8	2	8	4	0
middle age male	6	8	2	8	4	0
middle age female	4	7	2	7	3	1
old male	10	7	2	9	2	3
old female	8	4	1	3	1	0
Total	50	46	12	45	18	6

5. Discussion

5.1 Changing pastoral practices and drivers of change

Like other parts of Mongolia, pastoral practices in south Gobi Mountains have also changed drastically during last twenty years or so. In 1990, Mongolia changed from a communist country to a free-market democratic economy (Okayasu et al. 2007). During the transition livestock was privatized and subsequently their numbers have increased dramatically (Mearns 2004). The reason for this was that while the land remained state property and private ownership of pastures was explicitly not allowed, livestock were privatized. During this regime of transition all connections with Russia were severed and social services, veterinary and transport services broke down (Mearns 1996). Moreover, the trade of livestock products was impeded due to fuel scarcity, deterioration of roads, lack of maintenance and parts for primary mode of transportation which was Russian vehicles. Herding regulations did not exist and the herding economy was thrown back to subsistence level (Retzer 2004). After democracy and livestock privatization, goat number increased (Banzragch.B & Ochirbat.B 2003) though there was some sharp decline in between due to the harsh winter (Figure 5.1). All this impacted the pasture system (Johnson et al. 2006; Maria 2002). Now pastoralist have changed their lifestyle, strategies and attitude towards their society (Milner-Gulland et al. 2011) changing in myriad ways.

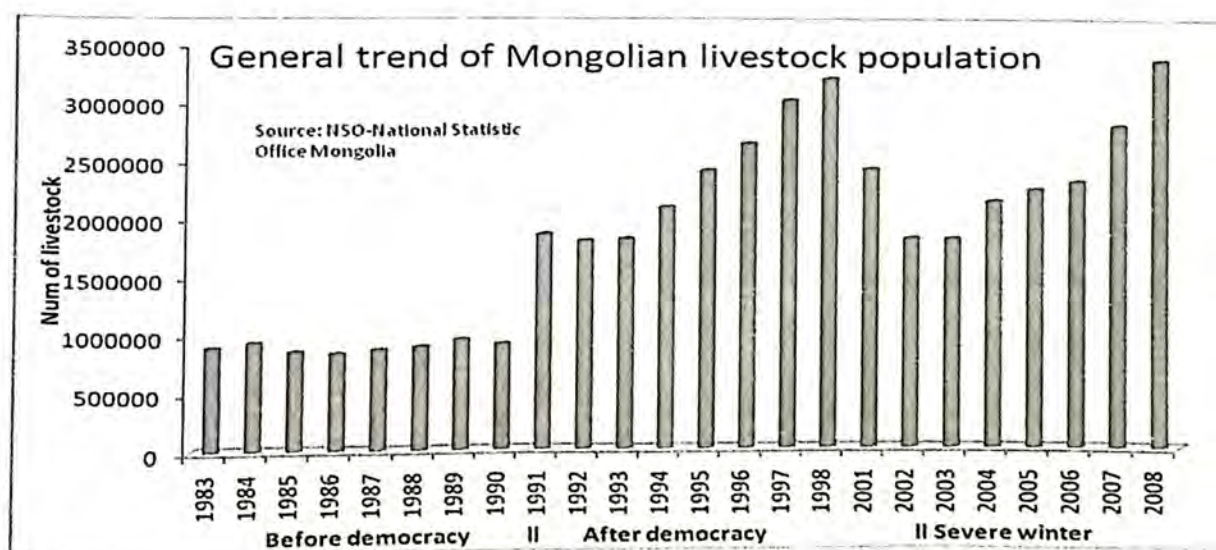


Figure 5.1: Livestock population trends in Mongolia

To adapt to the changes the poorer are coping with change for survival the wealthier people want to optimize their wealth security. Herder households are slowly shifting to urban settlers. Major changes in recent decades have been discussed below:

5.1.1 Livestock composition: Historically herders preferred to have diverse domestic livestock for preventing potential environmental and other hazards. This has shifted from diverse domestic species to single species of goat to yield more cashmere. Cashmere demand has increased drastically after democracy and open market.

5.1.2 Seasonal movement pattern: Although roughly 80% of total Mongolian land is pasture for year round livestock grazing (Banzragch.B & Ochirbat.B 2003; Leary 2008) many of them reduced their seasonal movement due to various reasons. Mobility was main feature of Mongolian pastoral practice that has now been altered to sedentary (26% n=37) mode of life. Some movement frequency is constrained by resource availability (grass and water) that has declined due to climate change (Batima et al. 2005). Sedentary lifestyle can potentially degrade rangeland productivity. In many parts of Mongolia pasture productivity has already declined 20-30 % in last decade (Leary 2008).

5.1.3 Changes in herding techniques: Motorbikes are increasingly being used (79% ; n=82) to herd livestock and this may be a reason for degradation of landscape and decrease in plant diversity along the road (Okayasu et al. 2007). Off-road driving causes a considerable environmental damage in pastureland (Rawat 2007).

5.1.4 Livestock stocking density: In addition to land tenure other livestock policies are required to be looked at in broader framework in policy level. According to the nomads, they were not experiencing problems of overgrazing in the past, due to the large rangeland and the relatively small livestock population. Livestock privatization has problem of overstocking and overgrazing and no control of public land for free grazing livestock.

The rangeland could support an increase in the livestock population, during good years. However, today the rangeland is much smaller and the livestock population is comparatively larger. The result has been that the herders could not keep as large populations as in the past, due to reduction in pasture availability. On the other hand the rangelands are also suffering due to

decline in the rangeland productivity that is now subject to what is known as the 'Tragedy of Commons'. Tragedy of the commons is a situation where individuals or units increase their stock, without thinking about the total population of the community and the carrying capacity of the resources. In situations where many individuals or units behave in this manner, the common property i.e. the rangelands will be overgrazed (Hardin 1968) . Among the respondents 84% of them hold more than 200 heads. Majority of herders blamed decreased precipitation and climate change for pasture deterioration and not overgrazing and overstocking. However, it requires established system of assessing the condition of state pasture resources or measuring carrying capacity of pastures and also needs to increase training workshop to straighten the capacity of province and *soum* governors to maintain and govern the rangelands in terms of livestock types and numbers *vis a vis* the carrying capacity.

