

**STATUS AND ECOLOGICAL CORRELATES OF OCCURRENCE
OF LEOPARD *Panthera pardus* (Linnaeus, 1758) IN BHAKTAPUR
DISTRICT, NEPAL**



SAPANA KHAIJU

T.U. Registration No. 5-2-37-72-2008

T.U. Examination Roll No. 48

Batch: 2070/71

A thesis submitted in partial fulfillment of the requirements for the award of the degree of
Master of Science in Zoology with special paper Ecology and Environment.

Submitted to
Central Department of Zoology
Institute of Science and Technology
Tribhuvan University
Kirtipur, Kathmandu

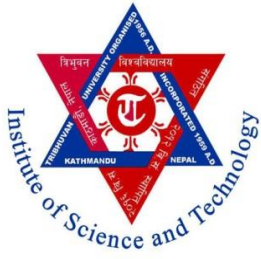
March, 2017

DECLARATION

I hereby declare that the work presented in this thesis entitled “**STATUS AND ECOLOGICAL CORRELATES OF OCCURRENCE OF LEOPARD *Panthera pardus* (Linnaeus, 1758) IN BHAKTAPUR DISTRICT, NEPAL**” has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

Date: 2nd March.

.....
Sapana Khaiju



TRIBHUVAN UNIVERSITY

☎ 01-4331896

CENTRAL DEPARTMENT OF ZOOLOGY

Kirtipur, Kathmandu, Nepal.

Ref.No.:

RECOMMENDATION

This is to recommend that the thesis entitled “**STATUS AND ECOLOGICAL CORRELATES OF OCCURRENCE OF LEOPARD *Panthera pardus* (Linnaeus, 1758) IN BHAKTAPUR DISTRICT, NEPAL**” has been carried out by **Ms. Sapana Khajju** for the partial fulfillment of **Master’s Degree of Science in Zoology** with special paper Ecology and Environment. This is her original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions.

Date:-

.....

Supervisor

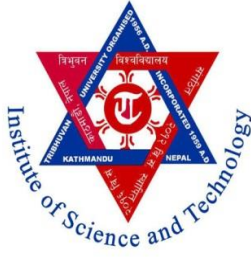
Dr. Mukesh Kumar Chalise

Associate Professor

Central Department of Zoology

Tribhuvan University, Kirtipur,

Kathmandu, Nepal



TRIBHUVAN UNIVERSITY ☎ 01-4331896
CENTRAL DEPARTMENT OF ZOOLOGY
Kirtipur, Kathmandu, Nepal.

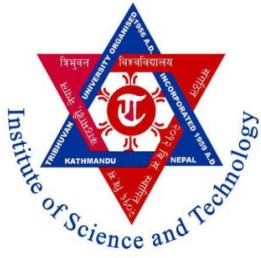
Ref.No.:

LETTER OF APPROVAL

On the recommendation of supervisor “Dr. Mukesh Kumar Chalise” this thesis submitted by **Ms. Sapana Khaiju** entitled “**STATUS AND ECOLOGICAL CORRELATES OF OCCURRENCE OF LEOPARD *Panthera pardus* (Linnaeus, 1758) IN BHAKTAPUR DISTRICT, NEPAL**” is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for **Master’s Degree of Science in Zoology** with special paper Ecology and Environment.

Date: 4th March

.....
Dr. Ranjana Gupta
Professor
Head of Department
Central Department of Zoology
Tribhuvan University, Kirtipur
Kathmandu, Nepal



TRIBHUVAN UNIVERSITY

☎ 01-4331896

CENTRAL DEPARTMENT OF ZOOLOGY

Kirtipur, Kathmandu, Nepal.

Ref.No.:

CERTIFICATE OF ACCEPTANCE

This thesis work submitted by **Ms. Sapana Khaiju** entitled “**STATUS AND ECOLOGICAL CORRELATES OF OCCURRENCE OF LEOPARD *Panthera pardus* (Linnaeus, 1758) IN BHAKTAPUR DISTRICT, NEPAL**” has been accepted as a partial fulfillment for the requirements of Master’s Degree of Science in Zoology with special paper Ecology and Environment.

EVALUATION COMMITTEE

.....
Supervisor
Dr. Mukesh Kumar Chalise
Associate Professor
Central Department of Zoology

.....
Dr. Ranjana Gupta
Head of Department
Professor
Central Department of Zoology

.....
External examiner
Judhha Gurung

.....
Internal examiner
Prof. Dr. Tej Bahadur Thapa

Date of examination: 14th March, 2017

ACKNOWLEDGEMENTS

I extend my first and foremost gratitude to my supervisor, Dr. Mukesh Kumar Chalise, for his continuous encouragement, support and valuable suggestions from the project formulation phase to completion of the thesis. I am also thankful to the investigator of NTNC, Mr. Ashish Bista and Dr. Narayan Prashad Kaju for their support, guidance and inspiration with important suggestions from the very beginning of research project.

I am eminently thankful to Prof. Dr. Ranjana Gupta, Head of Central Department of Zoology for her kind support, suggestions and encouragements. I am deeply indebted to assistant officer of DFO, Nhuchhe Ram Shrestha and other staffs for behaving friendly, serving and providing the needed information. Further, I would like to thanks to the Mr. Loknath Sapkota, a secretary of Hariyali Ban community forest of Sipadol VDC and other respondents within my study site, Bhaktapur district and other stakeholders who provided me with the information and shared ideas.

I appreciate the support that I received from Mr. Kavin Duwal, Ms. Rasmi Khagi and Mr. Purnaman Shrestha for providing the needed materials. I am very thankful to all colleagues Niru Magar, Sandhya Sharma, Binita Shrestha and all my friends who directly or indirectly helped me for my work.

At last but not least, I am grateful to family for the encouragement, support, and love which finally lead to the successful completion of the research work. Finally, I would like to dedicate this dissertation to my late father Mr. Jaaganath Khaiju.

Ms. Sapana Khaiju

Email: khaijus@gmail.com

Enrolled year: 2070/2071

CONTENTS

CONTENTS	PAGE NO.
DECLARATION	i
RECOMMENDATIONS	ii
LETTER OF APPROVAL	iii
CERTIFICATE OF ACCEPTANCE	iv
ACKNOWLEDGEMENT S	v
CONTENTS	vi-vii
LIST OF TABLES	viii
LIST OF PHOTOGRAPHS	ix
LIST OF FIGURES	x
ABBREVIATION/ACRONYMS	xi
ABSTRACT	xii
1. INTRODUCTION	1
1.1 Background	1
1.2 Statement of the problem	3
1.3 Objectives	4
1.3.1 General Objective	4
1.3.2 Specific Objectives	4
1.4 Limitation	4
2. LITERATURE REVIEW	5
3. MATERIALS AND METHODS	9
3.1 Study Area	9
3.1.1 Location	9
3.1.2 Geographical Feature	9
3.1.3 Climate	9
3.1.4 Flora	11
3.1.5 Fauna	12
3.1.6 Land use	12
3.1.7 Population and occupation of Bhaktapur district	12
3.1.8 Livestock in the villages	12
3.1.9 Tourism Development	13
3.2 Materials	13

3.3 Methods	13
3.3.1 Reconnaissance Survey	13
3.3.2 Data collection	13
3.3.2.1 Primary Data Collection	14
3.3.2.1.1 Field survey	14
3.3.2.1.2 Questionnaire survey	15
3.3.2.2 Secondary Data Collection	15
3.3.3 Data analysis	15
4 RESULT	16
4.1 Transect survey	16
4.2 Questionnaire survey	19
5. DISCUSSION	26
a. Ecological correlates	26
b. Leopard at the periphery of forest	27
6. CONCLUSION AND RECOMMENDATIONS	30
7. REFERENCES	31
8. APPENDICES	37
Appendix I	37
Appendix II	41
Appendix III	42

LIST OF TABLES

S.N.	Page No.
Table 1: Total area of the survey block	14
Table 2: Length of transect conducted in three blocks	16
Table 3: Sign encounter of leopard in different transects	16
Table 4: Sign encountered of prey species in different transects	17
Table 5: Directly encounter of fauna in different blocks	17
Table 6: Summary of factors loaded	18
Table 7: Summary of factors loading with high contribution variables	18
Table 8: Leopard rescued and killed by villagers	21
Table 9: Prey affected area	24

LIST OF PHOTOGRAPHS

S. N	Page No.
Photo 1: Interaction with local woman	41
Photo 2: Interaction with local herder	41
Photo 3: Interaction with farmers	41
Photo 4: Interaction with staffs of community forest	41
Photo 5: Encounter of <i>Muntiacus muntjack</i>	42
Photo 6: Feeding part of stem of <i>Schima</i> spp by <i>Muntiacus muntjack</i>	42
Photo 7: Grazing near the forest with herder	43
Photo 8: Grazing in the forest without herder	43
Photo 9: Scat of leopard	44
Photo 10: Remaining part of dog	44
Photo 11: Retaliatory Killing of leopard	45
Photo 12: Cub in Nagarkot VDC	45

LIST OF FIGURES

S. N	Page no.
Figure 1: Map of study area	10
Figure 2: Map showing different study blocks	11
Figure 3: Correlation between variables and factors	19
Figure 4: Number of respondents about presence and absence of conflict	20
Figure 5: Percentage of respondents who have seen and unseen	21
Figure 6: Direct and indirect sight of leopard	22
Figure 7: Seasonal variation of livestock depredation	22
Figure 8: Showing the time of seen and conflict according to local	23
Figure 9: Local perception towards leopard and regarding	24
Figure 10: People's perception towards the population of leopard	25
Figure 11: Conservation view of respondent	25

ABBREVIATION

CBS -	Central Bureau of Statistics
CCPL -	Cemeca Consultant Private Limited
CDZ -	Central Department of Zoology
CITES -	Convention on International Trade in Endangered Species
CNP -	Chitwan National Park
DDC -	District Development committee
DFO -	District Forest Office
DNPWC -	Department of National Park and Wildlife Conservation
GPS -	Global Positioning System
IUCN -	International Union for Conservation of Nature and Natural Resources
IEE -	Initial Environment Examination
KMTNC -	King Mahendra Trust for Nature Conservation
NRDB-	National Red Data Book
NTFP	Non-Timber Forest Products
NTNC -	National Trust for Nature Conservation
RBNP -	Royal Bardia National Park
VDC -	Village Development Committee
WWF -	Worldwide Fund
masl -	meter above sea level
CF-	Community Forest
PCA-	Principal Component Analysis

ABSTRACT

Understanding and conservation of wildlife species sustaining in human land use types, is challenging. Moreover, large cats are viewed as icons of wilderness (Athreya, 2014). The large cat species like leopard in human dominated area have attracted a great attention. The study was done with the main objective to the ecological correlate of the occurrence of leopard in the isolated forest area of Bhaktapur and human leopard conflict of leopard. For ecological variables line transects were carried out inside forest selecting some ecological parameters like density of trees, distance to water and settlements, mean height of trees, number of vegetation strata, presence of prey, canopy cover, and ground cover. Canopy cover, mean height of trees and ground cover were estimated while near distance to water bodies and settlement were pointed through GPS. Similarly, the social survey was conducted through questionnaire taking distance more or less 100-200 meters of adjacent to the forest edges. This study implied that parameter distance to water, canopy cover and density of trees species show most essential factors. Similarly, the stray dogs become victims followed by goats considering as conflict in villages. Therefore, many villagers think positive toward leopard. The night period found to be more active and prevalent time followed by evening period.

1. INTRODUCTION

1.1 Background

1.1.1 Leopard

Understanding and conservation of wildlife species sustaining in human land use types, is challenging. Moreover, large cats are viewed as icons of wilderness (Athreya, 2014). The large cat species like leopard in human dominated area have attracted a great attention. Certain landscape is attracted leopard in human-land use as it provides the biological resources which cause the manifold conflicts like human injury, livestock depredation and retaliatory killing of leopard. From the past, interaction between human and wildlife is common phenomena and have becomes significant problems throughout the world (Bhattarai, 2009).

The leopard (*Panthera pardus*) is large cat among the 12 cat species (Lamichhane et al., 2016) which is the most abundant and widespread wild representative of Felidae family (Nowell and Jackson, 1996). It is the top predator of the habitat in the case of the hilly region which is found in almost every kind of habitat ranging from tropical rainforests, tree-lined savannah, and barren dry deserts to mountain highland (Bailey 1993; Daniel, 1996). The geographical distribution of leopard extends throughout the Asia and Africa along with the Amur valley of Russia (Bailey, 1993 and Edgaonkar and Chellam, 1998). Leopards are the most widespread felid extending across much of the Sub-Saharan, Africa, the Middle East and much of tropical and temperate Asia (Nowell and Jackson, 1996). Pakistan, India, Nepal, Sri-lanka and Indo-China are part of South Asia, where Leopards are occur (Shrestha, 1997).

In Nepal, leopards can inhabit in areas below 4400masl of elevation (KMTNC, 1998) and even reported at 5200m of elevation (Jackson, 1984). The evidences of Leopard reported in 73 districts of Nepal except Dhanusha and Okhaldhunga (Shah et al., 2004) It has ability to adapt and remain elusive and unseen in the most adverse of habitats (Seidensticker *et al.*, 1990). Similarly, the leopard is widely distributed across the forested landscapes of the Indian sub-continent (Thapa, 2011), showing a remarkable degree of variation in range size between different regions (Bothma et al., 1997). The distribution pattern of large felid like leopard depends on the presence of prey resources, habitat and landscape features and attitude as well as activities towards leopard (Zimmermann, 2004) that reflects the diverse adaptability of the species even to human modified landscape (Hamilton, 1976 and Daniel, 1996).

Leopards are intrusive in nature (Malviya, 2015) and have catholic diet (Hayward, 2005). They have very good quality of feasible habit with amid even in human-dominated area (Kumar, 2013) and usually appeared in land use and land cover like maize that provide the excellent coverage for the leopard for movement and ambush (Karki and Rawal, 2014) which is significant for the natural habitat lover leopard. They preferred to hunt on

the medium sizes wild prey species like ungulates as a primary food (Bailey, 1993 and Thapa, 2011) followed by small preys (hare, rodents, birds, reptiles, mongoose, and porcupine) and large prey species like cattle and buffalo (kumar, 2011). Their diet ranges from beetles, insects, rodents, reptiles (snake) and even domestic livestock (Chalise, 2013). The preference habitat of leopard reveal to forest, bushes and agricultural land simultaneously so that the predation could be accessible to settlement area after the wild species delimited in the forest (Maharjun, 2016).

