

**PERCEPTION BY COMMUNITIES ON SOCIO-ECONOMIC IMPACTS OF HYENA  
PREDATION ON LIVESTOCK AROUND LAKE NAKURU NATIONAL PARK AND  
SOYSAMBU CONSERVANCY, KENYA**

**KOSKEY CHEPNGENO CHRISTINE**

**A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for  
the Master of Science Degree in Natural Resources Management of Egerton University**

**EGERTON UNIVERSITY**

**NOVEMBER 2021**

## DECLARATION AND RECOMMENDATION

### Declaration

This thesis is my original work and has not been presented in this university or any other for the award of a degree.

Signature: ..........

Date: 15/11/2021.

**Koskey Chepngeno Christine**

**NM11/11710/16**

### Recommendation/Approval

This thesis has been submitted with our approval as University supervisors.

Signature: 

Date: 15/11/2021.

**Dr. Dickson L. Mekanji**

**Department of Natural Resources**

**Egerton University, Njoro, Kenya**

Signature: 

Date: 24/11/2021

**Dr. George W. Eshiamwata**

**Kenya National Commission for UNESCO**

## **COPYRIGHT**

**© 2021, CHRISTINE CHEPNGENO KOSKEY**

All rights reserved. No part of this thesis may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, or otherwise, without permission from the author or Egerton University.

## **DEDICATION**

This thesis is dedicated to my parent Mr. and Mrs. Koskey, siblings, Peter, Caroline Jennifer, Edwin, Nancy, Gladys, Nicholas, Josephat and friends

## **ACKNOWLEDGEMENTS**

I greatly appreciate the support I received from the Department of Natural Resources, Faculty of Environment and Resource Development of Egerton University, throughout this journey. I am thankful to my supervisors Dr. Dickson L. Makanji and Dr. George W. Eshiamwata for their guidance, advice and patience during data collection and preparation of this thesis. I also acknowledge the immense support from staff of Lake Nakuru National Park and Soysambu Conservancy for their help during data collection. I am deeply indebted to the National Geographic through a project funded to California University and ‘Transforming African Agricultural Universities to Meaningfully Contribute to Africa’s Growth and Development (TagDev) project’ for funding my project and Christine Wilkinson of California University for her help with logistical support during data collection and technical guidance. I am also grateful to my friends for their moral support.

The successful development of this thesis was possible through contributions of many people. However, it is not possible to mention all of them here. Everyone who played a role is acknowledged.

## ABSTRACT

Human-wildlife conflicts may arise when expanding human populations and activities overlap or compete for spaces and resources with wildlife, or when growing wildlife populations encroach on those of human populations. The effects of human-wildlife conflict include livestock predation, harassment, property damage, habitat loss due to human activities, and interpersonal conflict over wildlife issues resulting in injuries or mortalities. The spotted hyena (*Crocuta crocuta*) is among animals involved in livestock predation for many reasons, including; their abundance, gregariousness, carnivorous nature, and wide-ranging behaviour. This study focused on understanding the co-existence between people and wildlife for better livelihoods and conservation outcomes through improved knowledge on human-wildlife interactions and conflicts within a human-wildlife dominated landscape. The study adopted a survey research design. Purposive sampling was employed in data collection. Data was collected using a structured interview schedule, and Focused Group Discussions (FGDs), targeting different segments of the community. Data was analyzed using descriptive statistics (charts, tables and graphs) and inferential statistics. The findings from the study were that 40% of the respondents indicated that poor park fencing is the major cause of conflict and people's perceptions towards hyena conservation was positive. Conservation of hyena depended on the demographic characteristics of the respondents, education, age, occupation, and ethnicity. There is a significance relationship between hyena conservation with education (chi square 44.961,  $p=0.000$ ), occupation (chi square 77.473,  $p=0.000$ ) and ethnicity (chi square 45.171,  $p=0.001$ ) of the respondents. Conservation of hyena leverage on education, occupation, and ethnicity of the local community. On the other hand, conservation of hyena corresponding to gender (chi square, 2.140,  $p=0.343$ ), age (chi square 12.294,  $p=0.422$ ) and religion (chi square, 0.743,  $p=0.994$ ) are not significant therefore conservation of hyena is not influenced by on gender, age nor religion in villages around Lake Nakuru National Park and Soysambu Conservancy. The respondents proposed that reinforcement of an electric fence and frequent monitoring of the faulty areas will help in reducing hyaenas attacks. These results contribute towards understanding of human-hyena conflicts and spatial dynamics for enhanced coexistence between wildlife and local communities through improved decision making on mitigation measures. The information emanating from this study provides a basis for policy formulation on wildlife conservation and management in both protected and non-protected areas.

## TABLE OF CONTENTS

<b>DECLARATION AND RECOMMENDATION</b> .....	ii
<b>COPYRIGHT</b> .....	iii
<b>DEDICATION</b> .....	iv
<b>ACKNOWLEDGEMENTS</b> .....	v
<b>ABSTRACT</b> .....	vi
<b>LIST OF FIGURES</b> .....	xi
<b>LIST OF TABLES</b> .....	xii
<b>LIST OF ABBREVIATIONS AND ACRONYMS</b> .....	xiii
<b>CHAPTER ONE</b> .....	1
<b>INTRODUCTION</b> .....	1
1.1 Background to the study .....	1
1.2 Statement of the problem.....	5
1.3 Objectives of the study .....	6
1.3.1 Broad objective.....	6
1.3.2 Specific objectives.....	6
1.4 Research questions .....	6
1.5 Justification of the study.....	6
1.6 Assumption/scope and Limitations .....	7
1.7 Definition of Terms. ....	8
<b>CHAPTER TWO</b> .....	10
<b>LITERATURE REVIEW</b> .....	10
2.1 Introduction to the Chapter.....	10
2.2 History of wildlife protection and management .....	10
2.3 Importance of protected areas .....	11
2.4 An overview on Human-wildlife conflict.....	11
2.5 Drivers of human-wildlife conflict.....	14
2.6 Socio-economic impacts from human-wildlife conflict.....	15
2.7 Impacts of human-wildlife conflict on wildlife conservation and management .....	16
2.8 Mitigation Measures to prevent and control Human-Wildlife Conflict.....	17
2.9 Policy and legislative Measures to prevent and control HWC.....	18

2.9.1 Wildlife Management and Conservation Act, 2013 .....	18
2.9.2 Environmental Management and Coordination Act of 1999 .....	19
2.9.3 Animal Disease Act CAP 364, Revised Edition 2012 .....	20
2.9.4 Tourism Act No 28 of 2011.....	20
2.10 Perceptions towards wildlife conservation.....	21
2.11 Ecology and social behaviors of hyena that predispose it to HWC .....	22
2.12 Gaps in knowledge on Human-Wildlife Conflicts studies .....	23
2.13 Theoretical framework .....	24
2.13.1 Social and ecological theory.....	24
2.13.2 Coupled human–natural systems and complexity theory .....	25
<b>CHAPTER THREE</b> .....	<b>27</b>
<b>METHODOLOGY</b> .....	<b>27</b>
3.1 Description of the Study area .....	27
3.1.1 Location.....	27
3.1.2 Climate and Hydrology .....	29
3.1.3 Conservation status (Management interventions) .....	30
3.1.4 Biodiversity (Fauna and Flora).....	30
3.1.5 Population and socio-economic activities .....	31
3.2 Research Design .....	31
3.3 Study population and Sampling unit .....	32
3.4 Sampling Procedure.....	32
3.5 Sample size calculation .....	32
3.6 Data collection.....	33
3.7 Data Validity and Reliability.....	33
3.8 Reliability .....	34
3.9 Ethical consideration .....	34
3.10 Data Analysis.....	35
<b>CHAPTER FOUR</b> .....	<b>37</b>
<b>RESULTS</b> .....	<b>37</b>
4.1 Introduction .....	37
4.2 Response Rate .....	37
4.3 Characterization of the population .....	37

4.3.1 Gender of the respondents .....	37
4.3.2 Age of the respondents .....	38
4.3.3 Education level of the respondents.....	38
4.3.4 Occupation level of the respondents.....	39
4.3.5 Ethnicity of the respondents .....	40
4.3.6 Religion of the respondents .....	41
4.4 Causes of human hyena conflict.....	41
4.5 Socio-economic impacts of hyena predation.....	43
4.6 Local community’s perception towards hyena conservation .....	44
4.6.1 Conservation of hyena.....	44
4.6.2 Reasons for conserving the hyenas.....	45
4.6.3 Reasons for not conserving hyenas .....	46
4.6.4 Demographic variables and relationship with hyena conservation .....	47
4.7 Severity of human hyena conflict.....	50
4.7.1 Level of compensation for hyena attacks in the study area.....	52
4.7.2 Community response to hyena attacks .....	52
<b>CHAPTER FIVE .....</b>	<b>54</b>
<b>DISCUSSION .....</b>	<b>54</b>
5.1 Introduction .....	54
5.2 Discussion of the results.....	54
5.2.1 Response rate.....	54
5.2.2 Economic loss due to livestock predation .....	54
5.2.3 Causes of livestock attacks.....	55
5.2.4 Severity of attacks .....	57
5.2.5 Perception on hyena conservation .....	57
5.2.6 Mitigation measures of human hyena attacks .....	58
<b>CHAPTER SIX .....</b>	<b>59</b>
<b>CONCLUSIONS AND RECOMMENDATIONS.....</b>	<b>59</b>
6.1 Conclusions .....	59
6.2 Recommendations .....	59
6.2.1 Recommendations for management.....	59
6.2.2 Recommendations for Further Research .....	60