5.1.5 Livelihoods - According to herders livestock is main asset to sustain their livelihoods. Current scenario of wealth represented by livestock holdings is as follows:

- (i) Wealthy households with excess of 500 heads of livestock. Households with more than 500 head of livestock only account for six percent of the total herding households.
- (ii) Full time herders with growing herds of between 200 and 500 animals, accounting for around 25 percent of herder households. Households are typically from middle or lower wealth levels. While herding can support the household, they are vulnerable to *dzud*, and restricted to increase herd numbers by access to capital and pastures.
- (iii) Full-time herders with fewer than 200 animals (and frequently less than 100) are poor households; often they hired by other herders (absentee herders) to tend their livestock along with own livestock. Many of them seek alternative income apart from livestock husbandry
- (iv) Periodic herders, usually with fewer than 200 animals, who come in and out of the livestock sector, depending on their economic circumstance. Often herding is used as a safety net, or fall back option. This group includes recent migrants to urban areas for whom the move may not be permanent.(Dollar et al. 2007)

Despite the fact that livestock husbandry contributes 18.8% of the GDP in Mongolian economy (Agency 2009), it is time to promote livestock productivity instead of increasing the number of livestock. Giving that land is state owned, the state itself needs to be responsible and control

overpopulating of domestic herds for grazing land under their contracts. Overgrazing problem is particularly acute especially in semi-arid rangeland where people compete for better pasture.

5.1.6 Land tenure-There is pressing need to understand herders changing land use in relation with land law management. Law implementer needs to clarify herders' confusion among the land tenure categories. According to current land law in 2003 herder can obtain title to their winter camp but not grazing land. Lack of awareness and land grazing regulation is serious problem locally. Customary grazing rights, however, remain powerful and are a major factor when considering land issues. Majority of (42.4%) herders complained land allotment to herders is main problem that is restricting their movement. However this was a misunderstanding, while the government allotted winter homes and corrals to herders, they assumed that the adjoining grazing lands also were allotted to them and herders restricted the movement of other pastoralists into these lands. This misunderstanding needs to be clarified by the government and herders since herders livelihood is depending on natural resources, the public policies has to be clear amendments.

5.1.7 Mining issue- Gold mining has been attracting people in recent years. Many herders have strong interest to do gold mining. Among interviewees (84.7%; n=102) were directly and indirectly involved with this alternative income. In gold mining business all different array of people are involved ranging from wealthy family (> 400heads n=6 families) to poorer family (<100heads n=25families). These people see few alternatives to gold mining, which offers the hope of earning higher income.

South Gobi region is vast and richly endowed with mineral wealth. copper and gold production in 2004-2008 led to 9% increase in GDP (Agency 2009). Although mining revenue is crucial for national economy of Mongolia, mining extensively damages pastureland and their surroundings due to inadequate waste management in last decades. It is the establishment of mines, together with their associated infrastructure needs and human population movements that could cause significant impacts on the environment (Batjargal 1998). Thus, impact of gold mining in changing herders' lifestyle cannot be ignored particularly in South Gobi pasturelands.

5.1.8 Urban settlements- Although, Mongolian herders are still primarily rural and dependent on livestock husbandry there is strong migration and tendency of herders move into urban area for many reasons. The herding communities face income insecurity due to continuous harsh weather (*dzud* and drought) and lost most of livestock. Many herders lose courage to continue and migrate to urban area to seek job. In recent years underground natural resources are attracting foreign investment and their exploitation. There is huge rush among young herders to get employed in those companies, rather herding livestock.

The study reveals that young kids education is one of the major reasons for settling in urban areas. Nearly 34.4% respondents claimed that they have no courage to send 5-6 years old kids to school hostel due to poor living conditions of dormitories and food supplies. Nowadays, parent centered teaching method has evolved in education regime that requires at least one of the parents to be with kids and to engage with teachers. Along with taking care of school many (25% n=36) young parents want to live in urban area to live comfortably with all facilities that development can offer

All these are key drivers of pastoral practice change. These are heavily influenced by policy, however policy decisions have ignored some crucial factors that may cause huge environmental, cultural and social loss in near future.

5.2. Human-wildlife conflict

5.2.1 Livestock mortality- According to herders' carnivore depredation stands third and fourth rank as a cause for livestock depredation, still herders considered it is big loss for them by economic value. Since conservationist care about charismatic species, some herders think it is worth complaining about the depredation and have hope to compensate their loss. On the other hand no one offsets the harsh winter mortality of livestock, which causes severe loss for herders. For that respondents may exaggerate their loss (Gillingham & Lee 1999; Treves et al. 2006) or attribute death of their animals to predators regardless of the actual cause of death (Mishra 1997). Livestock depredation is still one of the major threats facing carnivore conservation.

Interestingly, not much disease was reported during the survey. Instead, several (t 45) heads of livestock were reported to get killed due to consumption of poisonous plants. A particular plant

called *Ephedra equisetina* considered one of the major toxic plant in rangeland (Damiran & Darambazar 2002).

5.2.2 Carnivore depredation- The extent of the human/wildlife conflict is difficult to measure. Due to few problematic species local people usually exaggerate the facts and generalize bold behavior for all individual animals leading to negative perspective towards carnivores.

According to my study Baysah area marginally tends to lose more livestock to carnivores. It may attributed that their lack of preventive measures and conservation awareness of carnivores. Along with the risk of respondents amplifying their rates of conflict, there is also the possibility that respondents may have provided a response that they believe the interviewer wants to hear, rather than their true response.

5.2.3. Preventive measures for livestock depredation from carnivores- Livestock depredation preventive measures are very crucial for herders, rather killing the responsible animals. All preventive measures that the herders currently use such as flags, wire, smokes and scare crows, need to be frequently changed one to another method to reduce predator habituation (Gilsdorf et al. 2002).

Livestock depredation can be reduced by applying efficient livestock management practices (Ogada et al. 2003). Corral has been tested and going on successfully many places for controlling carnivore depredation (Jackson et al. 1996; Ogada et al. 2003; Wang & Macdonald 2006) especially from nocturnal animal such as snow leopard. But many herders complained that it requires lot of financial support to make corral. If herders can compare livestock losses to carnivores per year by monetary value of constructing corrals, they can easily build good corral for one season depredation. Same applies for guard dog as well, it may require one year to train the dogs, but it is worth the effort as the livestock is much protected after this. Only herders need to realize and adopt such long term solutions.