Unlike other large cats in Nepal, a large population of leopard resides outside protected areas. Due to its elusiveness, solitary and nocturnal habits, it can survive in both protected and non-protected habitats. The home range of leopard is so varied that from 6km² (Seidensticker, 1990) to over 2000km² (Bothma et al., 1997) can be occurred. Despite the forested areas turned to countable trees, agricultural land, settlement area and other anthropogenic disturbances causing the less or absence of corridor, it visits occasionally interacting with human (Shah *et al.*, 2004) and because of the long term survival on that habitat, consequently becomes the thrive to the leopard (Sanei et al., 2011). Common leopard is known to visit the human settlements quite frequently preying on domestic livestock and also terrorizing and sometimes injuring or killing the people (Athreya et al., 2013). Retaining top predators may assist in the conservation of biodiversity within multi-use landscapes by maintaining predator-prey dynamics and associated top-down processes (Swanepoel, 2014)

1.1.2 Forest in Bhaktapur district

In recent years through community forestry programs and plantations, the habitat is getting restored in many parts of the country which become a temporary hiding places for leopard and cannot support the prey species revealing increased level of human- leopard conflict thus human conflicts are increasing in many parts of the country

Bhaktapur District is the smallest district based on the land area of Nepal. According to report of District Forest Office (DFO), Bhaktapur for the fiscal year 2064/65 the total number of community forests in the district was 56, mentioning that about 8384households and approximately 19 % of the total populations of the district are involved in community forestry activities. Similarly, approximately 1832.4 hectares of forest area out of 1994.7 hectares of total forest area has been handed over to the local communities as community forest. Around 1923.79 hectors (14.44 % of the total land) covers forest land. 58 community forests have been handed over to the consumer groups. The forest land is also the source of anti-wood production such as Sugandhwal, Sunakhari, Timur, Gurjo, Laikopodiyam, Dhasingare and Nigalo. Bhakatpur has one religious forest, one leased forest and two private forests. The forest of Chittapol provides huge trunks necessary for Lingo Uthaune Jatra (Pole-raising festival) in Kathmandu, Bhaktapur and Lalitpur. Telkot, Nagarkot, Bageshwori, Sipadol and Suryavinayak forest are considered as important habitat for wildlife (DFO, 2016)

Though the community forestry program was initiated in 1978 on the ground of rapid decline of forest area and biodiversity (Shrestha et al., 2010), it has been practicing since two decades after commencement of master plan of Forestry Sector in Nepal 1988 and as a result the Forest Act 1993 (Laghu, 2009). Thus the community forest in Bhaktapur which is about 56 in numbers, are in progress condition in which some of the secondary forest is increasing simultaneously and the primary forest are in reserved area from where local peoples are restricted to use for household purposes. It is assumed that due to success of CF, the number of leopard is increasing significantly (Ghimire, 2006; Thapa, 2011). But because of small size of the forest, isolation and presence of various disturbances threaten to the survival of leopard in the habitat which was primary and residential previously (Sanie, 2011).

1.1.3 Conservation status of Leopard

Globally leopards are near threatened and nationally they are vulnerable under criterion D based on a population suspected to consist of fewer than 1,000 mature individuals (Jnawali et al., 2011; Thapa, 2014) and get killed for socio-economic reasons, as their demand for bones and skin is high (Bailey, 1993) and poached for their body parts (Hunter et al., 2003). The leopard is listed in Appendix I in the Convention on International Trade in Endangered Species (CITES) which prohibits trade of leopard or its body parts, and is protected under national legislation throughout most of their range. Leopard is not listed under the protected mammal of Nepal under the Department of National Parks and Wildlife Conservation Act 1973 (DNPWC 1973), but included as a susceptible mammal in National Red Data Book (NRDB, 1995).

1.2 Statement of the problem

Leopards are the serious problem to people and their livestock in Bhaktapur (Gosai *et al.*, 2014). Understanding about leopard and its ecological pattern in human use area is poor. The status of Leopard in Bhaktapur is uncertain. The forest areas of Bhaktapur are isolated and fragmented considering the occurrence of predator and preys and their activities as conflict. However limited studies have been carried out of certain forest areas of Bhaktapur. Most studies are belonging to the human-leopard conflict; neither has done on the status of leopard in Bhaktapur. There are some reports on the human leopard conflict where the mortality of leopard, livestock depredation and injury of human has been frequently occurred in area where the human settlement is thick. Despite of materialistic development the leopard enter into the village close to the forest and suburb that happen interface between people and animal. It is obvious that no any true wilderness is left behind the human influenced. But the nature especially corridor is declining due to social activities of human. The leopard itself is the strong mammal acts as the top predator of forest maintaining the ecosystem. Due to tourism development, the rural area of the district is facing populated densely that compelled to deforest trees. Moreover people might hunt the prey species for different purposes are a problem for the occurrence

of leopard. Thus, the conservation of carnivores becomes an important consideration in the discipline of conservation biology (Ginsberg, 2001).

1.3 Objectives

1.3.1 General Objectives

- To assess the status of common leopard in the forest areas of Bhaktapur district.

1.3.2 Specific objectives:

- To determine the most essential correlated ecological factor with the leopard's presence in the isolated forest of Bhaktapur district.
- To document the visit of leopard and human-leopard conflict at the periphery of the forest patches of Bhaktapur.
- To explore the local perception towards the leopard and its conservation.

1.4 Limitation

- ✓ Due to the slope area the ecological study was difficult to note down.
- ✓ The Pugmark and scat of leopard could not be observed due to the rainy time during field work.

2. LITERATURE REVIEWS

Twenty first century is the era of materialistic development where yearly new technologies are invented for the luxurious human life either deforesting or conserving the isolated and fragmented natural habitat. Consequently the anthropogenic activities are very wide influencing on the habitat of wildlife. At global scenario, human activities such as expansion of settlement, habitat loss, fragmentation, land use transformation, depletion of natural prey are occurring. Poaching and retaliation killing were greatest threat for carnivores (Nowell and Jackson, 1996; Thapa, 2011). Despite having such threat leopard is still most adaptable cats. Where other less adaptive cats are in verge of extinction, however leopard's ecological adaptation made them to survive in an area where there is a change in land use pattern (Marker and Dickman, 2005 and Kumar, 2011).

Large mammalian carnivores are threatened by anthropogenic environmental impacts particularly through habitat loss which often cause population declines. Swanepoel (2013) suggested that the suitability of leopard depends on the maintaining dispersal routes between areas with suitable habitat. Maharjun (2016) indicated that the settlement area, forest, bush, sparse forest and roads are some important environmental variables which have been deliberately chosen by leopard.

Athreya et al. (2007) stated that increasing population of leopard outside the forest in certain areas, accompanied by a large number of attacks on people showed the high density, was attributed on declining natural habitats and prey species, and preyed on feral domestic animals in huge number. The frequently sighted leopard cubs in agricultural fields indicated rising of the number of leopard.

Karanth et al. (2004) explained that carnivore density is known to be independent on prey density. Conflict tend to increase during periods of drought or when the leopard's natural preys became scare. A study conducted by Koirala et al. (2012) on human-leopard conflict in Annapurna Conservation Area of Nepal concluded that leopard killed more livestock than any other predators. The majority of the local people expressed strongly negative views toward conservation of the leopard.

Thapa (2011) showed the activity of leopard was found to be slightly higher during the night time about 52% both males and females were found to be crepuscular more active between 16:00 -22:00 hours, and they both ate nocturnal close to forest edge and points of disturbance. Leopard need some sort of cover to minimize kleptoparasitism (Kleptomania) by keeping carcass in trees, caves and large burrows or dragging them into dense vegetation reported by Sunquist and Sunquist (2002) adding leopard prefer to hunt in the area with intermediate cover level and where preys were easier to catch rather than where preys were more abundant reported Blame et al (2007).

Generally the leopards are most active between sunset and sunrise, and kill more prey at this time (Hamilton 1976, Bailey 1993). Livestock were killed by leopard at night (53%) whereas 47% killed during day from grazing grounds in nearby villages (Thapa, 2011).

Similarly, leopards are known to be bold and are commonly found in the proximity of human settlement, where they could prey upon livestock (Odden and Wegge 2005). Thus the conflict in terms of livestock depredation can be expected high in human settlement with livestock holding (Bailey 1993; Athreya 2006). In the study of Persian leopard's habitat the study reported that leopard has negative impact of the highway due to road accident and frequent casualty that likely restricts the movement of the Persian leopard (Erfanian, 2013).

Sanei (2011) documented that the forest converted to highway, housing areas and other land uses causing the low density of leopards due to small size of habitat despite of the availability of prey species. It is suggested that minimum four individuals survived in 1411ha protected area of Malaysia (Ayer Hitam Forest Reserve in Selangor). The study by Thapa (2011) clearly indicated that the leopard habitat use was affected by the human disturbance where leopard photo were not captured proportionally and the distribution was determined in less than 1km of distance from jungle and from water sources from all camera trap locations having low disturbance had been found of more availability and use of habitat of leopard. Long term survival of leopard population in the area is threatened due to small size of the forest, isolation and presence of various disturbances in the habitat. However, for large scale survey sign base indices along the forest trail is easiest and less expensive way to search sign of animals such as their tracks, scats or other signs (Kumar, 2011).

Understanding the interaction between human and leopard is important which is due to association with similar ecological features as well as with capture/removals of leopards. The extensions of vegetation cover -including irrigated croplands, rocky escarpments, and prey base in the form of feral and free-ranging dogs. Among 56 cases of leopard removals reported in Southern India, 91% did not involve human attacks, but followed livestock predation or only leopard sightings. The lack of knowledge on leopard ecology in human-use areas has resulted in unscientific interventions, which could aggravate the problem rather than mitigating it. The presence of resident, breeding leopards in human-use areas made let to propose a shift in management focus, from current reactive practices like removal and translocation of leopards, to proactive measures that ensure safety of human lives and livelihoods (Athreya, 2015).

Contribution of prey species more found to be on wild ungulates (Achyut 2009; Thapa 2011) followed by domestic mammals, birds, rodents and primates (Thapa, 2011). Leopards feed on small sized to medium- sized ungulates, but have varied diet including fish, reptiles, birds and mammals (Andrew and Hayseen, 2013). According to Karanth (1995) the average weight killed by leopard was 37.6kg and 45.4% by Eliasson (2003) found in his study in Royal Bardia National Park (RBNP), in case of leopard's diet where found to the composition of smaller chital, monkeys, smaller domestic and small wild mammals constituted their main prey in all seasons, with wild boar and birds as other important prey in the dry season. Bista (2016) found barking deer, primates, dogs, goats, cow, rodents and birds in the diet of leopard of Shivapuri Nagarjun National Park,

whereas dogs were high preferential in two years. In addition, during four year (2005-2009) data on depredation revealed that 230 heads of livestock were killed by leopard (Thapa, 2011).

In Nepal, till now detail status of leopard is not known yet. However, according to shah *et al.*, (2004) the distribution range has been suggested for 73 districts out of 75 districts except Okhaldhunga and Dhanusha which was based on sighting report, local views, news and literature including book, published and unpublished report. It was found that leopards frequently visit to densely populate urban areas like Kathmandu valley, Pokhara and elsewhere in Nepal (Shah *et al.*, 2004). Similarly the study conducted by Ghimire (2006) to know the status of common leopard in Kunjo VDC of Mustang district, Nepal indicating many evidences such as pugmark, scats and scraps from which concluded the presence of common leopard in that area and he reported that 39.46% local people agree that the leopard acts as a supportive to the tourism development, ecological balance, biodiversity conservation etc. while 30.26% people think that there are no benefits of leopard.

Swanepoel (2015) studied the comparative study on the estimation of densities of leopard across different land use types of protected as well as non-protected (matrix of commercial game and livestock farm) resulting the similar densities across the three sites and suggested that dense leopard can harbor in non-protected area therefore leopard management should not be neglected. Annual home ranges of the two males in the study conducted by Odden and Wegge (2005) in RBNP, Nepal found to be 47 and 48 km² and had an overlap of only 7%, whereas the overlap between the female's home range (17 km²) and that of one of the males was 56%. The movement data recorded by Grassman (1999) indicated that leopards occupied overall home range sizes of 8.8 to 18.0 km², the mean daily movement was found to be 1.95 km, and exhibited arrhythmic activity dominated by nocturnal and crepuscular tendencies in the last five years in the mid-hills including Annapurna Conservation Area (Aryal 2003).

Gosai *et al.* (2014) reported in the study of human urban wildlife conflict in Bhaktapur that 40% of livestock was lost due to wildlife whereas six people had been killed by leopard within the year of 2011-2014 indicating the inclination of the conflict of human-leopard in human dominated landscape.

Similarly, according to Thapa (2011) in his study of Chitwan National Park, of the total, majority of local people (65% or) expressed a positive perception toward the conservation of leopard of CNP. Reasons for positive perception can be categorized as importance of this felid species in the natural ecosystem; economy due to tourism and recreation; aesthetic and religion/cultural. The majority (44%) of livestock kill by leopard occurred during monsoon season followed by winter (33%) and summer (23%). Higher proportion (72%) people liked leopard in case of Kathmandu valley by (Thapa, 2015) and he documented the majority (45.45%) of livestock depredation by leopard occurred during winter season followed by rainy (27.27%), summer (18.18%) and autumn (9.1%). Cow

and dog were depredated in all season. However no goat was depredated during autumn season. According to the study of Pokharel (2015) the leopard encountered is high during the winter season followed by rainy season.

Population of leopard declined significantly in most of the African continent because of the value of the beautiful spotted pelts reported by Angelili, (1998). Similarly, Retaliatory killing occurs across the leopard range, but it is correlated with human attacks and livestock depredation (Shah *et al.* 2004). Thapa (2014) stated that 65% percent of all mortality death was human induced. Retaliation (31%) and lethal control (20%) of leopards involved in conflicts with human were the most prevalent sources of human-caused mortality. Other sources included poaching (n=4) and collisions with vehicles (n=3). Thirty five percent of total recorded deaths were possibly occurred due to natural causes. Retaliatory killing in response to livestock depredation and human attack was the most important cause of mortality for adult and sub-adult leopards.