<b>REFERENCES</b> .....	61
<b>APPENDICES</b> .....	75
Appendix 1: Household Questionnaire .....	75
Appendix 2: KWS and Soysambu Conservancy Checklist .....	81
Appendix 3: Data collection through Open Data Kit (ODK) .....	82
Appendix 4: Abstract of the publication .....	83
Appendix 5: Research Permit .....	84

## LIST OF FIGURES

Figure 1: Conceptual framework.....	26
Figure 2: Map of the study area.....	28
Figure 3: Sampling sites of the study .....	29
Figure 4: Gender of the respondents who turned up for the interviews .....	38
Figure 5: Occupation of the respondents .....	40
Figure 6: Distribution of respondents by religion .....	41
Figure 7: Major causes of hyena attacks on livestock .....	42
Figure 8: Season of hyena attacks .....	43
Figure 9: Number of livestock injured and killed by hyenas in the study area .....	43
Figure 10: Local community's perceptions towards hyena conservation .....	45
Figure 11: Reasons for hyena conservation.....	46
Figure 12: Reason against hyena conservation.....	47
Figure 13: Reports of hyena attacks on livestock.....	51
Figure 14: Ways of reporting hyena attacks .....	51
Figure 15: Community response to hyena attacks.....	52
Figure 16: Different ways of killing hyenas .....	53

## LIST OF TABLES

Table 1:	Knowledge Gaps .....	23
Table 2:	Summary of Data Analysis .....	36
Table 3:	Response rate .....	37
Table 4:	Age of the respondents.....	38
Table 5:	Education level of the respondents .....	39
Table 6:	Ethnicity of the respondents.....	40
Table 7:	Total loss to hyena predation .....	44
Table 8:	Chi-square interpretation.....	48
Table 9:	Demographic relationships and hyena conservation.....	50
Table 10:	Compensation for the livestock preyed on by hyenas.....	52

## **LIST OF ABBREVIATIONS AND ACRONYMS**

a.s.l	above sea level
CI	Confidence Interval
FGDs	Focused Group Discussions
GIS	Geographic Information System
GPS	Global Positioning System
HHC	Human Hyena Conflict
HWC	Human Wildlife Conflict
IUCN	International Union for Conservation of Nature
KIIs	Key Informant Interviews
KWS	Kenya Wildlife Service
LNNP	Lake Nakuru National Park
MCA	Member of County Assembly
ODK	Open Data Kit
SC	Soysambu Conservancy
SPSS	Statistical Packages for the Social Sciences
WWF	World Wide Funds for Nature

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background to the study

Human wildlife conflict (HWC) has been a controversial subject, eliciting a lot of debate on its impacts on environment, survival and extinction of species, human welfare, health and safety, as well as economic and social costs. It is considered as interactions between humans and wildlife, where negative consequences whether perceived or real, exist for one or both parties (Sillero-Zubiri & Switzer, 2001; Woodroffe, *et al.*, 2005). For example, wildlife that are perceived to be problematic are killed either illegally or legally by the government, private agencies or even local communities (Treves & Naughton-Treves, 2005; Woodroffe *et al.*, 2005). Human-wildlife conflict poses one of the greatest challenges to conservation and livelihoods globally although the form and impacts vary spatially and temporally. It is a significantly growing conservation problem around the world (Nyhus *et al.*, 2005) which may directly lead to habitat destruction (Ottichilo *et al.*, 2001).

Wildlife is important from an environmental and socio-economic point of view, considering the goods and services derived in the form of food, tourism, research, education, cultural, ecological, pollination and ecosystem engineers (Chardonnet *et al.*, 2002; Newsome *et al.*, 2005). However, human-wildlife conflict is considered to be one of the threats driving species to extinction (Conover, 2001; Woodroffe *et al.*, 2005). Globally, there has been an enormous decrease in wildlife. A decrease of 58% has been observed over the last 40 years due to human activities. Besides, habitat loss through deforestation and fragmentation, agricultural intensification and extensification, wildlife trade, pollution, and climate change have also contributed to the loss (Hall, 2015). Human wildlife conflict is considered to be one of the causes of threats consigning species to extinction (Kinnaird *et al.*, 2003). HWC is a global issue that has attracted the attention of wildlife managers, conservationists, ecologists and development experts due to the conflicts not being well-managed (Hill Osborn & Plumpré, 2002). Incidences of human wildlife conflict have increased over the years due to an increase in human populations encroaching upon wildlife areas including dispersal corridors previously used by wide ranging or migratory wildlife species (Kutatoi & Waweru, 2017; Le Bel *et al.*, 2011; Munthali *et al.*, 2018). Human communities have suffered from livestock predation, harassment by wildlife and property damage in many parts of the world (Mollel, 2017). Interpersonal conflicts over wildlife issues undermine human welfare, health, and safety, and have economic and social impacts (Messmer, 2000). A new thinking is required in the management of various conflicts that arise so that human wildlife conflict does not jeopardize

wildlife conservation objectives and aims nor endanger the well-being of man. How people perceive conflicts not only depend on the destruction wild animals are causing but also socio-cultural factors (Anand & Radhakrishna, 2017). According to Bennett and Dearden (2014) successful conservation is always predicated on local support for conservation which is powerfully influenced by perceptions of the impacts and the effects that are experienced by local communities and their opinions on management and governance. Additionally, to understand the attitudes and perception of people towards wildlife conservation is a fundamental factor and strategy which helps in conservation (Ebua *et al.*, 2011). On the other hand, different stakeholders have been creating awareness on conservation and management. Awareness initiatives notwithstanding, communities still consider them as hindrances maximizing the benefits both consumptive and non-consumptive (Ebua *et al.*, 2011; Songorwa *et al.*, 2000) and this hinders conservation. That is why when measures are put in place to control the conflicts, success can be sometimes minimal because top-down policy makers may fail to understand the complex human social factors and wildlife behavior.

Despite the fact that human wildlife conflict is a global phenomenon, the extent, magnitude, and impacts vary from one region to another (Packet *et al.*, 2013). Many species have been implicated in human wildlife conflict depending on their geographical distribution (for example lions, hyenas, leopards, elephants in Africa, bears in America and Europe, Tigers in Asia among others) (Anand & Radhakrishna, 2017; Distefano, 2005; Gross *et al.*, 2018). Lions (*Panthera leo*) and spotted hyena (*Crocuta crocuta*) may pose many socio-economic challenges through attacks on livestock. One way people respond to such a problem is to kill the problematic wildlife (Dickman *et al.*, 2014). Some of the socio-economic factors that perhaps lead to human wildlife conflict are the exposure when animals stray to human dominated landscapes or when people encroach on wildlife areas. Additionally, the perceptions of people towards wildlife can be influenced by the threats that the wild animals pose and also the susceptibility of those animals towards damages (Dickman, 2010). In Tibetan Plateau, India, the main conflict that has brought a lot of destruction is human–leopard conflicts (Li *et al.*, 2013). Leopards do not attack humans; instead they are associated with depredation of livestock and concomitant socio-economic loss. Livestock losses to snow leopards account for a significant portion of the annual income loss for many people. Therefore, snow leopard’s survival is low due to the retaliation that they face after the depredation (Li *et al.*, 2013). In Tanzania, over 125 lion killings, between the years 2000 to 2005 in the greater Tarangire-Manyara ecosystem were reported. Additionally, 35 lions were killed in the Ngorongoro Conservation Area between the years 1998-2004 (Frank *et al.*, 2006). The same pattern is

occurring in a wide range of areas; elsewhere in Maasai land but, no one has been counting (Frank *et al.*, 2006). In the areas near wildlife reserves in Zimbabwe, pastoralists experience livestock depredation by wild carnivores and 241 livestock were killed in 1999. Baboons (*Papio ursinus* Kerr), lions (*Panthera leo* Linnaeus) and leopards (*P. pardus* Linnaeus) were the most reported serious predators that contributed to 52%, 34% and 12% of kills, respectively (Butler, 2000).

In Kenya, about 80 percent of the land is arid or semi-arid, and 10 percent consists of woodlands, forests, national reserves, and game reserves (Kamau *et al.*, 2012; Rodriguez *et al.*, 2012). According to Kenya Wildlife Service, the country has 348 wildlife protected areas, which covers 8 percent of the total land in the country, within these areas, there are 350 species of mammals, 6,500 plant species, and 1,000 bird species, giving Kenya the second highest wildlife diversity of all African countries (Kamau *et al.*, 2012; Western *et al.*, 2009). Eighty percent of wildlife in the country is found outside the formal protected areas, thus leading to increased interactions between human and wildlife (Romanach *et al.*, 2007). As a result, the potential for conflict is always present due to interactions. According to Patterson *et al.* (2004) during a study undertaken in Tsavo National Parks on livestock predation by lions, predation depended on how the lions and humans interact and also the geographic description of the area. A total of 312 attacks reported claimed 433 heads of livestock. The lions were responsible for 86% of the 312 attacks while hyena and cheetah participated as other predators (Patterson *et al.*, 2004).