Among the preventive measures that the herders recommended mobile can be extensively used for potential depredation. Since almost most of herders know each other's livestock by their tag and identity, if someone witnessed unattended livestock (unknowingly left some portion of livestock) in pasture they can inform the owners to warn against potential predators.

5.2.4. Herders' tolerance level to predators: It is a major element in mitigating carnivore/human conflict. Though acceptance of losses varies among communities in general, pastoralists view large carnivores as a nuisance and see little financial or aesthetic value in them (Distefano 2005; Hazzah et al. 2009). Moreover, two areas herders tolerance levels differs that CBC Tost areas herders' acceptable number of livestock to carnivores far more than non-conservation areas' Baysah herders. This could be interpreted to mean that doing long term conservation activates are worthwhile as they can increase herders tolerance level.

Wolf is allowed to be hunted thought the year in Mongolia except in Eastern Steppe. People prefer to kill wolf where ever they see it even though they didn't lose any livestock. Culturally pastoralist have strong negative perception towards wolf (Mishra & Madhusudan 2003; Xu et al. 2008) across the world and it has always been considered the enemy of nomadic herders.

My research supports this statement that wolves seem to have had a stronger impact than snow leopard on human cognitive processes, because they are more frequently observed than snow leopard and their behavior is more readily interpreted as that of killing multiple livestock in one attack. Therefore herders' attitude towards wolf is equally negative to both areas.

5.2.5. Livestock depredation cause model: Changes in pastoral practice leads to herders seek alternative income thereby spending less time for livestock which becomes more vulnerable to carnivores. Also more number of livestock is difficult to manage by one person therefore many livestock are left behind in pasture making them prone to depredation from carnivores. CBC-Tost area herders more aware about some preventive measures and keep tidy their livestock better than non-conservation area Baysah. Therefore they may lose less livestock to carnivores.

5.3. Herders' attitude towards wildlife: Quantifying public perceptions is becoming a key component in translating ecology into management (White et al. 2005). Different type of livestock has different vulnerabilities towards carnivores. Therefore peoples' attitude differs by species like more hatred for wolf rather than snow leopard. One has endangered status where as another considered pest species in Mongolia. Also species extent of causing conflict is main driver for pastoralist perspective. Species are more prone to depredate surplus killing by one attack like wolf they extremely hate and other hand species doesn't harm directly like ungulates get better picture of attitude. Due to the pastoral practice changes there is potential high risk of

pasture competition between ungulates and livestock (Bhatnagar & Wanchuk.R 2006; Fox et al. 1991). It is clear picture shown that in both areas herders are positive about ungulates. Their main thought was ungulates don't cause any harm to humans therefore local people get aesthetic value from ungulates. As herders do not regard wild ungulates as competitors, there is no desire to reduce their numbers. In fact herders want to increase wild ungulates numbers so that there are fewer depredations on livestock. Therefore, there seemed no immediate threat to carnivores' main natural preys.

5.3.1. Herders' attitude towards carnivores model: So far as measuring herders' attitude towards carnivores is concerned, it is very complex task (Dickman 2005). For best significance statistical tests, I evaluated the strength of nine possible predictors, selected three important variables and concluded that proportion of livestock losses to depredation, age, and conservation and non conservation areas are key factors correlated with peoples' attitude towards carnivores. Although some variables are not highly inter correlated and therefore are individually significant they still have importance e.g. three respondents in Tost area were ready to retaliate and kill snow leopard as they were just right after depredation occurred. Eventually, as time goes on herders tends to leave anger behind. Moreover, my findings highlight that peoples' attitude answers are also shaped by how recent depredation incident happened, more recent depredation brings mainly strong negative attitude towards carnivores.

However, positive attitudes are less common in response to questions about carnivores, which frequently revealed very negative attitudes. The investigation of the impact of carnivores on the herders showed that most respondents had suffered at least one attack on their livestock, which was probably a major contributing factor for the negative attitudes. Beyond household experiences and conditions, large-scale sociopolitical and ecological factors also shape conflict and local attitudes toward wildlife. Some studies have shown that after the implementation of conservation initiatives, perceived conflict increases. For example, (Oli et al. 1994) found that since the establishment of a protected area in Nepal, snow leopards have been often held responsible for an increase in predation compared to before and same perspective occurs in Kenya as well by (Hazzah et al. 2009) . Tost *bag* herders perceived an increase in livestock depredation in the past two years, most often attributed to conservation activities. Respondents

indicated that this increase in conflict was a result of a growing snow leopard population and a change in snow leopard behavior getting more aggressive and bold. Interestingly, actual number of snow leopard in Tost area is quite few, estimated less than 20 adult individuals (McCarthy et al. 2010).

Surely peoples' attitude are influenced by their perception of how much loss has occurred (Bagchi & Mishra 2006). This is in contrast with Tost and Baysah areas, where respondents' attitudes are probably reflection of the far greater influence of carnivore conservation activities. This move toward community based conservation is very essential for carnivore species conservation (Gittleman 2001b) Positive attitude towards carnivores can be there only through long term conservation activities, achieved through many tireless years.

Conclusion

This study reveals that nomadic herders lifestyle in south Gobi mountains have changed drastically during last twenty years. Major drivers of change seem to be (i) education facilities poor condition and transition to school admission (ii) due to harsh climate condition frequently appears many people abandon herding husbandry (iii) illegal and legal gold mining alternative new jobs appearing and (iv) herders seeks development and better condition of life.

Mongolia is one of the countries many people livelihood depending on livestock husbandry therefore wildlife conflict makes the situation more serious. Combined with the increasing pressure of climate change, these developments have made herders and their flocks vulnerable to disaster, as seen during the mass animal deaths in the winter of 2010.

Finding from household to major level there is surely significant pastoral lifestyle changes going on that influencing carnivore conflict through in-depth analysis of socio ecological factor and individual herders' attitude towards wildlife. It is critical that integrate predator conservation with realistic livestock management. Research main emphasis is socio-economic influences also can affect wildlife conservation and human-wildlife interaction.