Due to its flexibility and wide spread character there is no approach of the specific management strategy for its conservation where leopards are surviving in considerable conflict with people outside the protected area according to Shrestha (2015). So for the mitigation, the conflict-mitigation program stress to urgency to initiate actions to rise up the number of leopard in non- protected area stated by Swanepoel (2014) and maintaining the habitat corridor (Swanepoel, 2013). In recent years through community forestry programs and plantations, the habitat is getting restored in many parts of the country which become a temporary hiding places for leopard and cannot support the prey species revealing increased level of human- leopard conflict thus human conflicts are increasing in many parts of the country (Thapa, 2011). According to Gurung (2008), successful habitat restoration measures through effective management of buffer zone and corridors have provided additional habitats for wild animal species in CNP creating habitat heterogeneity.

3. MATERIALS AND METHODS

3.1 Study area

3.1.1 Location

Bhaktapur is the smallest district of Nepal and a part of Kathmandu Valley, which occupies an area of 119 km². It is located in the region between the northern latitude of 27°36'-27°44' and the eastern longitude of 85°21'-85°32'. The length of east-west of this district is 16 km. The altitude ranges from 1,331 to 2,191m above the sea level. The district is surrounded by Kavrepalanchowk in east, Kathmandu in west and north and Lalitpur district in south (CBS, 2011).

3.1.2 Geographical Features

The highest peak of the district is Nagarkot. The geographical features of the district are almost same as that of Kathmandu and Lalitpur district, the two other districts of Kathmandu valley where hill areas and valley floor are divided. The entire eastern region and nearly half of the northern and southern region of district is covered with hills, which are part of the Mahabharata range. The valley lies at the central and eastern part of the district which is the remnant part of lake so it has highly productive soil. The topography of Bhaktapur is with high hills in east and low land in west respectively thus the origin of rivers is east hills. Besides a host of small streams, there are some major rivers; Manohara, Hanumante, Tabyakhusi, Mahadev Khola, Khasang khusung and Ghatte khola (DFO, 2016)

3.1.3 Climate

The prominent feature of Bhaktapur is warm temperate climate. The general climatic condition is cold in winter and hot in summer with average minimum temperature of -2°C and average maximum temperature is 35°C with average rainfall 56 mm. Summer falls between Chaitra and Asoj and the winter between Ashoj and Falgun. The climatic condition varies to a greater extent in view of several geographical factors. Monsoon wind flowing from Indian Ocean causes in the rainy season and the wind flowing from Equatorial Ocean causes negligible rain in winter. The district falls under the subtropical climatic region where the climate is fairly pleasant, generally rainy season starts in June and ends in September, average precipitation is 1400 mm. (CBS, 2011).

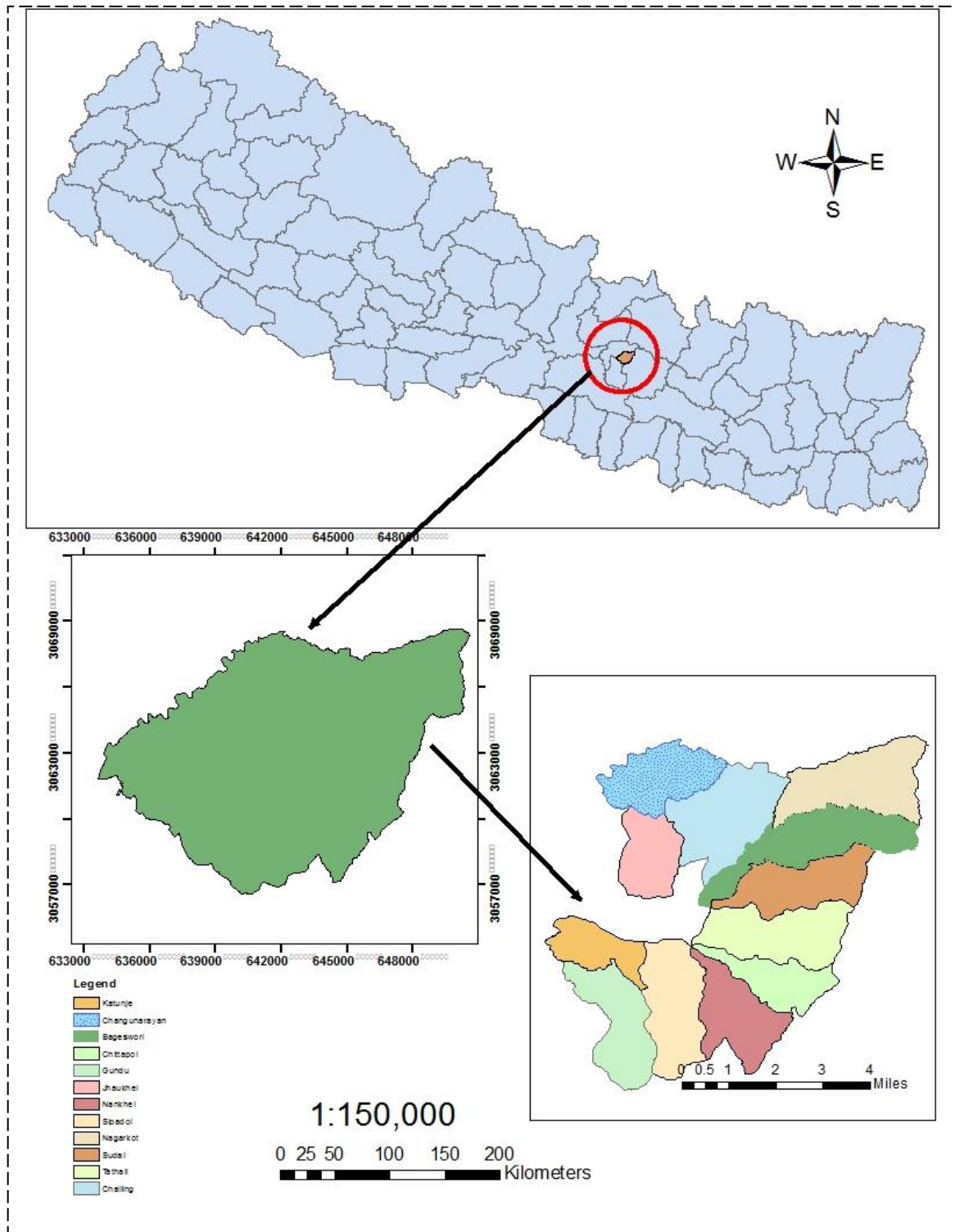


Figure 1 Map of study area

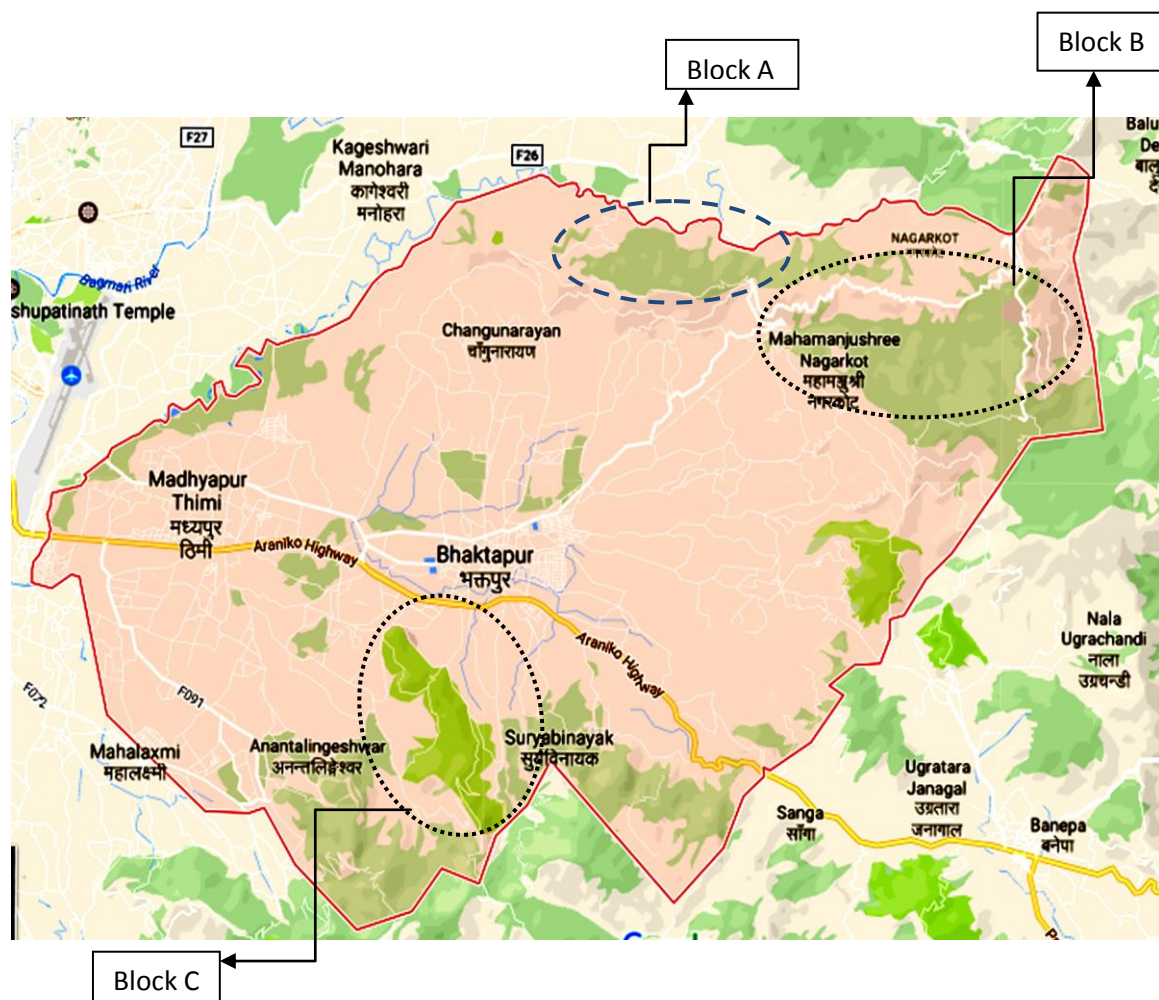


Figure 2 Map showing different study blocks

3.1.4 Flora

The district has subtropical and mainly temperate forest with enormous greenery. Local plant species like Chilaune (*Schima wallichii*), Katus (*Castanopsis indica*), salla (*Pinus roxburghii*), and Uttis (*Alnus nepalensis*) dominate the forest and agricultural land. Other plant species found are Seti kath *Myrsine capitellate*, Kaphal *Myrica esculenta* (IEE, 2010), *Buddleja asiatica* (Bhimsen pati), *Litsea monopelata* (Kutmiro), *Ficus semicordata* (Kanyu), *Lindera neesiana* (Siltimur), *Fraxinus floribunda* (Lankuri), *Prunus cerasoides* (Painyu), *Ficus religiosa* (Pipal), *Choerospondias axillaris* (Lapsi), *Bahunia purpurea* (Tanki), *Bahunia variegata* (Koiralo), *Albizia labbeck* (Sirish), *Bassia latifolia* (Mauwa), *Pisidium guyava* (Amba), *Saurauia nepaulensis* (Gogan), *Drepanostachyum intermedium* (Nigalo), *Dendrocalamus strictus* (Bans), *Maesa chisia* (Bilaune), *Urtica dioica* (Sisnoo), *Vitex negundo* (Simali), *Lyonia ovaliforiya* (Angeri), *Woodfodia fruticosa* (Dhangeri). The main NTFP species found are *Lindera neesiana* (Siltimur), *Asparagus racemosus* (Kurilo), *Azadirachta indica* (Neem), *Gaultheria fragrantissima* (Dhasingare), *Solanum surattense* (Kantakari), and *Rubia manjith* (Majitho) (CCPL, 2010)

3.1.5. Fauna

Though it is a small district comprises of many wild animals. Also because of the surrounding by Mahabharat range, it becomes a beautiful home for wild species. The major faunas found are: Chinese Pangolin (*Manis pendactyla*), Barking deer (*Muntiacus muntjack*), Leopard (*Panthera pardus*), Leopard cat (*Felis bengalensis*), Jackal (*Canis aureus*), Porcupine (*Hystrix spp.*), Hare (*Lepus spp.*), Yellow Throaten Martin, Squirrels (*Dremomys lokriah*), Wild boar (*Sus scrofa*) and so on. Bird diversity includes Kalij (*Lophura spp.*), Parakeet (*Psittacula spp.*) Titra (*Francolinus spp.*), Bulbul (*Pycnonotus cafer*), wildfowl etc according to the report of DFO of the fiscal year 2071/72. Similarly, Small Indian Mongoose (*Herpestes aurupunctuatus*), Orange-Bellied Himalayan Squirrel (*Dremomys lokriah*), Rhesus Macaque (*Maccaca mullata*), field rat (*Bandicota maxima*), Indian flying fox (*Pteropus gangeteus*), Shrew (*Sorex sp*), *Rhinoliphus spp.* etc. (Gosai *et al.*, 2014)

3.1.6 Land Use

The land of Bhaktapur district is suit for agriculture where about 80% of land of is suitable for agriculture; irrigated paddy production is dominant, in terraces up the slopes (CBS, 2001). Out of 11,900 hectares of land in Bhaktapur, 11,106 hectares of land is suitable for agriculture but only 8,077 hectares has been cultivated. 2,620 hectares of land is irrigated round the year whereas the land that has partial irrigation facility is about 3,271 hectares. The land without irrigation facility is about 2,186 hectares. The land use for agriculture found to be 102.4km², forest land is 21.2 km², shrubs is 1.62 km², settlement is 2.10 km² while other is 0.06 km² (DDC, 2015).