In Trans-Mara Sub County, 329 crop-raiding incidents by elephants were recorded since the year 2000 and only occurred in the nights during rainy seasons (Sitati *et al.*, 2003). In most of the Maasai landscape, especially in Kajiado and Narok, an increase in human wildlife conflict poses a big threat to wildlife conservation (Okello, 2005). There have been cases of lion mortalities from killing using weapons and poisons. In 2007, pastoralists near Lewa Wildlife Conservancy used the Furadan chemical and at least five lions died together with a number of different raptors which are known to be scavengers that had recently killed livestock (Odino & Ogada, 2008). This is one of the main reasons why there is a great decline in wildlife populations especially lions in Africa (Odino & Ogada, 2008). For example, the populations of lions have declined throughout Africa by 80% in a period of twenty years (Hazzah *et al.*, 2009).

The expansions of agriculture and settlement sites into the protected areas have led to the change reduction of wildlife habitat and wildlife corridors (Noe, 2003). An example of the Kitendeni corridor that is known to link Kilimanjaro National Park and other ecosystems like

the Amboseli National Park (Kenya) is the only functional wildlife corridor within this landscape. Other corridors have been blocked due to anthropogenic activities and expansion of infrastructures, which hinders the free movement of wildlife (Noe, 2003; Schübler & Stadtmann, 2018). In Kenya, Nairobi National Park (NNP) is known to be too small to permanently provide for feasible populations of many of the dispersal mammals that rely on the area especially during the dry season. In view of this, for the park to continue providing a stream of benefits, wildlife must disperse to the south into Kitengela area in the wet season. Nevertheless, Kitengela area is under private ownership and is currently in a process of fencing, subdivision and conversion of grasslands to croplands thus endangering its capacity to contribute to the dispersion of wildlife and the viability of the park (Odwori *et al.*, 2014). As a result, human-wildlife conflicts have been on the rise in this landscape.

According to Nyaligu and Weeks (2013) increase in human population, land fragmentation, fencing and agriculture nearby the lower slopes of Mount Kenya are significantly isolating the wildlife of Mount Kenya National Park Ecosystem. Consequently, these anthropogenic activities have led to the reduction of the total range available for wildlife. Additionally, it has disrupted the movements of large mammals between the mountain and the grassland/savannah habitats of the surrounding plains. This has led to the disappearance of Black Rhino (*Diceros bicornis*) and the African wild dog (*Lycaon pictus*), over the past three decades (Graham & Musyoki, 2012).

In Kenya, the Kenya Wildlife Service is a state corporation established by the Wildlife Conservation and Management Act CAP 376 under laws of Kenya with the main mandate to conserve, protect and manage wildlife in Kenya. Furthermore, the corporation enforces related laws and regulations (KWS, 2013; Musimbi, 2013). Kenya Wildlife Service manages about 8% of the total land mass of Kenya (Karanja, 2012; Musimbi, 2013). This land contains 22 National Parks, 28 National Reserves and 5 National sanctuaries. Besides, under Kenya Wildlife Service management are 4 Marine National Parks and 6 Marine National Reserves respectively at the coastal part of Kenya. According to Raini (2009) Lake Nakuru National Park (LNNP) is a world class National Park which has been described as “the lake of a million flamingoes”, “the world ornithological spectacle”, and is the bedrock to various tourism destinations. However, the areas near LNNP have been heavily settled, urbanized, industrialized, and highly cultivated, which may be contributing to conflict between humans and wildlife in this area. Over the last 70 years, various human activities have been found to be limiting the movement of large mammals in and around Lake Nakuru National Park (Jumba *et al.*, 2007). According to Daniela and Basset (2002) the conservation of Lake Nakuru National

Park has been driven by politics at national level and even at the local level since 1991. It is also an ethical problem that different tribes fight to be within Nakuru County because of the resources which are found in Lake Nakuru watershed and Soysambu Conservancy. It is also believed that wildlife contributes enormously towards the development of Nakuru County (personal observation). In addition to this, Lake Nakuru National Park is among the most visited protected areas in Kenya (Daniels & Bassett, 2002; Sindiga, 1995). On the other hand, Soysambu Conservancy is a privately- owned wildlife conservancy (Muller, 2018) that meant to conserve wildlife and promote the coexistence of wildlife with livestock which is relevant to today's modern society in Kenya. Establishment of wildlife conservancies is anchored in the Wildlife Management and Conservation Act 2013. The study therefore helps in understanding the main causes of human-hyena conflict and the appropriate mitigation measures that should be undertaken in order to minimize the conflict. Moreover, it elucidates the total cost lost to hyena through livestock predation. It is showing the interest of the community towards hyena conservation and if laws are implemented accordingly, people living adjacent to the park will benefit and the level of conflict will subside.

## **1.2 Statement of the problem**

Human-wildlife conflict has led to livestock death, injuries, and human fatalities, as well as retaliation against wildlife and negative attitudes towards conservation. Addressing this problem requires data and good information. The spotted hyena, which is the animal of greatest interest in this study, requires be taken care of and managed so as to limit the conflicts it causes in wildlife conservation. They are also one of the species in the family of hyaenidae that is known for human-hyena conflict. Despite the efforts undertaken by the government and other non-governmental agencies in mitigating human-wildlife conflict, conflict between spotted hyenas and the people living adjacent to Lake Nakuru National Park and Soysambu Conservancy are still rampant. The study therefore assessed the effectiveness of mitigation measures of human-hyena conflict, socio-economic impacts of spotted hyena predation on livestock and livelihoods in Lake Nakuru National Park and Soysambu Conservancy, how the residents are adapting and coping with this problem and their perceptions towards hyena which are crucial to conservation of the species. This is important for subsequent interventions and wildlife conservation efforts. This study therefore will contribute to alleviation of the problem of human- wildlife conflict with special emphasis on *Crocuta crocuta*.

### **1.3 Objectives of the study**

#### **1.3.1 Broad objective**

To enhance coexistence between people and wildlife for improved livelihoods and conservation outcomes by assessing the socio-economic impact of carnivores' predation on livestock.

#### **1.3.2 Specific objectives**

This study was guided by the following objectives:

- i. identify causes, mitigation measures of human hyena conflicts and local community's perceptions towards hyena conservation around Lake Nakuru National Park and Soysambu Conservancy
- ii. evaluate the severity of human-hyena conflict around Lake Nakuru National Park and Soysambu Conservancy
- iii. assess the socio-economic impacts of hyena predation on local livelihoods around Lake Nakuru National Park and Soysambu Conservancy

#### **1.4 Research questions**

- i. What are the causes, mitigation measures of human hyena conflicts and local community's perceptions towards hyena conservation surrounding Soysambu Conservancy and Lake Nakuru National Park?
- ii. How severe is human- hyena conflict in Lake Nakuru National Park and Soysambu Conservancy?
- iii. What are the socio-economic impacts of spotted hyena predation on local livelihoods?

#### **1.5 Justification of the study**

Several studies on wildlife have been undertaken in and around Lake Nakuru National Park. According to KWS (2012) and Musimbi (2013) areas adjacent to Lake Nakuru National Park have been experiencing human- wildlife conflicts over the years. For example it is noted that 269 cases of human wildlife conflict occurred in 2012, which were reported to the Community Department, Kenya Wildlife Service C, Nakuru and , broken down as follows; 7 (seven injuries) caused by Monkeys, hippopotamus, baboons, Buffaloes and Snake bites, 27 cases of livestock predation, 110 cases of crop destruction by buffaloes, Zebras, Eland and Water buck, 95 cases of threats and property damage by buffaloes, leopards, Lion and snake (specifically python) and 30 wildlife mortality. These mortalities were caused by communities

retaliating back by killing wildlife whenever they get to their farms and settlements. According to Ogutu *et al.* (2017) the hyena population decreased especially in the years 1996 to 2015. The reason may be due to food scarcity and human encroachment may be caused by increasing human population. In the years 1969 to 1999 the population of the Nakuru District, increased by 300% and a further increase of 74% was experienced from 1999 to 2009 (Ogutu *et al.*, 2017). The socio-economic impacts of spotted hyena predation on livestock have never assessed, especially in the communities adjacent to Lake Nakuru National Park and Soysambu Conservancy. Therefore, this study was undertaken to document such information which will back up existing information on human wildlife conflict in general and document the potential pathways for better conservation of *Crocuta crocuta*. All stakeholders involved in wildlife conservation stand to benefit from the results of this research, not forgetting the communities living around the two sanctuaries who would benefit from reduced conflicts if the recommendations contained in this report are fully implemented.

## **1.6 Assumption/scope and Limitations**

The study assumed that the spotted hyena movement within the villages adjacent to Lake Nakuru National Park and Soysambu Conservancy is one of the notorious species causing the human-hyena conflicts over a radius of 5km from the boundaries of the two study areas. In addition, the study assumed that all targeted respondents (the local community) would cooperate and provide relevant information that would be used in making the research valid and useful in making suitable conclusions and recommendations.

The study focused on human-wildlife conflict with a focus on carnivores (hyena). The study was confined to the villages adjacent to Lake Nakuru National Park and Soysambu Conservancy which lie within 36° 05' E and 0° 24' S northwest of Nairobi. The study focused on the causes of human-hyena conflicts particularly on the spotted hyena, its socio-economic impacts on the human population through livestock predation. The effectiveness of mitigation measures undertaken to curb the conflicts, and the perception toward spotted hyena conservation by the community and the severity of human -hyena conflict in those villages that are adjacent to the Lake Nakuru National Park and Soysambu Conservancy were also part of the study. The study was undertaken over a three month period and the respondents were adults aged above 18 years and had been living adjacent to the park and the conservancy for more than one year. In as much as there could be other carnivores involved in the human wildlife conflict, this study focused on the spotted hyena. The spatial delimitation of the study was 5km from the protected area.