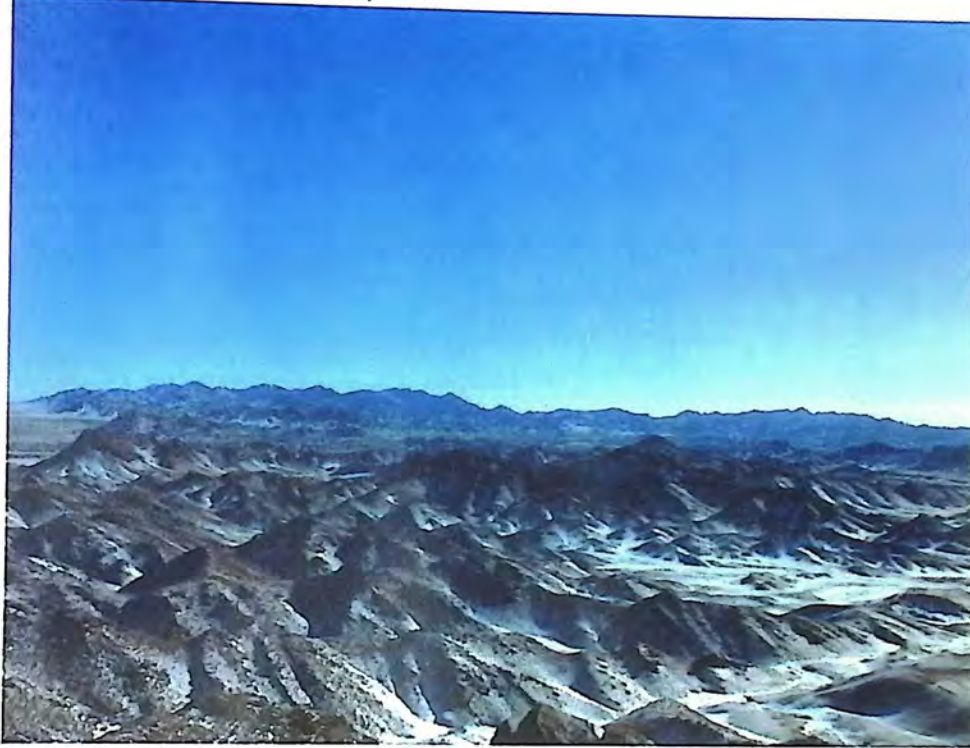
However, times are changing. This idyllic scenario is transforming the symbiosis of Mongolian pastoralists and the wildlife is slowly dying. With the fragmentation and transitions within Mongolian culture, the relationship has been altered. Clearly, there is no easy formula to address these types of long standing historical problems, but at the very least it is important to acknowledge current community based conservation activates in Snow leopard project in South Gobi Mongolia. To moving towards community based conservation activities are clearly essential for carnivore conservation. Hence whole carnivore conservation is on local communities hand their aspiration.

Glossary

<i>Altai</i>	Mountain system in Central Asia between Mongolia and China, between Kazakstan and Russia.
<i>AUE</i>	Animal Unit Equivalent
<i>Bag</i>	The smallest administrative unit. Soums are divided into bags.
<i>CBC</i>	Community based conservation
<i>Dzud</i>	A generic term denoting a natural disaster during which livestock are not able to graze. There are different types of dzud, including one which involves formation of a layer of ice over grazing land, often exacerbated by severe snowfall.
<i>Ger</i>	Transportable felt tent used as a dwelling by nomadic herders.
<i>GDP</i>	Total output of goods and services for final use within the domestic territory of a given country, regardless of the allocation to domestic and foreign claims.
<i>Gobi</i>	Arid pasture land (Mongolian). Source of the name "Gobi desert".
<i>NSO</i>	National Statistical Office.
<i>Soum</i>	Sub-province, below province level.
<i>Province</i>	The largest administrative unit. Mongolia is divided into 21 provinces.

Plate 3

a) A panoramic view of study area.



b) Unattended livestock is often prone to depredate by to carnivores



a) Traditional pastoral practice



b) Modern pastoral practice

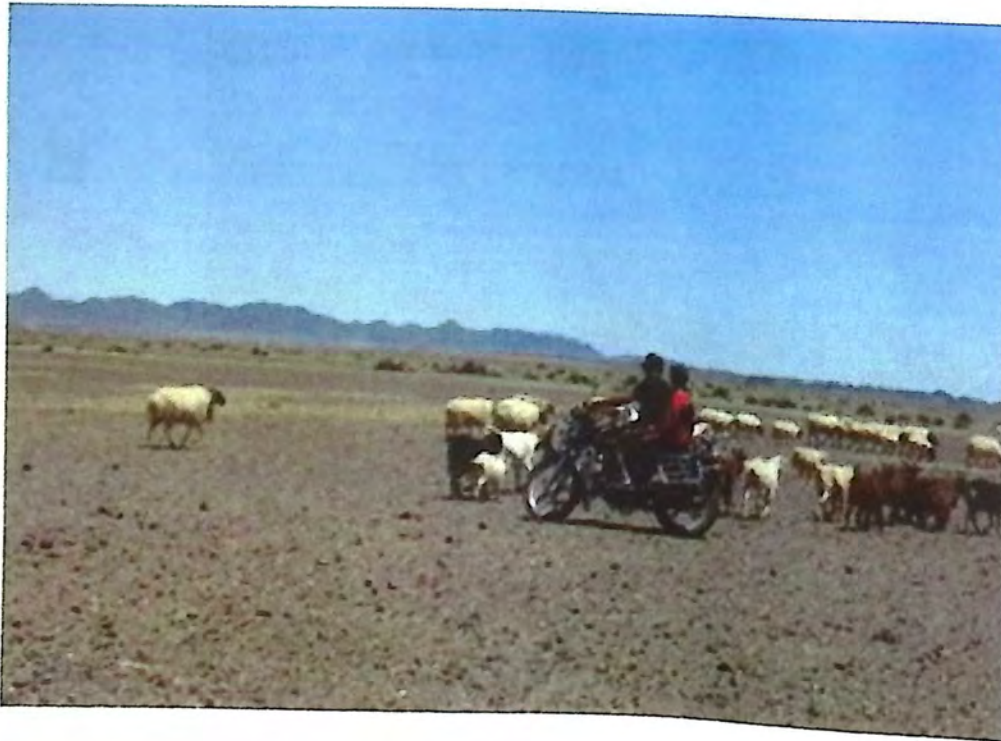


Plate5

During the harsh winter (dzud) many livestock suffer from starvation and hypothermia .