3.1.7 Population and occupation of Bhaktapur district

Total population of Bhaktapur is 3,03,027 out of which 1,54,006 (50.82%) are males and 1,49,021 (49.18%) are females. 9,701 males and 2,113 females have been migrated to foreign. The annual population growth is 2.96% with population grown by 34% in a decade. A total of 73,084 families reside in 50,086 households. The average number of family members is 4.15 and the population density is 2,546 per km². 54.1 % of the total population resides in urban areas. The literacy rate of Bhaktapur is 69.25% of which males are 89.17% and females are 57.01% (DDC, 2014). Agricultural as a prime occupation with 65% and that vegetables, paddy, wheat and maize are major crops in Bhaktapur, which covered 28%, 26%, 21% and 12% of the total agricultural area in Bhaktapur, respectively. Bhaktapur is one of the supply centers for fresh vegetables to the Kathmandu markets (Pandey, 2011)

3.1.8. Livestock in the villages

Livestock is one of the main income sources for the people of near forest and community forest. Farmers have tamed the livestock basically for dairy production, rather than meat. Milk used for the famous curd (King Curd) also comes from the villages. There are four

livestock service centers, 7 sub-centres (under District Livestock Service Office), 1 livestock fertilization centre, 39 livestock farmers groups/committees, 39 dairy production cooperatives, 2 milk freezing centres, 6 milk processing industries and 11 livestock feed industries. Similarly, there are 10 hatchery industries, 24 livestock medicine stores, 2 private veterinary clinics and 124 trained rural livestock health activists (CBS, 2011).

3.1.9 Tourism Development

Bhaktapur district is one of the tourist destination of Nepal. Fifty-five-window Palace, Datatraya Temple, Nyatapole, and Bhairab Temple are some historical famous for tourists lie in urban whereas, Suryabinayak Temple, Doleshwor Mahadev Temple, Pilot Baba Temple and Nagarkot are the prominent tourist destinations of Bhaktapur spread in different countryside of Bhaktapur. Similarly, the huge Shiva statue of Chittapol, Pancha Mahalaxmi Temple, Saraswotikhel of Duwakot, Baghhiti of Bageshwori, stone-engraving of Tathali, Saraswoti Temple of Sudal, Asapureshwor of Sipadol and Ranikot of Gundu are other popular tourist destinations in rural areas. Tourists seem to have inclined to visit the suburban and rural areas too.

3.2 Materials

During the filed study the materials used were GPS, Interview sheet, Measuring tape, Camera, Notebook, Pen.

3.3 Methods

To study in the field the following methods were followed:

3.3.1 Reconnaissance survey

A reconnaissance survey was conducted before the initiation of the field work. Preliminary information about forest types, leopard's occurrence and conflict status was gathered through informal meeting with secretary of DFO, VDC secretary and local people. Such information was useful to design sampling framework. The reconnaissance of forest areas of Bhaktapur was conducted in the month of February 2016 to identify the affected area done by leopard and to gather some ecological information of different forest areas.

3.3.2 Data Collection

Data were collected by primary and secondary. The primary data were collected through the field visit and direct observation while secondary data were collected from the DFO and other unpublished papers.

3.3.2.1 Primary Data collection

Direct observation and field visit were carried out during the study field from where the following methods were followed:

3.3.2.1.1 Field Survey

a. Sampling Design

The study was conducted in three main forests and was divided into 3 blocks (A, B and C) each having different areas. Northern side as Block A, Eastern side as Block B and Southern side as Block C were chosen. Each block was the combination of different community forests.

Table 1: Total area of the survey blocks.

S N	Block name	Direction	Name of area	Total area (km ²)	Area used (km ²)
1	A	Northern side	Telkot Jungle	3.12	0.346
2	B	Northern east side	Nagarkot Jungle	6.79	0.625
3	C	Southern side	Suryavinayak Jungle	8.85	0.74

b. Transect layout

For designing transect, the resource map of the area was consulted. Thirteen transects in total were drawn on the basis of different habitats in the study area with longest transect as 750m and shortest being 190 m with an average length of 410 m. 5m on both sides of the transect was also observed for the signs of the leopard. 10 ×10m² quadrates were laid down for the vegetation analysis. The transect lying was purposive and covers the possible habitat. Human as well as animal trails were used as transects. Three transect were laid in block A, five in block B and five in block C. Different indirect signs and marks were recorded i.e. carcasses, scats, pugmarks etc. The locations where the marks are found were noted with GPS.

c. Ecological parameters

For ecological data, the study sites were visited in three different forest areas of different direction of study area in the month of April and May. Within the study area, I surveyed three selected forest patches with primary and secondary vegetation. In the forest patches, among the most common environmental parameters in each forest site were recorded (1) distance from the settlement (DS), considering also the very small ones, if they are constantly occupied by people); (2) distance to the closest any water source (DW);, (3) number of vegetation strata (NVS), by checking for presence or absence of vegetation at

different heights from the ground: 1m, 2 m, 4 m, 8 m, 16 m; 32 m, (4) mean height (HT), and (40) Presence of preys (PP) (Angelici, 1997), (6) Canopy cover (CC) and (7) Ground Cover (GC) and density of trees (DT) for a detailed description of the methods. The distances of settlement and water resources were assessed through google earth. The parameters HT, CC, and GC were estimated while DT was carried out by measuring DBH of sampled trees. For all these parameters recorded was according to presence of leopard's sign (scat and carcass) and preys' evidences along with marking the GPS point. The geographic coordinates of the precise locations of the various surveyed sites and evidences were noted down by GPS.

3.3.2.1.2 Questionnaire Survey

The structure questionnaire survey was followed randomly with the local people. Based on preliminary survey villages adjoining to the forest were selected for questionnaire surveys. The more or less 100 meters around the forest area was selected to get the information on the conflict and activity patterns of leopard. About 128 questionnaires were carried out at the periphery of different patches or isolated community forests area namely Changu Narayan, Telkot Jungle, Nagarkot Jungle, Patle Ban and Suryavinayak forest area which are the reserved small fragmented forest area. Questionnaire survey was conducted using close ended having multiple options. This survey was conducted in last week of April to first week of June.

3.3.2.2 Secondary data collection

The information related to the occurrence of leopard was collected through different published and unpublished papers.

3.3.3 Data analysis

All the collected data were checked, refined and then entered in MS office Excel 2010 sheets. Data was assessed using descriptive statistics like mean, percentage and presenting in the form of chart, table form and bar diagram. Ecological data were analyzed using PCA tool in MS office Excel 2010. The conflict data were analyzed by using Poisson distribution in R package and chi square test in MS office Excel 2010.

4. RESULTS

4.1. Transect Survey

In total, 13 transects were conducted with the total length of 4.730km of transect length which gave evidences of common leopard's presence in the study area. In half (50%) of the transect observations, evidences of the presence of leopard in the area such as pugmarks, and scats were recorded. 54.81% of transects had leopard's sign whereas 62.05% had prey's sign. The details of all transects are given in table 2 and 3.

Table 2: Length of transect conducted in three blocks

Block Name	Common name of Dominant species	Scientific name of Dominant species
A	Chilaune	<i>Schima wallichii</i>
	Salla	<i>Pinus spp</i>
	Chilaune	<i>Schima wallichii</i>
B	Salla	<i>Pinus spp.</i>
	Utis	<i>Alnus nepalensis</i>
	Salla	<i>Pinus spp.</i>
	Simali	<i>Vitex negundo</i>
	Salla	<i>Pinus spp</i>
C	Chilaune	<i>Schima wallichii</i>
	Chilaune	<i>Schima wallichii</i>
	Katus	<i>Castanopsis indica</i>
	Salla	<i>Pinus spp.</i>
	Salla	<i>Pinus spp.</i>

There was found 12 signs of leopard in different transects. Among 13 transects only seven transects determined 12 signs of leopard in total distance of 2910m with average 4.12sign/km.

Table 3: Sign encounter of leopard in different transects.

SN	Transect no.	Sign of leopard
1	4	Scat
2	5	Pugmark
3	8	Pugmark
4	9	Scat and pugmark
5	10	Scat and scrape
6	12	Carcass and scat
7	13	Scat

Nine transects had direct and indirect signs of prey species. The average density of sign encountered of prey species found about 14.21 sign per km.

Table 4: Sign encountered of prey species in different transects.

Block	Transect no.	sign of preys	Observed no.
A	1	Sight of <i>Muntiacus muntjack</i>	1
	2	Pellets of <i>Muntiacus muntjack</i> Digging of <i>Sus scrofa</i>	3 3
B	5	Pellets of <i>Muntiacus muntjack</i> Bark biting by <i>Muntiacus muntjack</i> Sight of <i>Muntiacus muntjack</i> Burrow of <i>Manis pendactyla</i> Digging of <i>Sus scrofa</i>	5 1 1 4 2
	7	Pellets of <i>Sus scrofa</i>	2
C	9	<i>Lophura</i> sps seen	2
	10	Pellets of <i>Muntiacus muntjack</i> Burrow of <i>Manis pendactyla</i>	3 3
	11	Pellets of <i>Muntiacus muntjack</i>	2
	12	Pellets of <i>Muntiacus muntjack</i> Digging of the <i>Sus scrofa</i> Carcass of dog Burrows of <i>Manis pendactyla</i>	5 1 1 2
	13	Pellets of <i>Muntiacus muntjack</i>	6

During field study the following prey species were encountered directly in different forest areas of Bhaktapur randomly.

Table 5: Directly encounter of fauna in different blocks

Block	Fauna	No.
A	Barking deer (<i>Muntiacus muntjack</i>)	1
	Pheasant (<i>Lophura leucomelanos</i>)	2
B	Barking Deers (<i>Muntiacus muntjack</i>)	2
	Snake	1
	Pheasants (<i>Lophura leucomelanos</i>)	2
C	Barking Deer (<i>Muntiacus muntjack</i>)	1
	Pheasants (<i>Lophura leucomelanos</i>)	2
	Yellow Throaten Marten (<i>Martes flavigula</i>)	2

Ecological parameters

After surveyed study areas, the presence of leopard was confirmed in seven transects, whereas it is a possibility in other transects too. Scats, pugmark, scrapes and carcass were found in these sites with confirmed. The result showed that parameter distance to water (DW) and ground cover (GC) was significantly correlated ($r = 0.713$) while doing Principal Component Analysis which allowed to extract three factors. Ecological parameters which showed to be most essential related component for leopard's presence are CC, DW, and DT. The summary of the ecological data is as below:

Table 6: Summary of factors loaded.

	F1	F2	F3
Eigenvalue	2.889	2.054	1.208
Variability (%)	36.111	25.675	15.104
Cumulative %	36.111	61.786	76.890

\

Correlation value more than 0.4 were input to show the more importance where CC ranked the higher correlated followed by DW.

Table 7: Summary of factors loading with higher contribution variables

Parameters	F1	F2	F3
GC	-0.706	0.441	0.104
CC	0.846	0.417	-0.089
HT	0.682	-0.618	0.068
LDS	-0.349	-0.542	-0.568
LDW	0.355	0.790	-0.352
NVS	0.537	0.463	0.005
PPP	0.542	0.340	0.491
DT	0.494	-0.236	0.705

The selected ecological variables ground cover, distance from settlement, number of vegetation strata, and prey availability are other some less correlated variable in the habitat of leopard according to the result. More forest area more preferential to rest as the higher density of tree species has the higher potential in less human disturbance. In addition to this less distance to water bodies got more chance to the occurrence of leopard. Unlike DW, long distance from settlement (DS) is preferential habitat for resting leopard occurrence because the result shows negative correlation with presence of leopard.

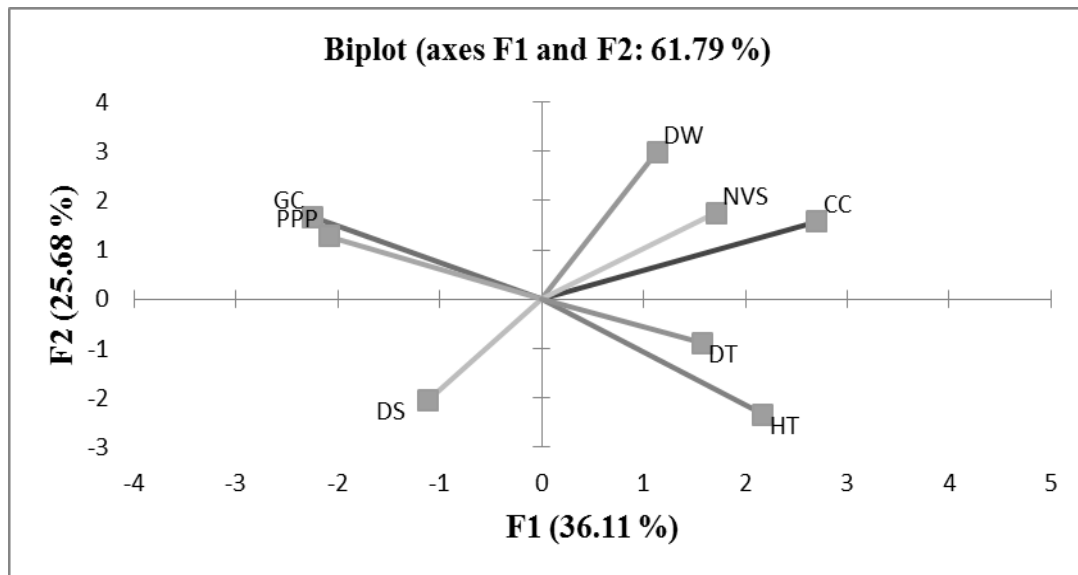


Figure 3: Correlation between variables and factors

Similarly the chi square test was used to analyzed result of the sign encounter of prey and predator among three blocks revealed that the densities between sampling sites (three blocks) were significantly different for encounter of sign ($F=5.38$, $df=2$, $P =0.0045$) which implied that more the forest area high density of the evidences of prey as well as predator.

4.2 Questionnaire survey

4.2.1 Status of respondents

Questionnaire survey was done at the periphery of forest edges of four main forest areas of Bhaktapur district. Among 128 respondents, 73 were male (57.03%) and 55 were female (42.97%). Mostly respondents were literate about 45.31% whereas 29.69% were illiterate. Very few of them were of higher education above SLC. The questionnaire was conducted from different aged people like 20-60 years above. Almost 68% of respondents primarily dependent on agriculture based occupation. Some of them involved in service and business as primary and also possessed land for agriculture. Some respondents answered clearly about the elusive cat and they have seen the leopard too, mostly encountered during morning time.

4.2.2 Presence of conflict

According to the questionnaire survey about half of the respondents faced the conflict in and around settlement area which are near the forest edges. 60 respondents (47.65%) said that the livestock was attacked by leopard so people said it as conflict whereas 28 of them (22.66%) viewed with absence of conflict but some responded as stray dogs and calves were become the victim of leopard. May be there was some problems of respondents of

not responding about the livestock and leopard interaction so about 12% did not say anything.