The study encountered various limitations, which included the unwillingness of respondents to give correct information during interviews, giving information without a reward, language barrier, culture differences between the researchers and the respondents. These limitations were overcome by liaising with the area chief to sensitize the community prior to data collection of the importance of the research. A brief introduction of the study to respondents was also done before an interview. Language barrier between the researcher and respondents was overcome by the use of local assistants to interpret the information during interviews. Chiefs, assistant chiefs and the elders who helped in mobilization were asked to clarify to the respondents that the exercise was voluntary, and the resources were limited and only for logistics. Culture difference was overcome by dressing according to the respondents' norm.

### **1.7 Definition of Terms**

**Conservancy-** is an area of land kept in its natural state, specifically for wild animals and plants to live in and be protected.

**Encroachment to protected areas-** is an act of intruding or trespassing into the protected areas designated for conservation and no human activity is permitted

**Endorheic** - are open systems where surface waters drain to the ocean in a well-defined pattern that involve streams and rivers temporarily seized by permanent freshwater lakes

**Extinction-** is the termination of a kind of organism or of a group of kinds

**Human-hyena conflict-**is the pattern of problematic interactions between Park and Conservancy, adjacent dwellers, and the hyena

**Human-wildlife conflict-** is the interaction between wild animals and people, people's perceptions of wild animals, and the resultant negative impact on people or their resources, or wild animals and their habitat and human safety.

**Hyper- eutrophic** - is a body of water that is highly loaded in nutrients and minerals.

**Mitigation-** is the effort to reduce loss of life and property by lessening the impact of human-wildlife conflict

**National Park-** is essentially state land which is managed exclusively for the conservation of flora and fauna.

**Open Data Kit Collect-** is an open-source Android application that replaces paper forms used in survey-based data collection that supports a wide range of question and answer types, and is designed to work well without network connectivity. It can as well be changed

from one language to another to ease the respondent understanding for correct information.

**Perception-** is an opinion, thoughts or beliefs which are held by people basing on how they organize identify and interpret sensory information in order to represent and understand the presented information or the environment.

**Predation-** is the biological interaction of where a predator (a hunting animal) kills and eats prey (the animal being attacked)

**Response rate-** is defined in survey research as the number of people who answered the survey divided by the total number of people in the sample. It is normally expressed in the form of a percentage. It is also known as the completion rate or return rate

**Severity in wildlife conflict-** is the degree of harshness or sternness of human- hyena conflict

**Shoats-** combination of sheep and goats

**Socio-economic-** is the interaction between social and economic habits of people

**Wildlife conservation-** is the practice of protecting wild plants and animals from going extinct

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction to the Chapter**

This chapter presents literature review related to socio-economic impacts of spotted hyena predation on livestock, the socio-economic implications of human-hyena conflict mitigation, and the perceptions of communities on spotted hyena with specific references to studies undertaken in relation to the topic of the study. It also reviews the knowledge gaps that this study bridged. It delves into theoretical frameworks towards human-wildlife conflict and develops a conceptual framework to represent the dependent variables, independent variables and also the intervening variables.

#### **2.2 History of wildlife protection and management and its effect on human wildlife conflicts**

The interactions between people, wildlife and livestock in East African savannahs has been existing since time immemorial. Human population growth, agricultural expansion, deforestation, and hunting have been known to cumulatively impact on the environment, natural habitats as well as wildlife populations (Owino *et al.*, 2011; Rodriguez *et al.*, 2012). According to Brown (2007) wildlife conservation in the United State has been based on the Public Trust Doctrine, where wildlife and fishes, water, and scenic places were considered too valuable. Native Americans utilized wildfire heavily until Europeans arrived in the 1400's. Americans finally took notice at the turn of the century, and during the Roosevelt era they set aside millions of acres in public parks, forests and wildlife protection. Human population in Kenya has doubled over the past 20 years. This has generated a lot of pressure to the protected areas as they are being changed to croplands (Rodriguez *et al.*, 2012). Wildlife protection is the act of protecting the endangered plants and animals to prevent them from becoming extinct (Baqá, 2010; Roy, 2013). It has become an important practice because of the harmful effects of anthropogenic activities on wildlife (Roy, 2013). Additionally, according to Roy (2013) wildlife protection has drawn the attention of governmental and non-governmental agencies towards implementing policies to conserve wildlife.

In Kenya over the last 30 years there has been a sharp decline of wildlife population in national parks and reserves. This was attributed to the conservation policies and integrated landscape practices that combine parks with private and community-based measures (Western *et al.*, 2009). In general, wildlife protection granted by the Kenya Wildlife Service since 1989

has restricted poaching, as evidenced by the steady increase of the two species most vulnerable to poaching (rhinos and elephants) (Western & Waithaka, 2005).

### **2.3 Importance of protected areas**

The origin of conservation can be traced back to religious and philosophical ancient times, where humans have unconsciously practiced conservation (Mosse, 2003). Protected areas remain to be a cornerstone of conservation with a credit of saving numbers of wildlife populations from range wide extinction (Treves, 2009). Before the establishment of protected areas, indigenous protected areas were used in protecting the animals (Stevens, 1997). Communities had their own laws and regulations allowing the harvesting of wildlife for consumption or for other goods. Both ways of conservation contribute to the availability of wildlife for tourism. Tourism is an important foreign exchange earner in Kenya and therefore the country expanded the sector through establishment of various protected areas (Manyara & Jones, 2007). In Kenya there are 22 National Parks, 28 National Reserves and 5 National sanctuaries. Besides, under the Kenya Wildlife Service management are 4 marine national parks and 6 marine national reserves that are highly protected for wildlife (KWS, 2008). On the other hand, Kenya has lost nearly 70% of its wildlife during the past thirty years. Therefore, wildlife conservancies have been established to offer hope for conservation. Conservancies are not only providing a public service by protecting and conserving the majority of the wildlife in the country but also enhancing livelihoods. Currently, Kenyan conservancies cover at least 6.3 million hectares which have directly impacted the lives of more than 700,000 households and secured the 65% of the country's wildlife that is found outside National Parks and Reserves (Bedelian, 2014). Their continued protection and sustainable use will be of benefit to the nation.

### **2.4 An overview on Human-wildlife conflict**

Human-wildlife conflict is a global problem (Dickman, 2010; Gandiwa *et al.*, 2013; Masago, 2018) which has no restriction to a particular geographical location or climatic condition, and occurs where wildlife and human beings interact, and share limited resources. However, the severity and management of the conflict is not uniform across the globe considering that different countries have varied mechanisms for dealing with the problem. Although many studies have conducted and mitigation measures being proposed, cost and inadequate resources hinder full adoption of mitigation measures. Therefore, mitigation measures proposed by the communities under different studies to reduce conflict should be put in place. Conflicts are a product of socio-economic and are particularly controversial because

the resources disturbed have their own economic value and the predators involved are of high profile and are frequently protected (Graham *et al.*, 2005). Additionally, not only the high-profile predators contribute to socio-economic loss but also the low profile wildlife depending on the harm to the community and the proximity to the protected areas. According to Distefano (2005) human –wildlife conflict is more intense in the tropics and in developing countries, where agriculture and keeping of livestock are vital components of rural people’s income and livelihood. As a result, Kenya is not an exception. It can be stated that competition for limited resources leads to conflicts, though in some areas, the need for people to migrate may result in conflicts, not necessarily out of competition between man and wildlife. Human-wildlife conflict encompasses a large diversity of species and situations (Dickman, 2010). Living adjacent to such species can lead to a variety of significant costs especially predation on livestock and local people (Dickman, 2010; Thirgood *et al.*, 2005). Moreover, crop-raiding or destruction of stored food (Pérez & Pacheco, 2006) human attacks (Parker & Osborn, 2006) disease transmission to livestock or humans (Thirgood *et al.*, 2005) and opportunity costs, where people forgo lifestyle choices due to the positions placed on them by the presence of wild animals or protected areas (Gandiwa *et al.*, 2013; Woodroffe *et al.*, 2005). On the other hand, man may be the aggressor, causing untold damage to wildlife. Examples have been documented in Africa, where hunting of elephants and Rhinoceros has caused a decline in numbers of the two species.

According to Messmer (2000) the impacts caused by wildlife on farm production vary depending on the size of land and dependence of people on land as source of livelihood. Areas settled for agricultural production are likely to suffer more economically where there is a conflict between man and wildlife. In some case, barriers have been constructed in order to lessen conflicts in the form of fences (electric fences in Mount Kenya and Aberdare) and trenches (e.g. in Uganda Budogo Forest) with varying degrees of success and failures attributed to many reasons as demonstrated by (Webber *et al.*, 2007). In some areas where the barriers and deterrents are constructed, frequent supervision should be undertaken to monitor the vandalized areas of the barrier. People bordering wildlife reserves should as well take the responsibility of reporting the weak spots and warn people who encroach the protected areas. Some of the reasons advanced for the failures include lack of identification of key stakeholders, objective evaluation to assess the efficacy and benefit of the intervention, participatory monitoring and evaluation, and long-term funding commitment by conservation agencies (Webber *et al.*, 2007). Carnivores are particularly important when considering human -wildlife conflict because their presence or absence alters entire ecosystems in terms of structure,

function, and prey regulation. Most large carnivores are in global decline partly due to conflicts with people, mainly over predation on small and large livestock (Koziarski *et al.*, 2016). In fact, poison is mostly used to kill these large carnivores because it is hard to kill them physically. As a result, many carnivores are killed leading to entire decline. Along tropical deforestation frontiers, large carnivores often shift from natural to livestock prey because of their increased proximity to human agriculture, thus increasing the likelihood of conflicts with humans (Michalski *et al.*, 2006). In Kenya, communities bordering the protected areas are found of grazing their livestock along and inside the protected areas. If carnivore species are not conserved then the biodiversity of an ecosystem can be destabilized (Noss, 1996; Treves & Karanth, 2003). Hyenas are known to be of ecological importance in the reserves and protected areas and eradicating them may lead to an unstable ecosystem and food web. Further, carnivores can even go to an extent of reducing tolerance toward species that are already threatened (Gandiwa *et al.*, 2013).