b) Gold mining in the pastures: recent cause of degradation and changes in pastoral practices



Appendix A

Questionnaire for herders

Note: All the questions will be translated to Mongolia and thus the wording may be a bit awkward

- Interview Code _____ Date ____/____/____
- Area Name _____
- GPS: Lat _____ Long _____ Alt _____
- Interviewees age _____ Gender _____ Education _____
- Occupation (nomad or semi-nomadic) Number of family members _____
- Do you hire herder? Yes _____ No _____ Relation to you _____
- Family mining involvement _____
- Do you have Bike _____ Car _____ Phone _____ TV _____ Solar panel _____

PASTURE MANAGEMENT QUESTIONS

1. How many times do you move per year?

	Summer	Fall	Winter	Spring
Freq of movement				
Duration of stay				

2. Why do you move this less times or don't move? Reason. _____
3. Where do you graze your livestock winter time? _____
4. Do you or your family involve with mining? _____
5. What is the major reasons are changing herders' lifestyle? _____
6. How often do go to *soum* center? _____

HUMAN-CARNIVORE CONFLICTS

7. How many livestock do you have?
Goat _____ Sheep _____ Horse _____ Camel _____
8. Who herds your livestock? Age _____ gender _____
9. Did you have any livestock loss during the last year? (Jan-Dec).

REASON	Species	Number	Where?	When?	Loss value
Disaster					
Disease					
Snow leopard					
Wolf					

10. How many times did you encounter carnivore species? _____
11. What kind of preventive measure do you use for protect livestock from carnivores?
12. What suggestion you give to make it better?

Continue...

HERDER'S PERCEPTION TOWARD WILDLIFE.

13. Do you believe into co-existence with those animals? (attitude question)

	Strongly disagree-2	Disagree-1	Neutral:0	Agree:1	Strongly agree:2
Snow leopard					
Wolf					
Ibex					
Argali					

14. How important is the existence of those animals in this landscape to you? (Knowledge question)

	Very important-2	Important-1	Neutral:0	Rather important:1	Totally Unimportant:2
Snow leopard					
Wolf					
Ibex					
Argali					

15. How much livestock loss by carnivore species is acceptable for you?

16. If numbers exceed acceptable limits what will you do? _____

17. If wolf depredate your livestock what will you do? _____

18. If snow leopard depredates your livestock what will you do? _____

19. How much below animals affects (negative ways) your livelihood?

	strongly affects	More or less affects	Not much
Snow leopard			
Wolf			
Ibex			
Argali			

19. What is the best way to spread conservation awareness activities? _____

20. Do you involve with any of those activities?

- a) Livestock insurance program b) Snow leopard Enterprises c) SL research program

References

- Agency, C. I. 2009. The CIA World Factbook 2010. Skyhorse Publishing.
- Albaum, G. 1997. The Likert scale revisited: an alternate version. *Journal of the Market Research Society* **39**:331-348.
- Allen, P., and D. Macray. 2000. Snow Leopard Enterprises Description and Summarized Business Plan. International Snow Leopard Trust.
- Allen, P., and T. McCarthy. 1999. Knitting for snow leopards. *Cat News* **30**:24-25.
- Andersone, Ž., and J. Ozoliņš. 2004. Public perception of large carnivores in Latvia. *Ursus* **15**:181-187.
- Azevedo, F. C. C. d. 2006. Predation pattern of Jaguars (*Panthera onca*) in seasonally flooded forest in the Southern region of Pantanal, Brazil. Major in Natural Resources in the College of Graduate Studies University of Idaho.
- Bagchi, S., and C. Mishra. 2006. Living with large carnivores: predation on livestock by the snow leopard (*Uncia uncia*). *Journal of Zoology* **268**:217-224.
- Banzragch, B., and Ochirbat, B. 2003. On sustainable development of cashmere production and goat population in Mongolia. System Science Research Center, Mongolian University of Science and Technology.
- Batima, P., L. Natsagdorj, and N. Batnasan. 2008. Vulnerability of Mongolia's pastoralists to climate extremes and changes. *Climate Change and Adaptation: Two Volume Set*:67.
- Batima, P., L. Natsagdorj, P. Gombluudev, and B. Erdenetsetseg. 2005. Observed climate change in Mongolia. *Assess Imp Adapt Clim Change Work Pap* **12**:1-26.
- Batjargal, Z. 1998. Desertification in Mongolia. Rala report
- Berg, K. 2001. Historical attitudes and images and the implications on carnivore survival. *Endang Species Update* **18**:186-189.
- Bhatnagar, Y. V., and Wanchuk, R. 2006. Perceived Conflicts Between Pastoralism and Conservation of the Kiang Equus kiang in the Ladakh Trans-Himalaya, India. *Environmental Management* **38**:934-941.
- Bland, J. M., and D. G. Altman. 1997. Statistics notes: Cronbach's alpha. *BMJ* **314**:572.
- Bruskotter, J. T., R. H. Schmidt, and T. L. Teel. 2007. Are attitudes toward wolves changing? A case study in Utah. *Biological Conservation* **139**:211-218.
- Burnham, K. P., and D. R. Anderson 2002. Model selection and multimodel inference: a practical information-theoretic approach. Springer Verlag.
- Chantsalkam, J. 2009. Sustainable rangeland management in Mongolia: The role of herder community institutions. Land Restoration Training Programme Keldnaholt, **112 Reykjavik, Iceland**.
- Chatty, D., M. Colchester, M. Montoya, K. A. Galvin, J. Ellis, R. B. Boone, A. L. Magennis, N. M. Smith, S. J. Lynn, and P. Thornton. 2010. Conservation and mobile indigenous peoples. *Slavic Studies* **11**:1.8.
- Cooper, L. 1993. Patterns of mutual assistance in the Mongolian pastoral economy. *Nomadic Peoples* (Sweden).
- Damiran, D., and E. Darambazar. 2002. Toxic/Poisonous to Livestock Plants of Mongolian Rangelands.
- Dawis, R. V. 1987. Scale Construction. *Journal of Counseling Psychology* **4**:481-489.
- Dickman, A. J. 2005. An assessment of pastoralist attitudes and wildlife conflict in the Rungwa-Ruaha region, Tanzania, with particular reference to large carnivores. *Conservation and Management University of Oxford*:95.
- Distefano, E. 2005. Human-Wildlife Conflict worldwide: collection of case studies, analysis of management strategies and good practices. Food and Agricultural Organization of the United Nations (FAO), Sustainable Agriculture and Rural Development Initiative (SARDI), Rome, Italy. Available from: FAO Corporate Document repository <http://www.fao.org/documents>.