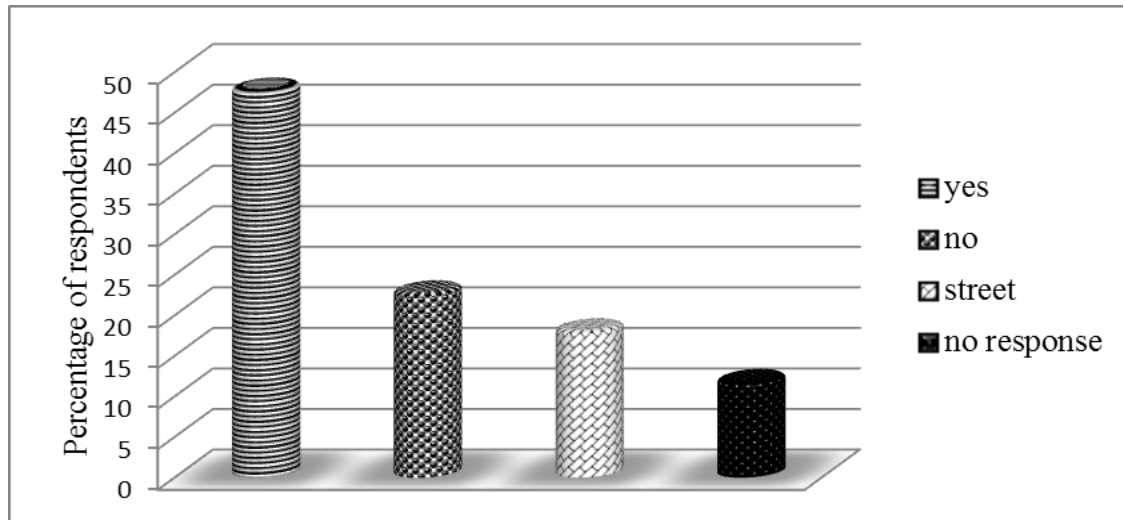


Figure 4: Number of respondents about presence and absence of conflict.

A Poisson distribution was used to analyze the data of conflict association with livestock and stray dogs. Estimated probability of prevalence of conflict was -2.127 ($P = 0.0086$). During my field there found less dogs in more conflicted area of leopard and more dogs in less conflicted nearby forest. Free ranging dogs (stray) were negatively associated with conflict which was -2.127 ($P = 0.033$) that inferred the reduction of chances of conflict on goat and other livestock.

4.2.3 Leopard encountered

Almost all the residential had heard the sound of leopard. Many of them had seen leopard and encountered in recent time in between 2070-2072 B.S. 44 respondents (34.375%) had seen leopard near the forest as well as settlement area, 56 respondents (43.75) had not seen but 21.875% had heard from other of leopard sight within two years.

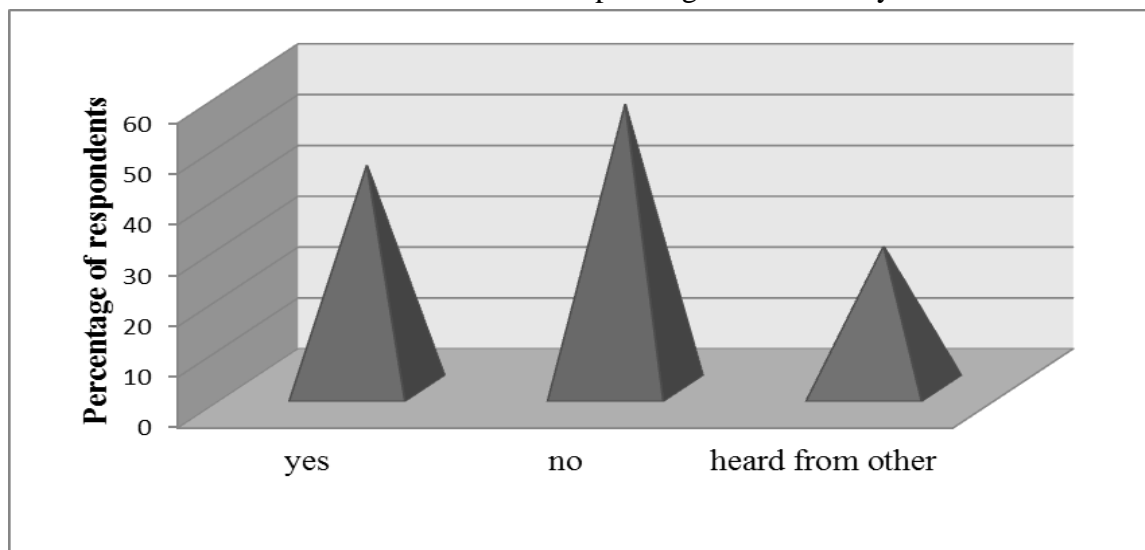


Figure 5: Percentage of respondents who have seen and unseen.

4.2.4 Information on leopard

The secondary data collected from DFO showed that the leopard came to different villages and interface between people. Data showed faced the retaliatory killed that implied the conflict on leopard. On the basis of questionnaire and report given by DFO, there were three cases of retaliatory killing on leopard by villagers after attacking to local people. Three cubs were rescued from Chhaling VDC by DFO but there were other two cubs in Nagarkot cared after villagers for one week according to questionnaire.

Table 8: Leopard rescued and killed by villagers

Condition of leopard	2070	2071	2072	VDC
Cub of leopard (rescued)	-	3	-	Chhaling-1
Adult female (dead)	-	1	-	Tathali -2
Adult (dead)	-	-	1	Bageswori-3
Adult (retaliatory killed)	1	-	-	Sipadol-1
Adult male (dead)	1	-	-	Sudal
Retaliatory killed	-	1	-	Changunarayan

(Source: DFO, 2015)

4.2.5 Seasonally leopard observation and livestock depredation

On the basis of survey, leopard visited and human interfaced the signs of it was highly in winter season. Direct sight or encounter and calling of leopard can be felt during winter in most of the places nearby forest patch and human settlement. But Nagarkot and Sipadol areas are the places where the roar of leopard can be heard almost all the season. 50% of respondents heard the calling while encounter rate was about 24.7%. Direct sighting or encounter rate was high during winter season followed by autumn about 46.37 % and 21.95% respectively.

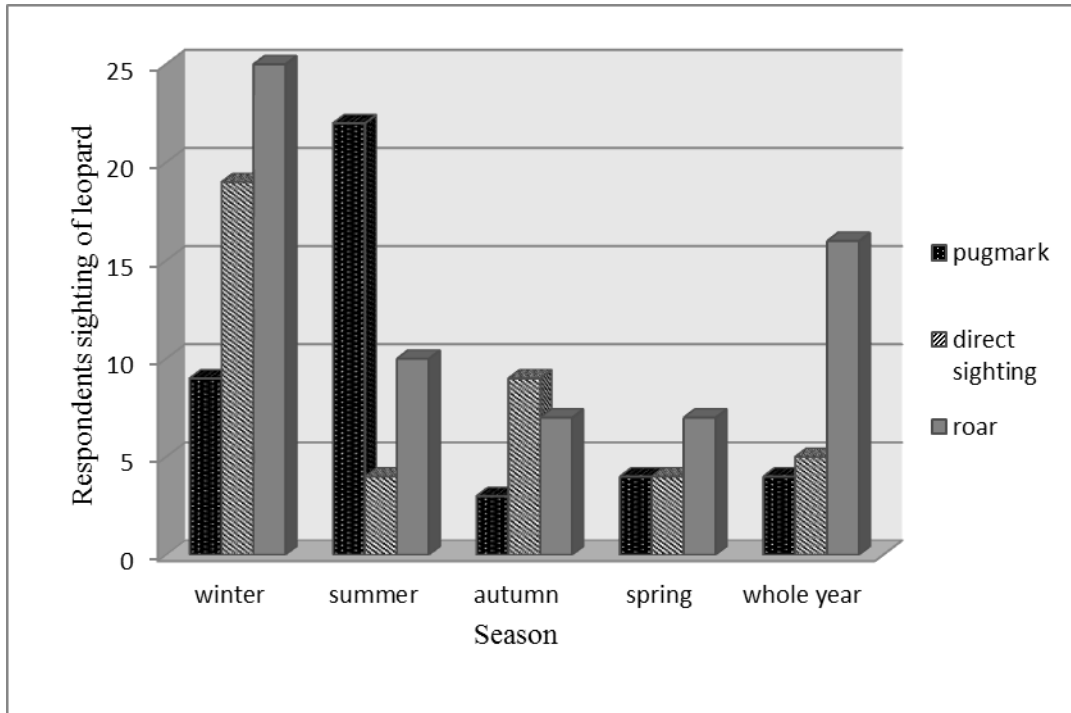


Figure 6: Direct and indirect sight of leopard

The people reared goat as a main domestic animal followed by cow, buffalo, dog and other cattle. Based on the questionnaire mean value of goats were 4.38, buffaloes were 1.24, cows 1.72, hens 2.8 and dogs 0.43 and other 0.04 were occurred currently. But the livestock depredation occurred mainly on goat. Altogether there was about 39 goats, 17 calves, 2 cows and 16 dogs were depredated within two years.

The majority of respondents noticed that winter season was more affected time for livestock. 56% of livestock was depredated by leopard during winter followed by autumn season about 20%, summer (17%) and spring (7%).

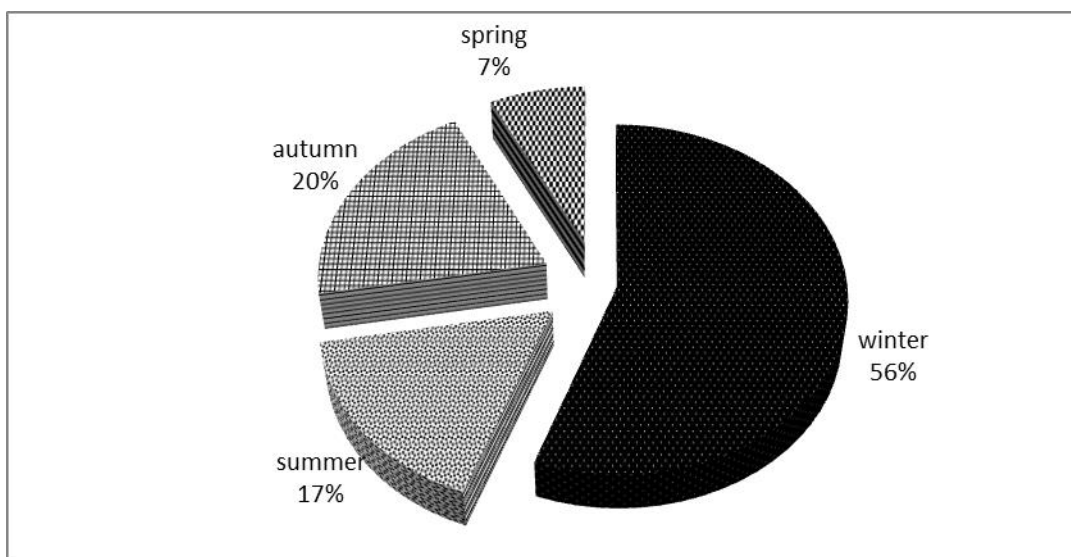


Figure 7: Seasonal variation of livestock depredation

Leopard usually could be seen at the time of evening and morning. According to the survey 44.75% of people encountered in the evening and about 34.2% seen in the morning about the depredation was mainly occurred during day time as goats were affected more while grazing at the day time inside the forest or near the forest. The day was more preferable for goat to leopard than evening. Night was preferential than morning especially for dogs and stray calves.

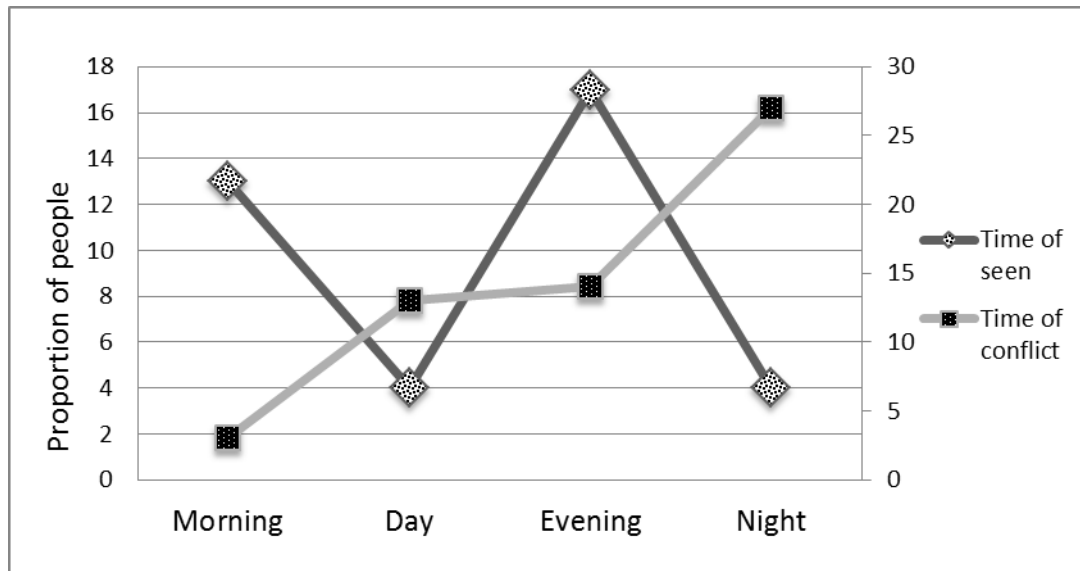


Figure 8: Showing the time of seen and conflict according to local.

4.2.6. Reason behind attack

According to the survey, 57% of respondents thought that the reason behind the predation was due to the human settlement near forest which is the habitat of wildlife. And 40% thought for predation only as there is less prey species while 3% thought due to habituation. Villagers living adjacent to forest used concrete wall for protection while 17% use nothing as husbandary practice due to which the predation on livestock usually occurred.

40 % of respondents tolerated killing livestock by leopard while grazing inside forest but 20% of depredated in open grazing place of village. The depredation period was at night 50% followed by evening and day because night time has less intense of light. From this study the darkness period of time was more affected. More attacked were occurred at night while there was no electricity.