In Canada and the United States of America, wolves (*Canis lupus*), American lions (*Panthera atrox*) and pumas (*Puma concolor*) are the dominant animals which cause death of livestock. Due to this, people have tried to protect their animals and as a result at least 14 wolves (*Canis lupus*) were killed in the year 2001 (Musiani *et al.*, 2003). In Europe also, even though both wolves and bears are present in these areas, wolves are known to cause the majority of killings (Graham *et al.*, 2005). This may be attributed to the social behavior of the wolves and their carnivorous behavior. Lion (*Panthera leo*), cheetah (*Acynonyx jubatus*), and spotted hyena (*Crocuta crocuta*) are the major causes of human-carnivore conflict in Kenya, which not only affects the rural and vulnerable communities but also has a large impact on commercial cattle ranches (Distefano, 2005). Commercial cattle ranches have even gone to extent of coming up with modern bomas with sensors and employing guards to provide security to the livestock against carnivores. This has helped in reducing the conflict but not completely because cattle are being grazed in the same area where lions and other carnivores are found. Therefore, the commercial cattle ranches should come up with exclusive zones for wildlife and livestock, where the interaction between carnivores and livestock is limited. According to Patterson *et al.* (2004) the three carnivore species that are responsible for attacks in Tsavo East National Park in Kenya are lions, spotted hyena and cheetah with the hyena targeting cows, steers, and bulls and the latter attacking the smaller adult livestock such as goats, sheep, and calves. Spotted hyena are the most found, among all the large carnivores in sub-Saharan Africa, tropical forests and also Alpine forests. Moreover, spotted hyenas are domestic hunters which are known to attack and kill humans (Gade, 2006). Moreover, in Kenya; hyenas are also known

to attack livestock which contributes to huge economic loss especially to the Communities bordering protected areas. According to Dejene *et al.* (2016) in eastern Ethiopia, the economic cost of livestock due to predation from hyena was about USD 7527.8 in the year 2011. There is a need to conduct research to generate up-to-date information to aid in understanding the current situation of livestock predation in many parts of the world. The research should be area and species specific to generate usable data for decision making.

## **2.5 Drivers of human-wildlife conflict**

There are many different events and trends which have contributed to human–wildlife conflict globally. Human population increase has caused an increase in settlement that has led to encroachment of the protected areas (Brandon & Wells, 1992; Noe, 2003). This is only true where frameworks for protection of wildlife sanctuaries are weak. The encroachment on protected areas leads to fragmentation and conversion of land for agriculture and other uses which are incompatible with wildlife (Makindi *et al.*, 2014). When this happens, the interaction between human beings and wildlife in that area leads to conflicts and extinction of wildlife. According to Distefano (2005) in sub-Saharan Africa increasing human population has led to direct competition with local wildlife communities. Intrusion into wildlife habitats and constriction of species into marginal habitat patches is the ultimate result leading to conflicts. Land use change is another driving force where forests, savannah and other ecosystems are transformed into agricultural lands and urban settlements. If this conversion occurs in areas where wildlife abounds, there is likely to be a conflict. Samburu, Taita, Trans-Mara, and Kwale areas in Kenya where conflict is intensified by habitat fragmentation (Distefano, 2005; Madden, 2004). Human population and land transformation in Kenya have led to wildlife habitat loss, habitat degradation, and fragmentation (Hooke *et al.*, 2012). Human population pressure and anthropogenic activities has contributed to rapid decline of wildlife populations and the increase in human-wildlife conflicts over the past few decades (Bateman & Fleming, 2012; Ogutu *et al.*, 2014; Ogutu *et al.*, 2016), which is a true case specifically in Kenya.

Increase in livestock population has created a diet overlap and forage competition with wild herbivores resulting in confined overgrazing and decline in wild herbivores (Distefano, 2005; Gordon, 2009; Mysterud, 2006). However, this may not be true in many African countries as livestock numbers have been on the decline due to several factors. On the other hand, a decrease in wild prey like zebras, gazelles can cause a predator to shift their diets to livestock due to their limited ability to escape as they cannot run as fast as zebras, and this leads to conflicts between wildlife and the farmers (Distefano, 2005). This will be true in cases where

there is livestock to be preyed on. In the absence of livestock, human beings can be preyed on thus causing a bigger problem of compensation in some cases. Climatic factors are also important causes of human-wildlife conflict. According to Patterson *et al.*, (2004), in Tsavo National Park lions are more likely to attack livestock during the rainy seasons. On the other hand, during the dry season, ungulates spend most of their time near water sources and therefore are easily spotted and killed. Additionally, stochastic events, for example fires, are also drivers of human-wildlife conflict. According to Nyhus and Tilson (2004) in the year 1997-1998, *El-Nino* provided conditions that are favorable for drought, which led to destruction of Sumatran forests. The tigers (*Panthera tigris*) which were fleeing this area were reported to have killed a person in Berbak National Park in Sumatra Island, Jambi province of Indonesia, Southeast Asia. Fires removes the ground cover which may force grazers to look for feeds on farms and as they do so, they cause damage. Additionally, carnivores are also forced to move out of the park leading to the interaction between them and livestock hence predation. There is evidence of crop destruction, injuries caused by wild animals, deaths, and predation of livestock animals by dangerous wild animals (Musimbi, 2013). The study revealed that 85% of the respondents indicated that human beings have been injured by wild animals, 78% admitted the occurrence of death 91% of respondent's reported crop destruction and 88% reported predation by wild animals (Musimbi, 2013).

## **2.6 Socio-economic impacts from human-wildlife conflict**

Human-wildlife conflict leads to socio-economic impacts locally, nationally, regionally, and globally as humans move from one place to another. People who are sedentary are affected as well. Large mammalian carnivores (lions, leopards, cheetahs, spotted hyenas and wild dogs), larger herbivores (elephants, buffalo and hippopotamus), and crocodiles are traditionally seen as the animals representing the greatest threat to humans and responsible for the majority of human-wildlife conflicts (Masago, 2018). Baboons are as well known to be a menace especially to people living at the edge of protected areas. The impacts of HWC can be direct, such as injury and death from dangerous animals like lions which are known to maim and kill cattle around the outskirts of Nairobi, and indirect, damaging crops and infrastructure (Lamarque *et al.*, 2009; Masago, 2018). They not only damage the crops but sometimes the whole plant is consumed unlike the tree crop which may suffer damage but can rebound if the conditions are right. The earliest example of direct impact of HWC dates to 1924 in South Africa. A 'Taungskull' was discovered, estimated to be two million years old, which belonged to a child that was killed by an eagle (Berger, 2006). In Southern Asia, due to high tiger numbers, they

are responsible for about 60 human deaths annually. Apart from human attacks, tigers cause injuries to livestock, prey on them, and cause harassment which leads to economic losses when both the attacks were equated to monetary value (Gurung, 2008). When these impacts are rated in terms of scale, the smaller animals can cause huge impacts which occur in large numbers. For example, the red locust in Africa which causes a lot of havoc and famine, is because of this infestation, and also the red-billed quelea causes cereal losses annually, which is estimated to be USD22 Million (Lamarque *et al.*, 2009). Large animals like lions, leopards, wild dogs and spotted hyena, cause the greatest impacts in terms of human- wildlife conflicts leading to minor, serious injuries and even death. According to Wang and Macdonald (2006) livestock predation by carnivores in Jigme Singye Wangchuck National Park, is conspicuous. The annual mean livestock loss faced by farmers is almost 1.29 head of stock leading to an economic loss amounting to USD 12,252 of which leopard and tiger kills accounted for 82% (US\$ 10,047). Most tiger kills were cows which in essence farmers keep for milk production and multiplication of future herds.

A study undertaken in Web Valley, Bale Mountains National Park in Ethiopia showed that a total number of 704 livestock were killed by wild carnivores over a 3-year period, causing a loss of potential revenue of USD 12 per year per household in a compounded interest. Spotted hyenas were reported to be responsible for most livestock predation. According to this study, hyenas killed all livestock types (horses, donkeys, mules, cattle, goats, and sheep) whereas leopards, common jackals and servals (medium wildcats) killed mostly goats and sheep (Atickem *et al.*, 2010).

On the other hand, baboons (*Papio papio*) have caused a lot of destruction to timber forest plantation in South Africa (WWF SARPO, 2005). This led to loss of timber economically as well as waste of resources. On the other hand, in Kenya the economic damage of wildlife to forest plantations meant for timber production is more severe and this leads to huge financial expenses. In Mt Kenya, where plantations are not well protected from wild game, damages are widely prevalent. The study indicated that well-designed animals' migration corridors and culling measures should be adopted to reduce the impacts from the wildlife to the forest plantations (Mugo *et al.*, 2013).