- Dollar, D. R., E. Ijjasz-Vasquez, R. Raturi, and A. Goodland. 2007. MONGOLIA Livestock Sector Study SYNTHESIS REPORT. Sustainable Development Department East Asia and Pacific Region.
- Dyson-Hudson, R., and N. Dyson-Hudson. 1980. Nomadic pastoralism. *Annual Review of Anthropology* 9:15-61.
- Fernandez-Gimenez, M. 1999. Reconsidering the role of absentee herd owners: A view from Mongolia. *Human Ecology* 27:1-27.
- Fernandez-Gimenez, M. 2000. The role of Mongolian nomadic pastoralism' ecological knowledge in rangeland management. *Ecological Applications* 10:1318-1326.
- Fernandez-Gimenez, M. 2001. The effects of livestock privatization on pastoral land use and land tenure in Post-Socialist Mongolia. *Nomadic peoples* 5:49-66.
- Fernandez-Gimenez, M., and B. Batbuyan. 2004. Law and Disorder: Local Implementation of Mongolia's Land Law. *Development and Change* 35:141-165.
- Fernandez-Gimenez, M., and D. Swift. 2003. Strategies for sustainable grazing management in the developing world. *Proceedings of the VIIth International Rangelands Congress*.
- Fernandez-Gimenez, M. E., and B. Allen-Diaz. 1999. Testing a Non-Equilibrium Model of Rangeland Vegetation Dynamics in Mongolia. *Journal of applied ecology* 36:871-885.
- Fox, J. L., P. Mathiesen, D. Yangzom, M. W. Naess, and X. Binrong. 2002. Modern wildlife conservation initiatives and the pastoralist/hunter nomads of northwestern Tibet. *Rangifer* 15:17-27.
- Fox, J. L., C. Nurbu, and R. S. Chundawat. 1991. The mountain ungulates of Ladakh, India. *Biological Conservation* 58:167-190.
- Francis, M. 2004. Livestock Depredation by Wolves. *Rocky Mountain Wolf Recovery Annual Reports*:16.
- Gillingham, S., and P. C. Lee. 1999. The impact of wildlife-related benefits on the conservation attitudes of local people around the Selous Game Reserve, Tanzania. *Environmental conservation* 26:218-228.
- Gilsdorf, J. M., S. E. Hygnstrom, and K. C. VerCauteren. 2002. Use of frightening devices in wildlife damage management. *Integrated Pest Management Reviews* 7:29-45.
- Ginat, J., and A. M. Khazanov 1998. *Changing nomads in a changing world*. Sussex Academic Press.
- Gittleman, J. L. 2001a. *Carnivore conservation*. Cambridge Univ Pr.
- Gittleman, J. L. 2001b. Interactions between carnivores and local communities: conflict or co-existence? . *Carnivore conservation*. Cambridge Univ. Press, Cambridge.
- GOM. 2002. *Law of Mongolia on Land*. (GOM Land Law 2002).
- Hardin, G. 1968. The tragedy of the commons. *Science* 162:1243-1248.
- Hardin, G. 1998. Extension of tragedy of the commons. *Science* 280:682-683.
- Hazzah, L., M. Borgerhoff Mulder, and L. Frank. 2009. Lions and Warriors: Social factors underlying declining African lion populations and the effect of incentive-based management in Kenya. *Biological Conservation* 142:2428-2437.
- Hill, K., J. Padwe, C. Bejyvgi, A. Bepurangi, F. Jakugi, R. Tykuarangi, and T. Tykuarangi. 1997. Impact of hunting on large vertebrates in the Mbaracayu Reserve, Paraguay. *Conservation Biology* 11:1339-1353.
- Homewood, K., and W. A. Rodgers. 1987. Pastoralism, conservation and the overgrazing controversy. *Conservation in Africa: people, policies and practice*:111-128.
- Humphrey, C., M. Mongush, and B. Telengid. 1993. Attitudes to nature in Mongolia and Tuva. *Nomadic peoples* 33:51-61.
- Jackson, R., and Wanchuk.R. 2001. Linking snow leopard conservation and people-wildlife conflict resolution: grassroots measures to protect the endangered snow leopard from herder retribution. *Endangered Species UPDATE* 18:138-141.
- Jackson, R., and Wanchuk.R. 2004. A community-based approach to mitigating livestock depredation by snow leopards. *Human Dimensions of Wildlife* 9:307-315.