4.2.7 High prevalence prey species conflict area

As per the study conducted on conflict, prey species like *Sus scrofa*, and *Muntiacus muntjack*, were more prevalence that effect to the crops cultivation. The season of potato, bean, yum, maize, soyabean etc. were more affected crops. 85% of affected respondents felt that a wild species *Sus scrofa* as curse and perception was totally negative towards this species.

Table: 9 Prey affected area

SN	Prey species	Highly affected area	Block near to affected area
1	<i>Sus scrofa</i>	Chhaling, Sipadol, Changunarayan, Bageswori, Nagarkot, Nankhel and Gundu	Block all
2	<i>Muntiacus muntjack</i>	Chittapol, Sipadol, Nankhel, Gundu	Block C

4.2.8 Local perception on leopard

The leopard visited in village very frequently in different area. Somewhere this report showed occasionally visit. In forest areas of Bhaktapur, 41% of respondents answered that leopard could be observed frequently, and very few people or about 17 % responded that leopard visited occasionally.

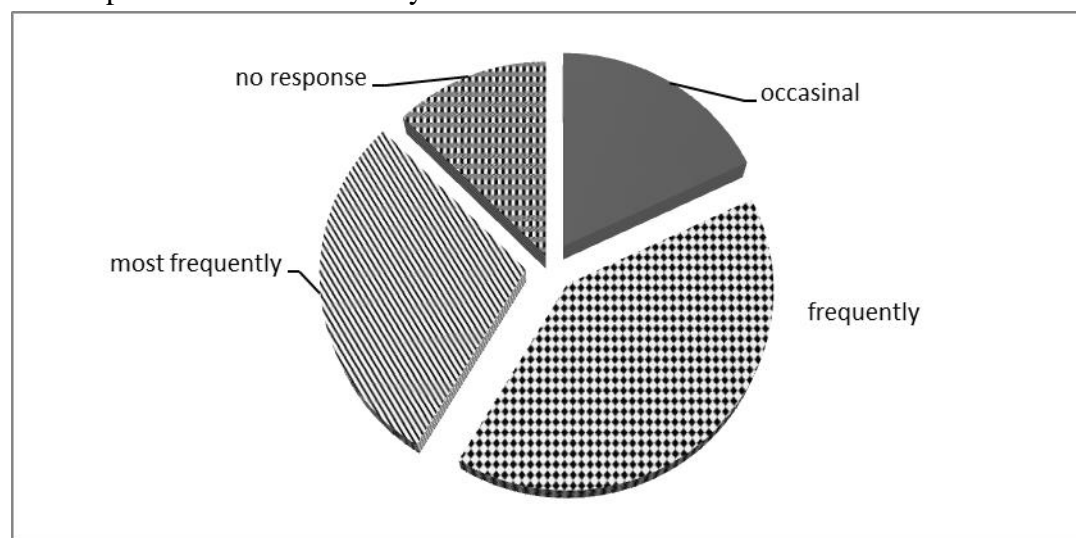


Figure 9: Local perception towards leopard and regarding

The population of leopard resulted as constant as previously. Out of 128 respondents, 44% of reported the number of leopard was neutral, 31% have felt in increasing trend, where 17% had no idea whether it is increasing or decreasing and very few of them reported as decreasing order may be due to population dominance, tourism development, fragmentation of forest area, or either decreasing of prey species.

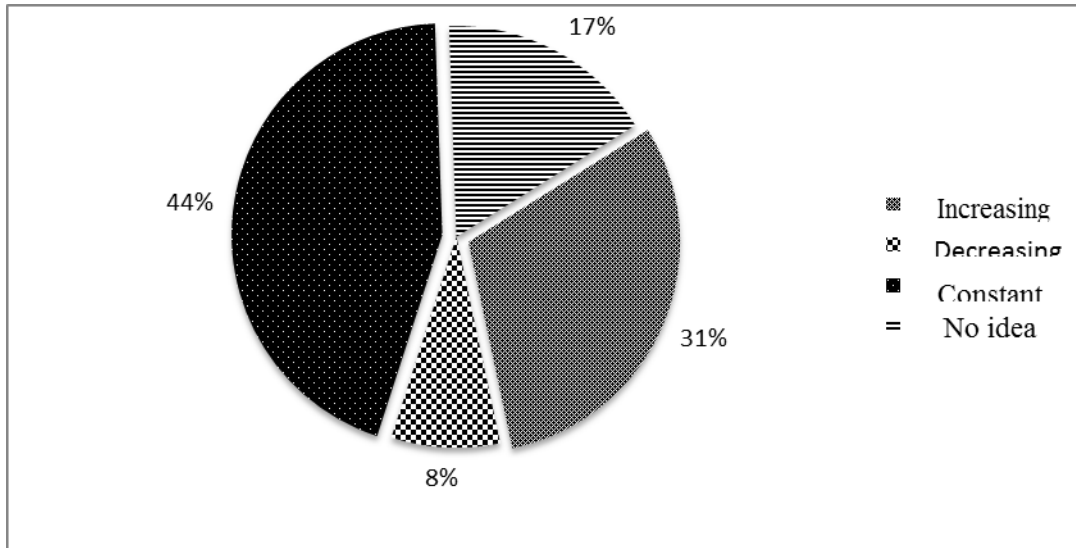


Figure 10: People's perception towards the population of leopard

Many of the respondents were agreed that the leopard must be protected. They have their own life and right to survive. After questionnaire, 26% had high positive view towards the conservation of the beautiful creature leopard where maximum of them were male respondents. And 56% respondents reported as positive only whereas 16% answered as no any benefit by conserving leopard.

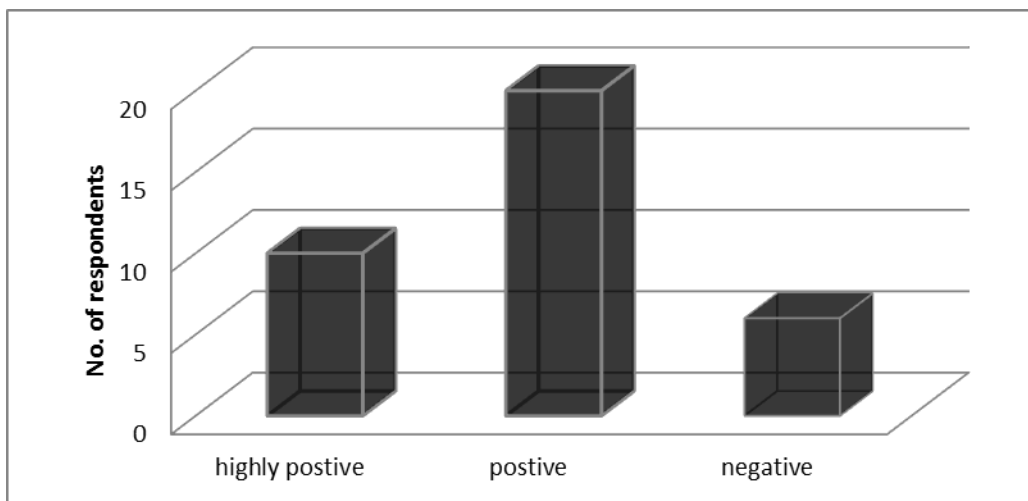


Figure 11: Conservation view of respondent.

5. DISCUSSION

5.1 Ecological parameters:

The total line transect of 4.73km shows the data of ecological parameters showed significantly correlated among the canopy cover, distance to water and density of tree species. Scat presence and absence in the forest area associating with the density of trees indicated that the mean density of trees was deemed to be nine stem per 100m². The result of correlation value 0.705 with cumulative percentage by 76.89 has shown that higher density of stem appraised more chance of leopard.

Water bodies are important for the wildlife. The correlation between the leopard presence and the variable distance to water bodies was positive ($r= 0.79$ and cumulative percent= 61.786) showing that distance between 100-200 meter or less was more preferential to occur.

Mostly Pine species dominated the forest area especially at high altitude of both Nagarkot and Telkot jungle with less canopy cover and supplement of meager number of vegetation strata and ground cover. High number of vegetation strata mostly occurred in abundance of ground cover as well as canopy cover except in Pine forest. Therefore more presence of scat was observed at more than 65% of canopy cover while ground cover with 40-55% along four number of vegetation which indicated that Pine forest is not suitable habitat for leopard.

Prey available found to be less important may be because of slope and difficult area with less forest area which was similar to the study of Blame *et al.* (2007). Therefore, prey density speculated not be an important factor for habitat selection by the leopards.

In addition to this likewise in the study of Thapa (2011) leopard was found to be sensitive to human disturbances showing approximately, 36% with no disturbance occasional (31%) and low (16%) level of disturbance, while remaining 16% with high and moderate level of disturbance which is the similar to this study as this study showed the negative correlation with occurrence of leopard with the distance to the settlement indicating less disturbance less chance to have leopard occurred for resting in the habitat. Further, less height of trees were prefer with high canopy cover as forest of Bhaktapur like Katus(*Castanopsis* spp) and (*Rhododendron* spp) etc. Whereas high trees seemed less in number except dominated *Pinus* forest which are maximum at the high level of almost all blocks but presence of less vegetation strata so the leopard did not prefer *Pinus* forest.

Based on the result the occurrence of leopard was correlated to canopy cover, density of trees, resembling the forest area is preferential to survival which is may be due to of ample survival of prey species as well as less disturbances. Angelici (1998) demonstrated the relationship of occurrence of leopard with the some ecological parameter like forest area, water sources and the abundances of Antelope and primate assuming that the

presence of preys in surrounding the water bodies. Despite of this the detection of leopard seems hard due to its extremely elusive behavior.

b. Leopard at the periphery of forest

Distribution of leopards was determined assessing sign survey. The sign encounter rate was estimated as 4.12 per km. On the basis of result more area of forest has more chance to encounter the sign of leopard. The variation could be related to the size of forest patch where C with more area has higher density than other blocks. The forest of Block A and B are near to Shivapuri National Park having least corridor to migrate whereas the southern side of forest (C) is attached with the large forest of Kavre and Godawari forest. This study showed that Block C has more forest area whereas Block A and B have less forest area with dominant of *Pinus* spp which help to reduce the water holding capacity (Prajapati, 2012) so that the sign was less in less canopy cover with greater mean height. It also indicated that number of vegetation strata is less in Pine forest that shows the less priority of rest by leopard and found to be more affected more conflicted VDCs of crop depredation by prey species as well as human leopard interface occurred frequently occurred.

Eventhough the distance from settlement was found negatively correlated with leopard activities, while questionnaire with local people they had seen leopard with two cubs in the road of near Telkot jungle, Nagarkot area and even Sipadol side which are human dominated areas, visiting freely which revealed that leopard became habituated with human. And according to local, leopard entered to settlement area at dusk in search of stray dogs and calves and returned back at dawn. Similar study by Ngoprasert *et al.* (2007) also revealed that leopard activities were negatively correlated with distance from the villages. Similar negative impact of settlements on leopards was reported in the Congo basin (Henschel, 2008). These implied that leopard compelled to migrate from one to other forest patch through human habitat. About 34% of villagers had sighted leopard because mostly villagers were farmer with more than 50% of respondents and lived at the adjacent of forest edges.

Athreya (2015) reported, 91% did not involve human attacks, but followed livestock predation or only leopard sightings. Currently study revealed that majority of local had seen this cat but few (four) incidences (2 men and 2 women) were injured by leopard within two year on human and more conflict on livestock. But recently news media reported that children and women become the victims of leopard in Baitadi (Onlinekhabar.com) due to the fragmentation and lack of prey species.

Result of Poison distribution analysis revealed that the dog is important prey factor for leopard than wild or other cattle. Moreover leopard presence was facilitated by extent of vegetative cover- including irrigated croplands, rocky escarpments, and prey base in the form of feral and free-ranging dogs and calves. Higher probabilities of livestock/human attack by leopards were associated with similar ecological features like water bodies. The case study of Thapa (2011) reported the major season was monsoon for leopard but Thapa

(2015) documented winter was more effected and then monsoon season, preferentially preyed upon goats and followed by dogs as diet. Even this study implied the winter season has prevalence of more encounter of prey species even in the open area affecting the local crops cultivation which showed that the leopard is more sighted or conflicted on human dominance landscape during winter and this is because of low intensity of light as light or electricity plays significant role in predation on livestock. Less light more chance of conflict especially near the forest area. Current study implied the encounter rate was found to be high during winter season about 46.34% and low during summer about 9.76% unlikely the documentation of Pokharel (2015) which showed high prevalence in summer (60%). It is because the winter season is dry season with less grass in cultivated land so the herders use to graze their cattle to near or inside the forest area. According to the local people high encounter prevalence during winter was may be due to the cold temperature at the high altitude so leopard might be visited to the open place of human habitat with less sloppy to feed free ranging dogs or calves and other accessible prey species at night and evening time. In addition the livestock depredated during winter and autumn because of lacking prey species in the forest area and increasing population of goats as herder usually make these ready for selling to the market as autumn is the festive season of Hindu.

When encounter rate of wild prey in study area was remarkably lower. Unlike tarai and chure forest supporting with favorable vegetation for wild ungulates, forests of Bhaktapur have less supportive because beside Suryavinayak forest area other two areas have *Pinus* spp as dominant at the peak especially while at the base *Shicma* spp and *Castanopsis* spp and *Rhododendron* spp are dominant. Due to *Pinus* spp dominancy the other vegetation like herbs and shrubs do not let them grow. So this kind of vegetation is high in the forest area of Bhaktapur that do not allow maintaining high herbivore population as that in terai. Availability of suitable prey species determined the habitat of carnivore leopard (Blame, 2007). The leopard prefers habitat type of agricultural land to bush and forest as these areas have greater affinity towards prey base that serves as food for them (Maharjun, 2015). Agricultural land has gentle slope and easy to attack preys due to less requirement of effort. Based on the result of this study winter monsoon season had more vegetation and crops like maize were planted which got leopard to hide and easily capture to prey like goat. Normally goats were grazed in or around the forest edges so become victim of leopard. In addition to this the grazing of livestock usually done during day time about 10:00-16:00 hours thus attack to them. In my study the day and evening time was more effected for livestock like goats and then night for either domestic or free-ranging dogs. Almost all the villagers were aware and applied the precaution as they have made the concrete cowshed or closed shelf to protect livestock. Consequently the stray dogs and calves become victims of leopard at night time.