## **2.7 Impacts of human-wildlife conflict on wildlife conservation and management**

The main goal for wildlife conservation is to protect the wildlife and the habitat for future generations to enjoy and view different species in their natural habitats thus important for ecological sustainability (Abraham & Kumar, 2017). This should not mean that current

generations cannot enjoy the benefits of conservation. Sustainable multiple use management should be overriding aim of conservation. Different organizations, public and private are teaming up in order to bring about wildlife conservation by funding different research concerning the wildlife conservation and management into reality (Mtango & Spinach, 2007). This may not be successful if the researchers will not concentrate on the impacts of wildlife to communities and impacts of human population on the protected areas. Funding for wildlife conservation can come from the sale of fishing licenses, hunting licenses, game tags, and excise taxes from the hunting equipment and ammunition, which collects up to USD 200 million annually (Abraham & Kumar, 2017). It can also come from individuals who calling is towards conservation, and therefore have devoted part of their wealth to support conservation activities. However, there are a lot of impacts caused by the human-wildlife conflicts which can halt effective wildlife conservation. For instance, the retaliation towards wildlife after killing or causing damages instead of supporting conservation (Conover *et al.*, 1995). In addition, negative attitude towards conservation is contributed by human population pressure, poverty hence poaching, low awareness creation on conservation and lack of integration of local population (Kanyamibwa, 1998). It can also be contributed by lack of awareness towards wildlife conservation. For instance, in Africa, people put snares near the protected areas aiming to injure and kill wild animals for food and other purposes. War is such an example or case where the wealthy people want to make more money through illegal means. Such people may cause conservation efforts to fail as they are also influential in the communities. Cultural activities are another challenge to conservation and may lead to conflict. During cultural festivities, people may want to kill animals for their feathers and skins, and this does not augur well for conservation.

## **2.8 Mitigation Measures to prevent and control Human-Wildlife Conflict**

Several effective methods have been used to mitigate HWC. These methods can be direct or indirect. The direct method is by reducing the severity or occurrence of meetings with wildlife and indirect method is through raising human tolerance for happenstances with wildlife through involvement of different interventions (Conover, 2001; Dhakal & Thapa, 2019; Hockings, 2009; Treves & Karanth, 2003). According to Mwamidi *et al.* (2012) different approaches can be adopted to reduce such impacts or to deal with wild animals in a friendly way. Electric fences which are more and the most effective way of managing wildlife especially the crop-raiding elephants has been used widely (Davies *et al.*, 2011; Kioko *et al.*, 2008; Osborn & Hill, 2005; Redpath *et al.*, 2013; Young *et al.*, 2013). Additionally, electric

fences can also be used with human –shaped dummies which have been used in India to keep away tigers from attacks (Nyhus & Tilson, 2000). According to Kassilly *et al.* (2008) barrier fences have been used in controlling the problematic wildlife since prehistoric period. A GIS mapping software and GPS tracking collars can also be used to find out the conflict hotspots, be it the farm, ranches, or buffer zones, which helps in revealing how conflict-causing wildlife are behaving and how to avoid such areas to reduce conflict (Hulbert & French, 2001). This is strictly not a method to prevent but can help in mapping danger spots and help in deciding on effective mitigation measures. According to Makindi *et al.* (2014) the Tsavo Conservation Area community identified indigenous strategies of minimizing the conflicts. Among the methods is the use of noises from objects especially metal objects, scarecrows, burning of hot pepper, use of fire, burning of cow dung, use of dogs, use of spears, use of traps, burning of rubber and killing animals using arrows. These methods may work for some animals, especially for those that learn that they may face danger when such methods are employed. However, some animals are attracted to those noises and see the noise makers as prey. Poverty does increase when human-wildlife conflicts are high, especially when farmers depend on crops alone which are later destroyed by animals (Barua *et al.*, 2013). To combat such a situation ecotourism is encouraged to boost the local economy and by this the communities adjacent to the park can not only depend on farming but also be supported by the wildlife, through infrastructural developments for example roads, schools and hospitals. Moreover, based on benefits accruing from ecotourism for locals, communities have been reported to support conservation (Newmark *et al.*, 1994; Manyara & Jones, 2007). In Taita Hills, the community living adjacent to the forest use various indigenous methods in controlling or minimizing the human-wildlife conflict. These methods are both destructive and non-destructive (Mwamidi *et al.*, 2012). The destructive methods include killing the problematic animal and exposing it to scare other animals, use of trooping, trench digging and snaring. The non-destructive methods on the other hand include; community collective agreement, burning of dung of the wild animals, use of scare crows, painting of primates, use of black thorn (*Acacia mellifera*), use of brew and drum beating (Mwamidi *et al.*, 2012). As indicated earlier, the success rate is species or animal dependent.

## **2.9 Policy and legislative Measures to prevent and control HWC**

### **2.9.1 Wildlife Management and Conservation Act, 2013**

In Kenya, the management of wildlife is governed by the Wildlife Management and Conservation Act, 2013 (Didi, 2013). The Act provides for protection, conservation sustainable

use and management of wildlife in Kenya and other connected purposes which are related. The Act applies to all wildlife resources on public, community and private land and Kenya territorial waters. The Act is supported by the wildlife policy and chapter four to eleven comprise the all-inclusive policy framework for sustainable wildlife conservation countrywide. Some of the key elements include: (1) enactment of a comprehensive wildlife law to implement this Policy; Wildlife Policy, 2007 (2) mainstreaming of wildlife conservation into national land use systems; (3) decentralization of wildlife conservation planning, implementation and decision-making processes to the constituency level; (4) wildlife conservation and management will be ecosystem-based; (5) community participation in wildlife conservation and management through establishment of community wildlife conservation areas and sanctuaries; (6) mainstreaming research and monitoring in wildlife conservation and management; (7) provision of appropriate incentives and user rights to communities and other stakeholders to promote sustainable wildlife conservation and management from the revenues collected from the tourists, researchers and other non-governmental organizations; (8) innovative measures to mitigate human wildlife conflict like use of drones in monitoring wildlife , camera traps and motion sensors ; (9) establishment of the Wildlife Compensation Fund to broaden the financial resource base for compensation of wildlife damage to human, crop, livestock and property(e.g. the car fee entry); and (10) regional and international cooperation in the conservation and management of shared wildlife resources and its regulations e.g. Wildlife Conservation and Management (Protection of Endangered and Threatened Ecosystems, Habitats and Species) Regulations, 2016.

### **2.9.2 Environmental Management and Coordination Act of 1999**

According to EMCA, Regulations, 2016, legal No. 60, The Environmental Impact Assessment should be done on the conservation of biological diversity. Lack of an Environmental Impact assessment license issued by the authority, may lead to the unsustainable use of natural resources. A person shall not engage in any activity that may have any impact on the ecosystem or that leads to introduction of any exotic species. The Authority shall, in consultation with the relevant lead agencies (i) Impose bans, restrictions on the access and use of any threatened species to ensure its regeneration and maximum sustainable yield; (ii) to issue licenses for the establishment and maintenance of facilities for the recovery and rehabilitation of threatened species and (iii) Determine full recovery and rehabilitation measures of threatened species to ensure its restoration into its natural habitat. Any person who intends to access genetic resources in Kenya shall apply to the Authority. An application should (a) state

the purpose of seeking an access permit; (b) be in the form set out in the First Schedule and, (c) be accompanied by such as fees set out in the Second Schedule. Every applicant issued with an access permit in accordance with these regulations shall strictly comply with the terms of that permit. Where purpose for which the permit was issued, the applicant shall notify the authority and apply for approval to undertake the new activities. If any person violates the provisions of this section, commits an offence. The holder of an access permit shall facilitate an active involvement of Kenyan citizens and institutions in the execution of the activities under the permit. The facilitation by the holder of an access permit shall include enjoyment of both monetary (e.g., access fees or fee per sample collected or acquired) and non-monetary benefits arising from the right of access granted and the use of genetic resources(e.g. Sharing of research and development results and Joint ownership of relevant intellectual property rights).

### **2.9.3 Animal Disease Act CAP 364, Revised Edition 2012**

Every person having in his possession or charge an animal infected with a notifiable disease or suspected of being infected with a notifiable disease shall keep such animal tied up or enclosed in a boma or other enclosed place and kept separate from other animals not so infected or suspected of being infected; and forthwith give notice of that fact to the nearest administrative officer. Any veterinary surgeon who has reason to believe or suspect that any notifiable disease exists on any farm or in any area shall, notwithstanding the provisions of subsection (1), immediately give notice to the nearest administrative officer. An administrative officer shall notify all owners or occupiers of farms and owners of stock in the neighborhoods of the outbreak, and further inform the most senior veterinary officer in the neighboring district on being satisfied of the existence or suspected existence of a notifiable disease within his district. To prevent notifiable disease, director prohibits the movement of animals from one area to any other area. There shall be no stock moved from or into any infected area to place within such area without the written permission of the Director, or of any person authorized in writing by the Director to give such permission. The carcasses of all animals infected with notifiable disease shall be disposed of in accordance with any general or specific instructions issued by a veterinary officer or an inspector.