- Jackson, R., and R. Wangchuk. 2000. People-wildlife conflicts in the trans-Himalaya. Management Planning Workshop for the Trans-Himalayan Protected Areas.
- Jackson, R. M., G. Ahlborn, M. Gurung, and S. Ale. 1996. Reducing livestock depredation losses in the Nepalese Himalaya. Pages 241-247.
- Jackson, R. M., C. Mishra, T. M. McCarthy, and S. B. Ale 2010. Snow leopards: conflict and conservation. Oxford University Press, UK.
- Jackson, R. M., and R. Wangchuk. 2004. A community-based approach to mitigating livestock depredation by snow leopards. *Human Dimensions of Wildlife* 9:1-16.
- Johnson, D. A., D. P. Sheehy, D. Miller, and D. Damiran. 2006. Mongolian rangelands in transition. *Sécheresse* 17:133-141.
- Karanth, K. K., R. A. Kramer, S. S. Qian, and N. L. C. Jr. 2008. Examining conservation attitudes, perspectives, and challenges in India. *Biological Conservation* 141:2357-2352 2353 2356 2357.
- Kellert, S. R., M. Black, C. R. Rush, and A. J. Bath. 1996. Human Culture and Large Carnivore Conservation in North America. *Conservation Biology* 10:977-990.
- Kenkel, N. C., and L. Orlóci. 1986. Applying Metric and Nonmetric Multidimensional Scaling to Ecological Studies: Some New Results. *Ecology* 67:919-928.
- Knapp, C. N., and M. E. Fernandez-Gimenez. 2009. Understanding Change: Integrating Rancher Knowledge Into State-and-Transition Models. *Rangeland Ecology & Management* 62:510-521.
- Krebs, C. J., S. Boutin, R. Boonstra, A. Sinclair, J. Smith, M. R. T. Dale, K. Martin, and R. Turkington. 1995. Impact of food and predation on the snowshoe hare cycle. *Science* 269:1112.
- Kreutzmann, H. 2004. Pastoral practices and their transformation in the North-Western Karakoram. *Nomadic peoples* 8:54-88.
- Leary, N. 2008. Climate change and adaptation : Climate change and vulnerability. Earthscan, London.
- Likert, R. 1932. A technique for the measurement of attitudes. *Archives of psychology*.
- Lindsey, P. A., J. T. d. Toit, and M. G. L. Mills. 2005. Attitudes of ranchers towards African wild dogs *Lycaon pictus*: Conservation implications on private land. *Biological Conservation* 125:113-121.
- Linnell, J. D. C., J. Odden, M. E. Smith, R. Aanes, and J. E. Swenson. 1999. Large carnivores that kill livestock: do "problem individuals" really exist? *Wildlife Society Bulletin* 27:698-705.
- Mahul, O., and J. Skees. 2007. Managing agricultural risk at the country level: the case of Index-Based Livestock Insurance in Mongolia. World.
- Maria, F.-G. 2002. Spatial and social boundaries and the paradox of pastoral land tenure: A case study from postsocialist Mongolia. *Human Ecology* 30:49-78.
- McCarthy, T., K. Murray, K. Sharma, and O. Johansson. 2010. Preliminary results of a longterm study of snow leopards in South Gobi, Mongolia. *Cat News* 53.
- McCarthy, T. M. 2000. Ecology and conservation of snow leopards, gobi brown bears, wild bacterian camels in Mongolia. PhD University of Amherst.
- Mearns, R. 1996. Community, collective action and common grazing: the case of post-socialist Mongolia. *Journal of Development Studies* 32:297-339.
- Mearns, R. 2004. Decentralization, rural livelihoods, and pasture-land management in post-socialist Mongolia. World Bank.
- Mech, L. D., and L. Boitani 2003. Wolves : behavior, ecology, and conservation. University of Chicago Press, Chicago.
- Midgley, J., and H. Mitsuhiko 2011. Grassroots Social Security in Asia: Mutual Aid, Microinsurance and Social Welfare. Routledge.
- Milner-Gulland, E. J., J. M. F. P. D., and A. R. E. Sinclair 2011. Animal Migration: A Synthesis. Oxford University Press.
- Mishra, C. 1997. Livestock depredation by large carnivores in the Indian trans-Himalaya:

- conflict perceptions and conservation prospects. *Environmental Conservation* **24**:338–343.
- Mishra, C., P. Allen, T. O. M. McCarthy, M. D. Madhusudan, A. Bayarjargal, and H. H. T. Prins. 2003. The Role of Incentive Programs in Conserving the Snow Leopard
El Papel de Programas de Incentivos en la Conservación del Uncia uncia. *Conservation Biology* **17**:1512–1520.
- Mishra, C., and M. Madhusudan, D. 2003. An incentive scheme for wildlife conservation in the Indian Trans-Himalaya. *Environmental conservation* **24**:338–343.
- Mishra, C., S. E. Van Wieren, P. Ketner, I. M. A. Heitkönig, and H. H. T. Prins. 2004. Competition between domestic livestock and wild bharal *Pseudois nayaur* in the Indian Trans-Himalaya. *Journal of applied ecology* **41**:344–354.
- Musiani, M., T. Muhly, C. C. Gates, C. Callaghan, M. E. Smith, and E. Tosoni. 2005. Seasonality and reoccurrence of depredation and wolf control in western North America. *Wildlife Society Bulletin* **33**:876–887.
- Myers, R. H., D. C. Montgomery, and G. G. Vining 2002. Generalized linear models. Wiley New York, New York, USA.
- Namgail, T., J. Fox, and Y. Bhatnagar. 2007. Carnivore-Caused Livestock Mortality in Trans-Himalaya. *Environmental Management* **39**:490–496.
- Neupert, R. F. 1996. Population and the Pastoral Economy in Mongolia. *Population Journal* **11**:27–46.
- Ogada, M. O., R. Woodroffe, N. O. Ouge, and L. G. Frank. 2003. Limiting Depredation by African Carnivores: the Role of Livestock Husbandry
Limitando la Depredación de Carnívoros Africanos: el Papel de la Crianza de Ganado. *Conservation Biology* **17**:1521–1530.
- Ojima, D., and T. Chuluun. 2008. Policy changes in Mongolia: implications for land use and landscapes. *Fragmentation in Semi-Arid and Arid Landscapes*:179–193.
- Okayasu, T., M. Muto, M. Jamsran, and K. Takeuchi. 2007. Spatially heterogeneous impact on rangeland after social system change in Mongolia. *Land Degrad. Development* **18**:555–566.
- Oli, M. K., I. R. Taylor, and M. E. Rogers. 1994. Snow leopard *Panthera uncia* predation of livestock an assessment of local perception in the Annapurna conservation area, Nepal. *Biological Conservation* **68**:63–68.
- Olson, K. A., T. Mueller, S. Bolortsetseg, P. Leimgruber, W. F. Fagan, and T. K. Fuller. 2009. A mega-herd of more than 200,000 Mongolian gazelles *Procapra gutturosa*: a consequence of habitat quality. *Oryx* **43**:149–153.
- Oppenheim, A. N. 1998. Questionnaire design, interviewing and attitude measurement. Continuum.
- Packer, C., D. Ikanda, B. Kissui, and H. Kushnir. 2005. Conservation biology: Lion attacks on humans in Tanzania. *Nature* **436**:927–928.
- Peet, R. K. 1974. The measurement of species diversity. *Annual review of ecology and systematics* **5**:285–307.
- Pretty, J. N. 1995. Participatory learning and action: a trainer's guide.
- Pyankov, V. I., P. D. Gunin, S. Tsoog, and C. B. Clanton. 2000. C₄ Plants in the Vegetation of Mongolia: Their Natural Occurrence and Geographical Distribution in Relation to Climate. *Oecologia* **123**:15–31.
- Rawat, G. S. 2007. Pastoral practices, wild mammals and conservation status of Alpine meadows in western Himalaya. *Journal of the Bombay Natural History Society* **104**:5–11.
- Reading, R. P., D. J. Bedunah, and S. Amgalanbaatar 2004. Conserving biodiversity on Mongolian rangelands: implications for protected area development and pastoral uses. *Rangelands of Central Asia: Transformations, Issues and Future Challenges*. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO, USA. .
- Retzer, V. 2004. Carrying capacity and forage competition between livestock and