Many respondents were farmer, some were involved in job and others were doing small business. But majority of the people had livestock either for own benefit or commercial. Local people somehow depended on the grass of community forest especially during dry season but not allowed for daily household works. The living woods were strictly

prohibited to use for firewood. So the secondary forest is increasing year by year which is under control of government as a result the prey species may be increased due to suitable habitat and therefore the population of leopard might be increased. But this field resembled the constancy in population. In case of Kunjo VDC, the population of leopard increased as the community forest progressed by Ghimire (2006). In case of this field the population of leopard is perceived to be stable. Similar stability can be seen in the study of Thapa (2015). Despite this, local perception towards leopard was negative in Kunjo VDC some (30.26%) thought no any fruitful and 31.57% opined the supporting role for tourism development in ACAP, Mustang (Ghimire, 2006). Similarly Thapa (2011) figured out about 65% positive and Thapa (2015) reported 64% positive view on leopard conservation whereas this field study also revealed positive view (56%) and more positive about 26%. Very few of them considered as not beneficial on the basis of this study. Most of them had positive view as leopard balanced the ecosystem, maintain the biodiversity value and thinking of religious value. Negative perception perceives that locals could not tolerant their livestock depredation which is similar in this study too as perception of people towards leopard was positive about 56% but less viewed highly positive due to attacking to livestock and thought that leopard occurrence has no benefit. Many farmers did not have aware about the provision of compensation so some of them took leopard as a negative sign.

Though locals did not accept about hunting and poaching, there have been found retaliatory killed after attacking to human in Tathali and using the skin over body reported by Thapa (2015). There was a story of killing leopard and hunting preys like barking deer (*Muntiacus muntjack*), fowl (*Lophura* spp) and wild boar (*Sus Scrofa*) while visiting villages. Thapa (2014) reported retaliatory killing in response to livestock depredation and human attacks has been the most important cause of mortality for leopards. Retaliatory killing occurs across the leopard range, but it is correlated with human attacks and livestock depredation (Shah *et al.* 2004). Within two years there found to be dead leopard and rescued leopard in the villages which are near to forest as well as human dominated place according to the report of DFO. As per this study found the report from DFO and questionnaire, three cases were of retaliatory killing of leopard in Sipadol, Chhaling and Tathali villages. These cases were happened after attacking to people.

The field study was a famous as well as tourism destination places, so the habitat fragmentation, deforestation of primary forest like of Suryavinayak, road construction, crowds of people, sophisticate life style are in progress, so these can be said as thrive to leopard. Among them habitat destruction is one of the very important factors that is having a negative impact on the survival of the species. Road construction and deforestation are some of the factors which are contributing negatively to the habitat destruction of common leopard according to Thapa (2011). Major human activity inside the park was tourism (presence of tourists and concessionaire hotels) and patrolling by conservation staff (park staff and Army protection force).

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

The ecological data showed that there is association of the occurrence of leopard in forest area with distance to water bodies, canopy cover and trees density as essential factors. Besides, ground cover, presence of prey species and human settlement intensification have less correlated implying the habituation of leopard in human dominance. The informal discussion with key persons, questionnaire to local people and transect showed the presence of leopard in the area in a very good way. The sign observation in Suryavinayak and Nagarkot area provided the fruitful results. The signs of prey species in three areas showed the suitable habitat for leopard because of the sufficient food due to success of secondary vegetation.

Forests of Bhaktapur are small patch and isolated from each other with less corridor management. Encounter and interaction have been occurred frequently in morning and evening which can be assumed two matters one leopard is returning after searching food from village and next is passing from one forest to another forest area using human habitat which clearly determined the requirement of sufficient and easy food and path to pass through. The contribution of livestock is varied from goat to dog and killed them in open area that simplified the less ground cover and less slop area is preferred to preyed. . Prey species like *Sus scrofa*, *Muntiacus muntjak*, *Lophurus* spp etc. are some of the important wild species found in forest to prey on, but due to high slope area wild species are not accessible unlike in tarai. Consequently leopard forced to come out from forest to predate on free ranging dogs.

But after all the analysis of the ecological correlation to the presence of leopard concluded that it is elusive and intrusive species which is migrated from one place to another in search of food in the human-use landscape. Because of the availability of free ranging dogs nearby forest or somehow far from forest it attacks dogs rather than goat because goats keep in close shed. Therefore, it can be say that goats become victim during day time while dogs become at night time.

The distribution of leopard is not definite and population might be stable as per the data collected and also can be concluded that the progressive of forest significantly increase the population of leopard.

5.2 Recommendations

- Database must be prepared and maintained on livestock loss, human attack and leopard mortality with compensation provision should be accessible for villagers.
- The way for passing and moving from one place to another must be monitored and establishment of suitable corridor without any disturbance. This could prevent the interaction and encountered.
- Conservation awareness program should be launch either formally especially for students focusing in curriculum of school or informally for villagers about role of species in food chain mentioning as predators of hilly region.

REFERENCES

- Adhikari, S., Shrestha, S.M., Singh, R., Upadhaya, S. and Stapp, J.R. 2016. Land Use Change at Sub-Watershed Level, Bhaktapur, Nepal. *Hydrology current Research*, **7**:3.
- Andheria, A.P., Karanth, K. U., & Kumar, N.S. (2007). Diet and prey profiles of three sympatric large carnivores in Bandipur Tiger Reserve, India. *Journal of Zoology*, **273**(2), 169–175.
- Angelici, F.M., Akani, G.C. & Luiselli, L. 1998. The leopard (*Panthera pardus*) in southeastern Nigeria: Status, ecological correlates of occurrence, and conservation implications, *Italian Journal of Zoology*, **65**(3):307-310.
- Athreya, V. (2006) Is relocation a viable management option for unwanted animals? The case of the leopard in India. *Conservation and Society*, **4**: 419–423.
- Athreya,V; Odden, M; Linnell, J.D.C; Krishnaswamy, J; and Karanth, U. 2013. Big Cats in Our Backyards: Persistence of Large Carnivores in a Human Dominated Landscape in India.
- Athreya, V., Srivathsa, A., Puri, M., Karanth, K., Kumar, N.S., and Karanth, K.U. (2015). Spotted in the News: Using Media Reports to Examine Leopard Distribution, Depredation, and Management Practices outside Protected Areas in Southern India.
- Bailey, T. N. 1993. *The African Leopard Ecology and Behavior of a Solitary Felid*. Columbia University Press, New York.
- Balme, G. A., Hunter, L., and Slotow. R. 2007. Feeding habitat selection by hunting leopards *Panthera pardus* in a woodland savanna: prey catchability versus abundance. *Animal Behaviour* **74**:589–598.
- Bhattacharai, B.R. (2009). *Human-Tiger (Panthera tigris tigris) conflict in Bardia National Park, Nepal*, MSc Thesis, Ernst Mortiz Arndt University of Greiswald, p. iii.
- Bista, A. 2016. Study on nature, extent and major causes of Human-Wildlife conflict in Kathmandu Valley. A report submitted to NTNC, Khumaltar, Kathmandu, Nepal.
- Bothma, J.D.P., Knight, M.H., Riche, E.A.N. and Van Hensbergen, E.A.N. 1997. Range size of Kalahari leopards. *South African Journal of Wildlife Research* **27**: 94-99.
- CBS. 2012. Central Bureau of Statistics, Government of Nepal National Planning Commission Secretariat, Kathmandu, Nepal. National Population and Housing Census 2011 (National report).**02**.

Cemeca Consultant (P.) Ltd. 2010. Initial Environmental Examination of Bhatkekopati-Jitpur- Mahamanjushree- Chareli- Kalamasi- Nagarkot Road Sub- Project Bhaktapur District, Nepal. Government of Nepal Ministry of Local Development.

Daniel, J.C. 1996. The leopard India: A Natural History. Natraj Publishers, Dehradun, 228p.

DDC, 2014. District profile analysis. District Development Committee, Bhaktapur, Nepal14.

Deo, R. 2014. Diet composition of common leopards in Bardia National Park and the adjacent buffer zones and habitat corridor in Nepal.

DFO. 2015. Annual report of fiscal year 2014/15 of Bhaktapur, Nepal.

DNPWC. 1973: Department of National Parks and Wildlife Conservation Act

Eliassen, T. 2003. Niche separation and food competition between tigers (*Panthera tigris*) and leopards (*Panthera pardus*) in Royal Bardia National Park, Nepal. An M.Sc thesis submitted to Agricultural University of Norway, Norway.

Erfanian, B., Mirkarimi, S.H., Mahini, A.S. & Rezaei, H.R. 2013. A presence-only habitat suitability model for Persian leopard *Panthera pardus saxicolor* in Golestan National Park, Iran. *Wildlife Biology* **19**: 170-178.

Gosai, K.R., Koju, N.P., Karmacharya. D.K. and Basukala, S. 2014. Conflict between Humans and urban Wild life in Bhaktapur. *The journal of University Grants Commission* **3**(1).

Grassman Jr. L.I. 1999. Ecology and behaviour of the Indochinese Leopard in Kean Kranchan National Park, Thailand. *Natural History Siam Society* **47**: 77-93.

Gurung, B. B. 2008. Ecological and sociological aspects of human-tiger conflicts in Chitwan National Park, Nepal. Ph. D. Thesis. University of Minnesota, USA.

Hamilton, P. H. 1976. The movements of leopards in Tsavo National Park, Kenya, as determined by radio-tracking. University of Nairobi.

Henschel, P. 2008. The conservation biology of the leopard *Panthera pardus* in Gabon: Status, threats and strategies for conservation. Ph. D Thesis, Georg-August-Universität zu Göttingen, Germany.

Henschel, P., Abernethy, K.A. and White. L.J.T. 2005. Leopard food habits in the Lope´ National Park, Gabon, Central Africa. *African Journal of Ecology* **43**:21–28.

Initial Environmental Examination. 2010. Conservation on establishment of zoological garden and recreational centre at Suryabinayak, Bhaktapur. A report submitted to National Trust for Nature.

Jackson, R.M. 1984. The snow leopard. The plight of the cats: Proceedings of the meeting and workshop of the IUCN/SSC Cat Specialist Group at Kanha National Park, Madhya Pradesh, India, 9-12 April 1984. Unpublished Report, pp. 197-198, IUCN/SSC Cat Specialist Group. Bougy, Switzerland.

Jacobson A.P., Gerngross P, Lemeris Jr. J.R., Schoonover R.F., Anco C, Breitenmoser-Würsten C, Durant S.M., Farhadinia M.S., et al. 2016. Leopard (*Panthera pardus*) : status, distribution, and the research efforts across its range.

Jnawali, S.R., Baral, H.S., Lee, S., Acharya, K.P., Upadhyay, G.P., Pandey, M. et al. 2011. The Status of Nepal Mammals: The National Red List Series, Department of National Parks and Wildlife Conservation Kathmandu, Nepal.

Karanth, K.U. and Sunquist, M.E. 2000. Behavioural correlates of predation by tiger (*Panthera tigris*), leopard (*Panthera pardus*) and dhole (*Cuon alpinus*) in Nagarhole, India. *Journal of Zoology*, **250**: 255–265.

Karki, J.B. and Rawal, G.S. 2014. Human-leopard conflict in Nepal: A case study from Baitadi district. Special issue DNPWC, pp 50-60.

Koirala, R.K., Aryal, A., Parajuli, A., & Raubenheimer, D. 2012. Human-common leopard (*Panthera pardus*) conflict in lower belt of Annapurna Conservation Area, Nepal.

KMTNC. 1998. Project proposal for Manaslu Conservation Area. The King Mahendra Trust for Nature Conservation, Lalitpur.

Kumar, D. 2011. Study of Leopard Menace, Food Habits and Habitat Parameters in Mandi District, Himachal Pradesh, thesis PhD, Saurashtra University, India.

Kumar, S. 2015. Behavioural Correlates of Predation by Tiger (*Panthera tigris*) & Leopard (*Panthera pardus*) in Corbett Tiger Reserve, Ramnagar UK. India. *International Journal of Science and Research (IJSR)*, Vol. 4.

Lamichhane, B.R., Kadariya, R., subedi, N and Dhakal, B.K., Dhakal, M., Thapa, K. and Acharya, K.P. 2016. Rusty-Spotted Cat: 12th Cat Species Discovered In Western Terai Of Nepal. *Catnews* **64**.

Liu S, Dong Y, Deng L, et al. 2014. Forest fragmentation and landscape connectivity change associated with road network extension and city expansion: A case study in the Lancang River Valley. *Ecological Indicators*, **36**:160–168.

Lovari, S., R. Boesil, I. Minder, N. Mucci, E. Randi, A. Dematteis and S.B. Ale. 2009. Restoring a keystone predator may endanger a prey species in a human-altered ecosystem: The return of the snow leopard to Sagarmatha National Park. *Animal Conservation* **12**: 559-570.

Maharjun, B. 2015. Geo-Spatial Analysis of Habitat Suitability for Common Leopard (*Panthera pardus*) in Shivapuri Nagarjun National Park, Nepal. Msc. thesis submitted to Kathmandu Forestry College (KAFCOL), Kathmandu, Nepal

Malviya, M. and Ramesh, K. 2015. Human-felid conflict in corridor habitat: Implication for tiger and leopard conservation in Terai Arc Landscape, India. *Human-wildlife Interaction* **9**(1):48-57.

Minnie, L., Boshoff, A.F. and Kerley G. I.H. 2015. Vegetation Type Influences Livestock Predation by Leopards: Implications for Conservation in Agro-Ecosystems. *African Journal of Wildlife Research* **45**: 204-214

Nowell, K. and P. Jackson. 1996. Wild Cats: Status Survey and Conservation Action Plan. IUCN/SSC Cat Specialist Group. IUCN, Gland, Switzerland.

Ngoprasert, D., Lynam, A. J. and. Gale, G.A. 2007. Human disturbance affects habitat use and behaviour of Asiatic leopard *Panthera pardus* in Kaeng Krachan National Park Thailand. *Oryx* **41**: 343– 351

NRDB. 1995. National Red Data Book, Biodiversity profile project, Technical publication No. 4. DNPWC, Ministry of Forest and soil conservation, His Majesty's government of Nepal, Kathmandu.

Odden, M. and P. Wegge. 2005. Spacing and activity patterns of leopards *Panthera pardus* in the Royal Bardia National Park, Nepal. *Wildlife Biology* **11**: 145-152.