### **2.9.4 Tourism Act No 28 of 2011**

Although it is not clearly documented in the tourism Act 2011, many people have benefited by keeping wild animals in their farms. Wild animals are known to attract tourist

locally and internationally. Through this, there is park fee charged to help in running the farm and providing proper protection and conservation to the wild animal. Good examples are the conservancies that are privately owned by individuals. Farms are highly important in protecting especially threatened and endangered species that are nearly facing extinction. Additionally, wildlife farms create employment opportunities to many people whether economically, socially, or even culturally. Wildlife conservation projects bring the community together by calling for a team effort from rangers to administrators; conservation initiatives invite the opportunity for a new preservation-based economy. However, these individuals (farm owners) undergo several challenges like snaring, conflicts, and human encroachments in their farms. There is therefore a need to create awareness starting from the younger generation on how important wildlife are locally, regionally as well as nationally to stop killing and human encroachments towards the protected areas.

## **2.10 Perceptions towards wildlife conservation**

It is essential to understand the attitudes of the community living adjacent to wildlife to inform the design of wildlife management and human wildlife conflict interventions (Kansky & Knight, 2014). Perceptions towards wildlife differ across communities, countries, globally and are important in informing conservation interventions at various hierarchical scales. Otherwise, many conservation measures fail because of the community's unlikeliness to conserve wildlife. According to Hill (2010), primates are perceived as gods or evil spirits and are killed for food because of the damage they cause to crops and sometimes to different properties. They are perceived as descendants from human ancestors in some communities. The perceptions may work for or against conservation.

According to Manfredo *et al.* (2009) perceptions towards wildlife conservation, provide insight on how a community prefers diverse management options and even the extent of damage the community is willing to tolerate and the desirability of different species on both private and communal land. The local community adjacent to protected area in Nepal had a negative attitude towards the conservation of snow leopards but have positive attitudes towards establishments of protected areas (Karanth & Nepal, 2012). The reason behind this was that snow leopards do prey on livestock and cause economic losses (Bagchi & Mishra, 2006). Hyena are sport hunted in some places even though they are not in demand for trophy hunters since they are not attractive and are sometimes hunted for food or medicine (Höner *et al.*, 2002). People's perception towards carnivore especially the spotted hyena are often negative when it relates with damage –causing predators and efforts of conserving the large carnivores may fail

if the communities are not involved (Yirga & Bauer, 2010). Livestock predation of the spotted hyena has insignificant impacts to the agricultural sector and affects minority of the farm (Kruuk, 2002). However, the predation can economically be significant especially to the subsistence farmers (Yirga & Bauer, 2010). Any farmer wants to keep livestock for meeting various needs. Attacks by hyenas may disrupt the normal functioning of farms regardless of the size.

### **2.11 Ecology and social behaviors of hyena that predispose it to HWC**

From the earliest literatures on African wildlife up to today, spotted hyenas have been viewed with considerable dislike (Abay *et al.*, 2011; Bearder, 1977). The family of hyaenidae has only four living species therefore becoming the smallest family amongst the mammalian carnivores. According to Watts and Holekamp (2007) there are four species in the family of hyaenidae. They include; aardwolf (*Proteles cristata*) with the lowest group size of 2 and are known to prey on termites. The striped hyena (*Hyaena hyaena*) has group size of 2 to 4 and they as well scavenge on vertebrate's remains. The third family is the brown hyena (*Parahyaena brunnea*) with group size 3 to 14 which scavenge on remnants from the vertebrates. Spotted hyena (*Crocuta crocuta*) has the largest group size of 10-90 and is known to prey on large ungulates. The Spotted Hyenas (*Crocuta crocuta*) are nocturnal animals and are listed as the least concern in the IUCN global Red list of threatened species (Yirga *et al.*, 2016). Their species are widespread in Africa with continuous distributions over large areas in Ethiopia, Tanzania, Namibia, South Africa, Botswana and even Kenya (Yirga, *et al.*, 2013; Yirga, *et al.*, 2014). Spotted hyenas are large terrestrial predators which occur throughout sub-Saharan Africa. Moreover, they exhibit many similarities to cercopithecine primates with veneration to their life histories, size and density of their social groups (Holekamp *et al.*, 2007). Males reach their generative maturity at 24 months of age, and most of the females start bearing young in their third or fourth year. According to Engh *et al.* (2000) hyena clans contain a multiple adult male and multiple matrilineal of adult female with offspring, comprising of individuals from several overlying generations.

Furthermore, in Africa they are known to be the greediest and ugly animal in the wild. Hyenas are divided into several clans. The members of a clan feed alone or in small groups and possibly associate at a large food supply near a den. Associations between clan members are highly flexible. Some individuals have regular contact with one another while others are unsociable (Bearder, 1977). A new member can a times be accepted and the same stretch there is always a competition between neighboring clans.

## 2.12 Gaps in knowledge on Human-Wildlife Conflicts studies

Table 1: Knowledge Gaps

<b>Author &amp;Year</b>	<b>Study Title</b>	<b>Findings</b>	<b>Knowledge gap</b>
Messmer (2000)	The emergence of human wildlife conflict management: turning challenges into opportunities	Urban households reported a mean loss of \$63 per household or a total loss of \$1.9 billion because of wildlife damage. Urban residents also reported spending over 260 million hours trying to solve or prevent these problems.	The study only focused on the emergence of HCW and increasing stakeholder participation in managing human wildlife conflicts
Mwamidi <i>et al.</i> (2012)	The use of indigenous knowledge in minimizing human-wildlife conflict: the case of Taita community, Kenya	Taita people living in the neighborhood of these forests had indigenous knowledge which they used to control or minimize human-wildlife conflicts. The practices were non-destructive and destructive practices	The study only focused on the indigenous practices of controlling or minimizing the human wildlife conflict
Kassilly <i>et al.</i> , 2008	Mitigating human-wildlife conflicts through wildlife fencing: a kenyan case study	The study compared the intensity of human-wildlife conflicts between one local community neighboring Lake Nakuru National Park	The study discusses the problematic wildlife around Lake Nakuru National Park and Maasai Mara Game reserved

		(a fenced wildlife protection area) and another community neighboring Maasai Mara Game Reserve (an unfenced wildlife protection area).	
Musimbi (2013)	Factors influencing human wildlife conflict in communities around the park: a case of lake Nakuru National Park.	Human wildlife conflict has increased in the areas surrounding Nakuru National Park. The increase of conflict has been so endemic that it has called for the need to find an cordial solution to the problem	The study focused on how competition over resources influences human-wildlife conflict in communities living around LNNP as well as the establishment of the extent to which human encroachment to wildlife corridors and protected influences human-wildlife conflict in communities living around LNNP

## 2.13 Theoretical framework

### 2.13.1 Social and ecological theory

According to the WCS (2018) successfully limiting human-wildlife conflicts requires an understanding of the roles of both animal and human behavior. Human wildlife interactions (HWIs) can be conceptualized as the outcome of two separate but interacting systems: social and ecological. The need for social-ecological integration is very clear in the management of human-wildlife interactions (HWIs) (Lischka *et al.*, 2018). In reference to Dickman (2010) although HWIs are the direct result of human and animal behavior, various ecological and

social factors contribute to the stipulations shaping those behaviors. Therefore, it very critical to understand the complexity of drivers of HWIs since the value people place on these interactions finally provides the foundation for wildlife conservation and management (Riley *et al.*, 2003).

### **2.13.2 Coupled human–natural systems and complexity theory**

Human beings have constantly interacted with natural systems leading to the development of coupled human and natural systems. Untangling the complexities in the natural systems can lead to new scientific discoveries that are essential in developing effective policies for ecological and socio-economic sustainability (An, 2012; Liu *et al.*, 2007). Human interactions with wildlife are a defining experience of human existence and can be positive or negative (Hughes & Carlsen, 2008). People compete with wildlife for food and resources leading to conflict (Nyhus, 2016). This conflict has led to the extinction and reduction of numerous species and uncountable human deaths and economic losses (Nyhus, 2016). Dogs and cats can cause conflict through predation on other wildlife, disease transmission, wildlife disturbance, hybridization, and direct attacks on livestock (Nyhus, 2016). Cats and dogs are particularly at risk for conflict with people because of their large habitat, dietary requirements, and large physical sizes (Macdonald, 2004). Their abundance is often determined by availability of prey; therefore, the increasing number of livestock increases prey density that can potentially lead to increased conflict (Macdonald, 2004).

## **2.14 Conceptual framework**

The independent variables of the study are; hyena habitat encroachment by human, ecological importance, poor security (fences at the bomas, park and the conservancy), hyena food scarcity and perception of local community towards hyena conservation. On the other hand, the independent variable is human-hyena conflict and the severity of conflict. The intervening variables are population growth, wildlife policy and climate change. Combination of all these independent variables plays a role in influencing human hyena conflict. When proper fences are erected (boma and park fences), human encroachment and KWS response strategies are properly managed through working management strategies, assuming land and compensation policies are constant then human -hyena conflict will be minimized to a manageable level.