- a small mammal, the Mongolian Pika *Ochotona pallasii* in a non-equilibrium ecosystem, South-Gobi, Mongolia. PhD Philipps-University of Marburg
- Retzer, V. 2007. Forage competition between livestock and Mongolian Pika *Ochotona pallasii* in Southern Mongolian mountain steppes. *Journal of Arid Environment* **67**:157-164.
- Saberwal, V. K., J. P. Gibbs, R. Chellam, and A. J. T. Johnsingh. 1994. Lion-Human Conflict in the Gir Forest, India. *Conservation Biology* **8**:501-507.
- Schaller, G. B., R. Junrang, and Q. Mingjiang. 1988. Status of the snow leopard *Panthera uncia* in Qinghai and Gansu Provinces, China. *Biological Conservation* **45**:179-194.
- Schmidt, S. M. 2006. Pastoral community organization, livelihoods and biodiversity conservation in Mongolia's Southern Gobi Region. USDA Forest Service Proceedings RMRS-P-39:18-29.
- Schulze, A. 2009. Land legislation and pastoral adaptation to climate change- The example of Mongolia. . Energy and climate change in cold regions of Asia. Proceedings of the seminar
- Shiirevdamba.Ts. 1998. Mongolia Biological Diversity, Ulaanbaatar.
- Sternberg, T. 2008. Environmental challenges in Mongolia's dryland pastoral landscape. *Journal of Arid Environments* **72**:1294-1304.
- Stumpp, M., K. Wesche, V. Retzer, and G. Miehe. 2005. Impact of Grazing Livestock and Distance from Water Source on Soil Fertility in Southern Mongolia. *Mountain Research and Development* **25**:244-251.
- Teel, T. L., R. S. Krannich, and R. H. Schmidt. 2002. Utah Stakeholders' Attitudes toward Selected Cougar and Black Bear Management Practices. *Wildlife Society Bulletin* **30**:2-15.
- Treves, A., R. B. Wallace, L. Naughton-Treves, and A. Morales. 2006. Co-managing human-wildlife conflicts: a review. *Human Dimensions of Wildlife* **11**:383-396.
- Tsegmid, S., and V. Vorobiev. 1990. The national atlas. Mongolian People's Republic (in Russian). Moscow, SSSR: GUGK SSSR and GUGK MNR.
- Van Duyne, C., E. Ras, A. E. W. de Vos, W. F. de Boer, R. H. G. Henkens, and D. Usukhjargal. 2009. Wolf Predation Among Reintroduced Przewalski Horses in Hustai National Park, Mongolia. *Journal of Wildlife Management* **73**:836-843.
- Vitousek, P. M., H. A. Mooney, J. Lubchenco, and J. M. Melillo. 1997. Human domination of Earth's ecosystems. *Science* **277**:494.
- von Wehrden, H., W. Hilbig, and K. Wesche. 2006. Plant communities of the Mongolian Transaltay Gobi. *Feddes Repertorium* **117**:526-570.
- Wang, S. W., and D. W. Macdonald. 2006. Livestock predation by carnivores in Jigme Singye Wangchuck National Park, Bhutan. *Biological Conservation* **129**:558-565.
- Webster, J. C. 2007. Missing cats, stray coyotes: one citizen's perspective. *Wildlife Damage Management Conferences*.
- Wesche, K. 2007. Plant survival in southern Mongolian desert steppes -Ecology of communities, interactions and populations. Inst. of Biology - Geobotany and Botanical Garden Martin-Luther-University Halle-Wittenberg Germany PhD:92.
- White, P. C. L., N. V. Jennings, A. R. Renwick, and N. H. L. Barker. 2005. Questionnaires in ecology: a review of past use and recommendations for best practice. *Journal of applied ecology* **42**:421-430.
- William D. Newmark, D. N. M., Deo-Gratias M. Gamassa, Hashan I. Sariko. 1994. The conflict between wildlife and local people living adjacent to protected areas in Tanzania: human density as a predictor. *Society for Conservation Biology* **8**:249-255.
- Wingard, J. R., and P. Zahler. 2006. Silent Steppe: the Illegal Wildlife Trade Crisis in Mongolia: . Discussion Papers, East Asia and Pacific Environment and Social Development Department. World Bank, USA. .

- Winter, S. J., K. J. Esler, and M. Kidd. 2005. An index to measure the conservation attitudes of landowners towards Overberg Coastal Renosterveld, a critically endangered vegetation type in the Cape Floral Kingdom, South Africa. *Biological Conservation* **126**:383-394.
- Woodroffe, R., and J. R. Ginsberg. 1998. Edge Effects and the Extinction of Populations Inside Protected Areas. *Science* **280**:2226-2228.
- Woodroffe, R., S. J. Thirgood, and A. Rabinowitz 2005. People and wildlife: conflict or co-existence?
- Xu, A., Z. Jiang, C. Li, J. Guo, S. Da, Q. Cui, S. Yu, and G. Wu. 2008. Status and conservation of the snow leopard *Panthera uncia* in the Gouli Region, Kunlun Mountains, China. *Oryx* **42**:460-463.
- Yirga, G., and H. Bauer. 2010. Livestock Depredation of the Spotted Hyena (*Crocuta crocuta*) in Southern Tigray, Northern Ethiopia. *International Journal of Ecology and Environmental Sciences* **36**:67-73.
- Zar, J. H. 1999. Biostatistical analysis. Pearson Education.