Pandey, H and Pandey, P.R. 2011. Socio-economic Development through Agro- tourism: a case study of Bhaktapur, Nepal. *The Journal of agriculture and environment*. vol. **12**.

Pokharel, M. 2015. Human-Leopard conflict in the Kathmandu Valley, Nepal. Master Thesis. Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal.

Pokhrel, G.K. and Shah, K.B. 2008. Role of Community Forests in Faunal Diversity Conservation: A Case Study of Community Forests within Satbariya Range Post of Dang District. Nepal. *Journal of Science and Technology* **9**:111-117.

Prajapati, M., 2012. "Scope of Payment for Ecosystem Services Mechanism for better Water and Watershed management Bhaktapur. M.Sc. Thesis., Khwopa College, Tribhuvan University.

- Sanei, A. and Zakaria, M. 2011. Occupancy status of Malayan leopard prey species in a fragmented forest in Selangor, Malaysia. *Asia Life science* **7**: 41-55
- Santiapillai, C. and Ramono W. S. 1992. Status of the leopard (*Panthera pardus*) in Java, Indonesia. *Tigerpaper* **19**: 1-5.
- Seidensticker, J. 1991. Leopards. London. Great cats. Merehurst pp. 106-115.
- Seidensticker, J., Sunquist, M.E. and McDougal, C.W. 1990. Leopards living at edge of the Royal Chitwan National Park, Nepal, In Daniel, J.C. and Serro, J. S. eds., *Conservation in Developing Countries: Problems and Prospectus*, pp 415-423: Bombay Natural History Society, Bombay, India: Oxford University Press, London.
- Simcharoen, S., Barlow, A.C.D. Simcharoen, A. and Smith, J.L.D. 2008. Home range size and daytime habitat selection of leopards in Huai Kha Khaeng Wildlife Sanctuary, Thailand. *Biological Conservation* **141**:2242–2250.
- Shah, K.B., T.B. Thapa and Budha, P.B. 2004. Status survey of the forest Leopard (*Panthera pardus* Linnaeus, 1758) in Nepal. A Report Submitted to WWF Nepal Program, Kathmandu, Nepal.
- Shrestha, P. M. 2015. “Diet composition of Leopard (*Panthera pardus* Linnaeus, 1758) in Shivapuri Nagarjun National Park, Nepal.” Master Thesis. Central Department of Zoology.
- Shrestha, B., and Basnet, K. 2005, Indirect Method of Identifying Mammals: A Case Study from Shivapuri National Park, Nepal, Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal.
- Simcharoen, S., A.C.D. Barlow, A. Simcharoen and J.L.D. Smith. 2008. Home range size and daytime habitat selection of leopards in Huai Kha Khaeng wildlife Sanctuary, Thailand. *Biological Conservation* **141**: 2242- 2250.
- Smout, S., Asseburg, C., Mattiopoulos, J., Fernandez, C., Redpath, S., Thirgood, S., & Harwood, J. 2010. The functional response of a generalist predator. *PLOS One*, **2(5)**
- Sunquist, M.E. and F. Sunquist. 2002. *Wild Cats of the World*. The University of Chicago Press, Chicago, USA
- Swanepoel, L.H. et al. 2013. Extent and fragmentation of suitable leopard habitat in South Africa. *Animal Conservation*. **16**: 41–50.
- Swanepoel, L.H. et al. 2014. Survival rates and causes of mortality of leopards *Panthera pardus* in southern Africa. *Oryx*. **1**: 1–9.

Thapa, K., Shrestha, R., Karki, J., Thapa, G.J., Subedi, S. and Pradhan, N.M.B. et al. 2014. Leopard *Panthera pardus fusca* Density in the Seasonally Dry, Subtropical Forest in the Bhabhar of Terai Arc, Nepal. *Advances in Ecology*. 1-12.

Thapa, N.R. 2015. Leopard in human dominated landscape: A case study from Kathmandu Valley, Nepal. Master Thesis. Department of Environmental Science, Khwopa College, Bhaktapur.

Thapa S. 2014. A checklist of mammals of Nepal. *Journal of Threatened Taxa* **6**, 6061-6072.

Thapa, T.B. 2011, “Habitat suitability evaluation for leopard (*Panthera Pardus*) using remote sensing and GIS in and around Chitwan National Park, Nepal”, thesis PhD, Saurashtra University, India.

Thapa, T.B. 2014. Human caused mortality in the leopard (*Panthera pardus*) population of Nepal. *Journal of Institute of Science and Technology* **19**(1): 155-159.

Zimmermann, F. 2004. Conservation of the Eurasian Lynx (*Lynx lynx*) in a fragmented landscape – habitat models, dispersal and potential distribution. Ph. D. Thesis, University of Lausanne, Switzerland.

<http://ddcbhaktapur.gov.np/en/brief-introduction/>

<http://www.iucnredlist.org/details/15954/0>

<http://rds.icimod.org/Home/DataDetail?metadataId=9224>

Appendix I

प्रश्नोत्तर

- व्यक्तिको नाम: उमेर : लिङ्ग : पु. म.
जिल्ला : गाविस: वार्ड नं.
अन्तर्वार्ता स्थानको जिपिएस : N E Elevation meter
- जमिन कति छ ?
 - शिक्षा : क) साक्षर ख) निरक्षर ग) शिक्षित : तह
 - परिवारको पेशा :

चितुवाको अवलोकन

- के तपाईंले पछिल्लो दुई वर्षमा (असोज २०७० देखि कार्तिक २०७२ मा) चितुवा देख्नुभएको छ ?
क) छ ख) छैन ग) सुनेको
- चितुवा गाउँमा आएको कसरी थाहा पाउनुभयो ?
क) आफ्नै आँखाले देखेको ख) अरुले देखेको सुनेको ग) कराएको सुनेको घ) पदचिह्न देखेको
- कुन समयमा चितुवा देख्नुभएको थियो ? क) साँझ ख) बिहान ग) दिउँसो घ) राती
- वर्षमा कतिपटक देख्नुभएको छ ?

	वर्षभरि देखिन्छ	२ पटकभन्दा बढी	वर्षमा दुई पटक	कुन महिना ?
पदचिह्न देखेको				
चितुवा देखेको				
चितुवा कराएको सुनेको				

चितुवाबाट पाल्तु पशुपक्षीमा भएको क्षतिविवरण :

- क) पशुपक्षी माथि हमला : छ छैन
- यदि छ भने हमला भएको स्थानको जिपिएस लोकेसन N S
- तपाईंको जानकारीमा अन्य कसैको पाल्तु पशुपक्षी माथि चितुवाले हमला गरेको छ ? क) छ ख) छैन
- छ भने हमला भएको स्थानको जी.पी.एस. लोकेसन : N S
- छ भने त्यसको मात्रा, कति जनावर मारियो?

	२०७१ को नोक्सान रुपैया	२०७२ को नोक्सान रुपैया		पदचिह्न/जनावरलाई देखेको/दात र नडराको निशानबाट
गाई				
गोरु				

गाईको वाच्छा/वाच्छी				
भैसी				
भैसीको पाडा पाडी				
बाखा/भेडा				
कुखुरा				
कुकुर				

13. कुन समयमा चितुवाले आक्राण गरेको थियो ? क) साँझ ख) बिहान ग) दिउँसो घ) राती
14. चितुवाले कुन अवस्थामा आक्रमण गरेको हुन सक्छ ? क) गाउँ पस्दा ख) वन क्षेत्रमा पाल्नु जनावर चराउँदा ग) गोठमा बाँधिएको अवस्थामा घ) अन्य.....
15. वन क्षेत्र अथवा गाउँमा घटना हुँदा गोठाला जनावरसँग थियो ? क) थियो ख) थिएन
16. गोठमा घटना भएको भए कस्तो किसिमको गोठ थियो ? क) चारैतिर पर्खाल भएको गोठ ख) छत मात्र भएको र चारैतर्फ खुला गोठ ग) विना गोठ बाहिर बान्ने गरेको
17. घटना हुँदा बत्तीको स्थिति कस्तो थियो ? क) उज्यालो ख) अँध्यारो
18. अहिले आफूसँग भएका जनावरलाई कसरी पाल्नुहुन्छ ?
क) गोठालोले दिउँसो वनमा चराउन लान्छ
ख) विना गोठालो दिउँसो वनमा चर्न जान्छ ग) गोठमै राखेर चारा खुवाएर पाल्नुहुन्छ
घ) गाउँमा चराउनुहुन्छ ड) अन्य
19. कति पशुपक्षी पाल्नुभएको छ ?

प्रजाति	२०७१	२०७२
गाई/गोरु		
गाईको वाच्छा/वाच्छी		
भैसी र भैसीको पाडा पाडी		
बाखा/भेडा		
कुखुरा		
कुखुरा		
(घरको १०० मि. वरिपरिको अनुमानित कुकुर संख्या)		

20. चिताको हमलाबाट बच्न केही सुरक्षाको व्यवस्था अपनाउनुभएको थियो ? क) थियो ख) थिएन

21. यदि थियो भने कस्ता उपाय अपनाउनुभएको थियो ? क) तार बार गर्नुभएको
 22. ख) घर आँगन र गोठमा उज्यालो राखेर ग) विद्युतीय तार घ) घर र गोठ वरिपरि पर्खाल लगाएर ड)
 अन्य
23. दूध उत्पादन क) दैनिक घरका लागि ख) व्यापारका लागि

चतुवाद्वारा मानव क्षति

24. के चितुवाले तपाईंको घरको सदस्यमाथि हमला गरेको छ ? क) छ ख) छैन
 25. यदि छ भने क) चोटपटक लाग्यो ख) ज्यान गयो
 26. हमला भएको स्थानको जी.पीएस. लोकेसन : N S
 27. चितुवाले हमला गरेको व्यक्तिको क) उमेर ख) लिङ्ग
 28. तपाईंको जानकारीका अरु कोही माथि चितुवाले हमला गरेको छ ? क) छ ख) छैन
 29. यदि छ भने हमला भएको स्थानको जी.पीएस. लोकेसन : N
 30. चितुवाले हमला कति बेला गरेको थियो ?
 क) वन क्षेत्रमा घास दाउरा गर्दा ख) वन क्षेत्रको बाटो बाट हिँड्दा
 ग) घर वरिपरि काम गर्दा वा बसिराख्दा घ) वन क्षेत्रमा गाई भैसी चराउन जाँदा
 ड) चितुवालाई गाउँमा समाल्ने बेला च) अन्य
- हरिण तथा अन्य जङ्गली जनावरद्वारा बालीमा क्षति
31. के जङ्गली जनावर (हरिण प्रजाति) ले नोक्सान गर्छ ? क) गर्छ ख) गर्दैन
 32. यदि गर्छ भने कुन जनावरले कति मात्रामा क्षति गर्छ ?

प्रजाति	कुन महिनामा धेरै नोक्सानी हुन्छ ?	कति पटक (प्रति वर्ष) हुन्छ ?
बँदेल		
रातो बाँदर		
चित्तल		
छाडा पशु		
अन्य		

क्षतिपूर्ति

33. के तपाईंलाई थाहा छ, चितुवाको क्षतिवापत सरकारले राहत स्वरुप धनराशि दिने गरेको छ ? क) छ
 ख) छैन
 34. यदि सरकारी राहत बारे थाहा छ र चितुवाबाट क्षति भएको छ भने, क्षतिपूर्तिको लागि के तपाईं वन
 कार्यालय वा निकुन्जमा निवेदन दिनुभएको छ ? क) छ ख) छैन
 35. वन कार्यालय वा निकुन्जबाट के कोही बुझ्न आयो ? क) छ ख) छैन
 36. क्षतिपूर्तिको लागि निवेदन दिनुभएको छ भने के धनराशि पाउनुभयो ? क) छ ख) छैन
 37. क्षतिपूर्ति केका लागि पाउनुभयो ? क) गाईवस्तुको शिकारको लागि ख) मानव क्षतिको लागि

38. धनराशि पाउन कति समय लाग्यो ? वर्ष महिना
39. के गाउँमा वन्यजन्तुको शिकार हुने गर्छ ? क) गर्छ ख) गर्दैन
40. के तपाईं वन्यजन्तु संरक्षण प्रति सकारात्मक हुनुहुन्छ ? क) अत्यधिक सकारात्मक छु ख) सकारात्मक छु ग) न्यून मात्रामा सकारात्मक छु घ) नकारात्मक छु
41. वन्यजन्तु संरक्षणबाट केही लाभ हुन्छ ? क) धेरै छ ख) ठीकै छ ग) कम छ घ) छैन
42. वन्यजन्तुको हमलालाई कसरी लिनुहुन्छ ? क) थाहा छैन ख) सकारात्मक छु ग) न्यूनमात्रामा सकारात्मक छु घ) नकारात्मक छु
43. वन्यजन्तु संरक्षणबाट के आशा राख्नुभएको छ ?

.....

.....

Appendix II. Summary

Coordinates of attacked on human by leopard

SN	Latitude	Longitude
1	27.64994	85.47033
2	27.70971	85.41661
3	27.67147	85.49211
4	27.65466	85.41643
5	27.69433	85.47747

Summary of mean and deviation of the ecological parameters

Variable	Minimum	Maximum	Mean	Std. deviation
CC	30.000	78.500	58.054	16.594
GC	26.000	56.000	41.200	10.250
HT	9.500	14.400	12.180	1.749
LDS	10.250	447.500	192.275	122.361
LDW	11.250	510.000	179.735	175.851
NVS	3.000	4.000	3.700	0.483
PPP	0.000	4.000	1.900	1.370
Densit of trees	25.000	100.000	41.273	21.679

Appendix II Some snaps



Photo 1 Interaction with local woman



Photo 2 Interaction with local herder



Photo 3 Interaction with farmers forest



Photo 4 Discussion with staff of community



Photo 5 Encounter of *Muntiacus muntjack*



Photo 6 Feeding part of stem of *Schima* spp by *Muntiacus muntjack*



Photo 7 Grazing near the forest with herder



Photo 8 Grazing near forest without herder



Photo 9 Scat of leopard in Nagarkot



Photo 10 Remaining part of prey dog



Photo 12 Retaliatory killing of leopard

(source: Ram Hari Khatri)



Photo 13 Cub in Nagarkot VDC

(Source: Bijaya Lama)