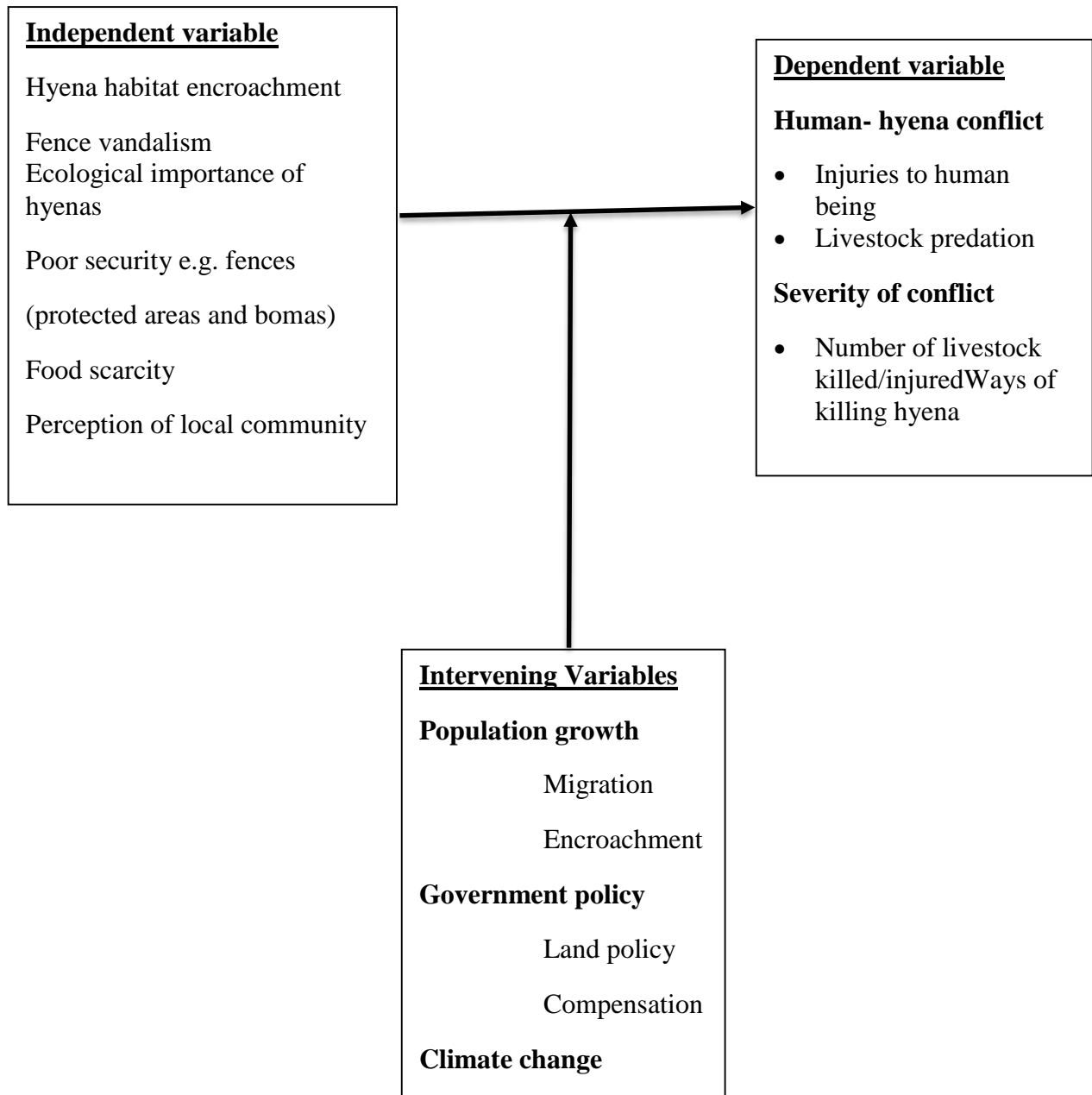


Figure 1: Conceptual framework showing the relationship between factors that contribute to HWC and the impacts of the conflicts

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Description of the Study area**

##### **3.1.1 Location**

The study was carried out in villages (as shown in figure 2) that border Lake Nakuru National Park and Soysambu Conservancy. The Park has an area of 188 km<sup>2</sup> and is found in Nakuru County, approximately 160 km northwest of Nairobi and lies at an altitude of 1952m above sea level. Soysambu Conservancy, which is adjacent to the Lake Nakuru National Park, covers an area of 199km<sup>2</sup> that lies 1700m above sea level (Daniels & Bassett, 2002; Musimbi, 2013). Lake Nakuru National Park and Soysambu Conservancy lies within 36° 05' E and 0° 24' S. Lake Nakuru National Park was gazetted as a bird sanctuary in the year 1960, and eight years later, elevated to a National Park. Soysambu Conservancy is on the west of LNNP and shares a boundary of 12.1 km. It was created in the year 2007 to serve as an entity of conserving the flora, fauna, and the scenery of Soysambu Ranch.

The Park has been enlarged partly to provide the sanctuary for the black rhinos and the electric fence has been erected. In 1976, the whole park was fenced with a chain link and in 1986 a solar electric fence was installed along the inside of the chain link. This construction of electric fence has helped in keeping out poachers rather than to restrict the movement of wildlife. Soysambu Conservancy was founded in 1906. The conservancy covers the northern, western, and part of the southern shores of Lake Elementaita. Additionally, the conservancy offers quite extensive wildlife viewing, as well as camping.

The two sites (SC and LNNP) have a dry and warm climate with temperature ranging between 19°C to 26°C. The soil is moderately to highly fertile, ranging from volcanic soils, lacustrine, deposits, clay, sandy and loam soils. Middle altitudes in this area have higher fertility. Rains are bimodal, with long rainy periods between March and May and short rainy periods between October and December. Rainfall is moderate with an average rainfall of 750mm. Annual mean values for evaporation, radiation and temperature correspond to 1800mm, 490 langley and 27°C, respectively (Kassilly *et al.*, 2008).

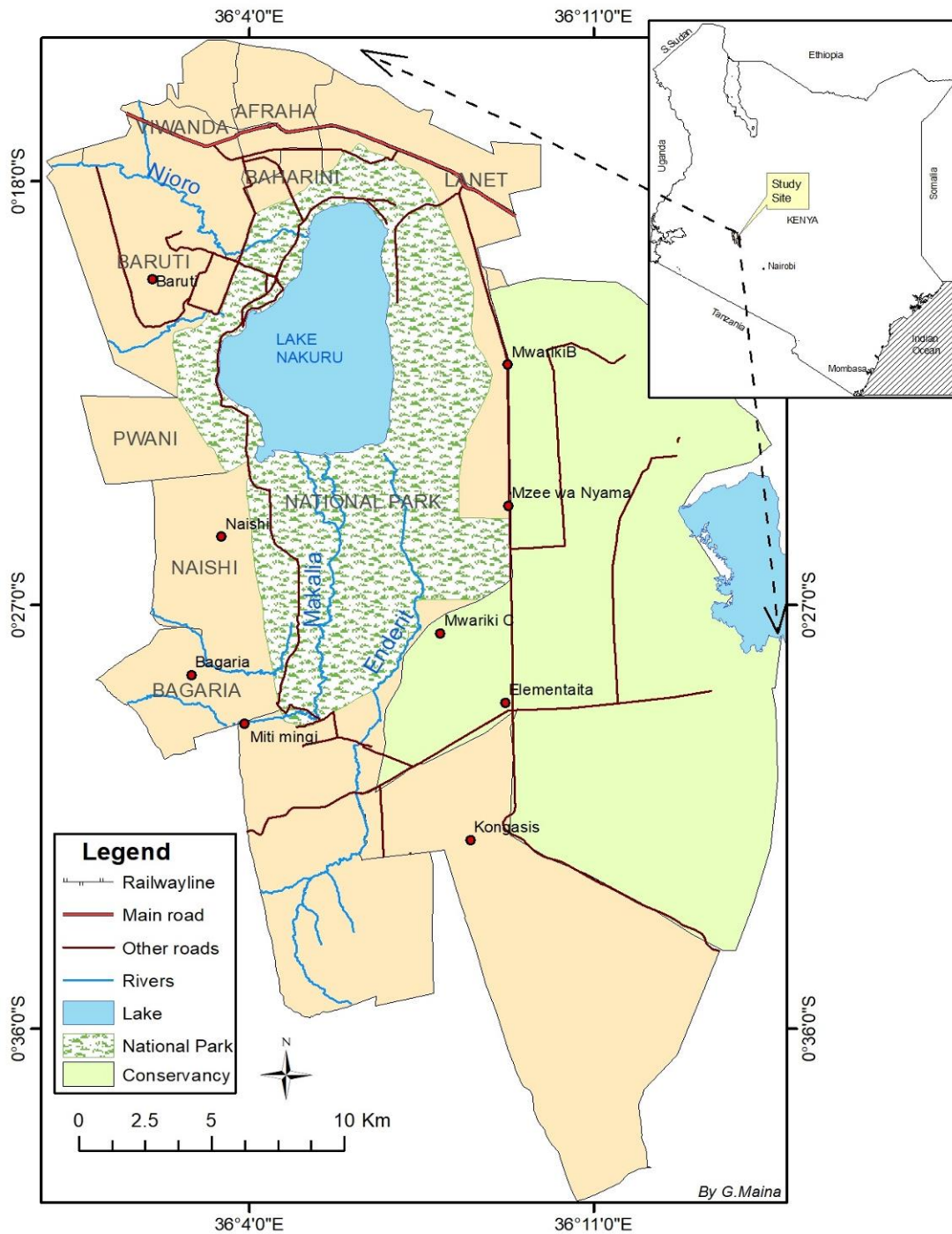


Figure 2: Map of the study area showing Lake Nakuru National Park and Soysambu Conservancy

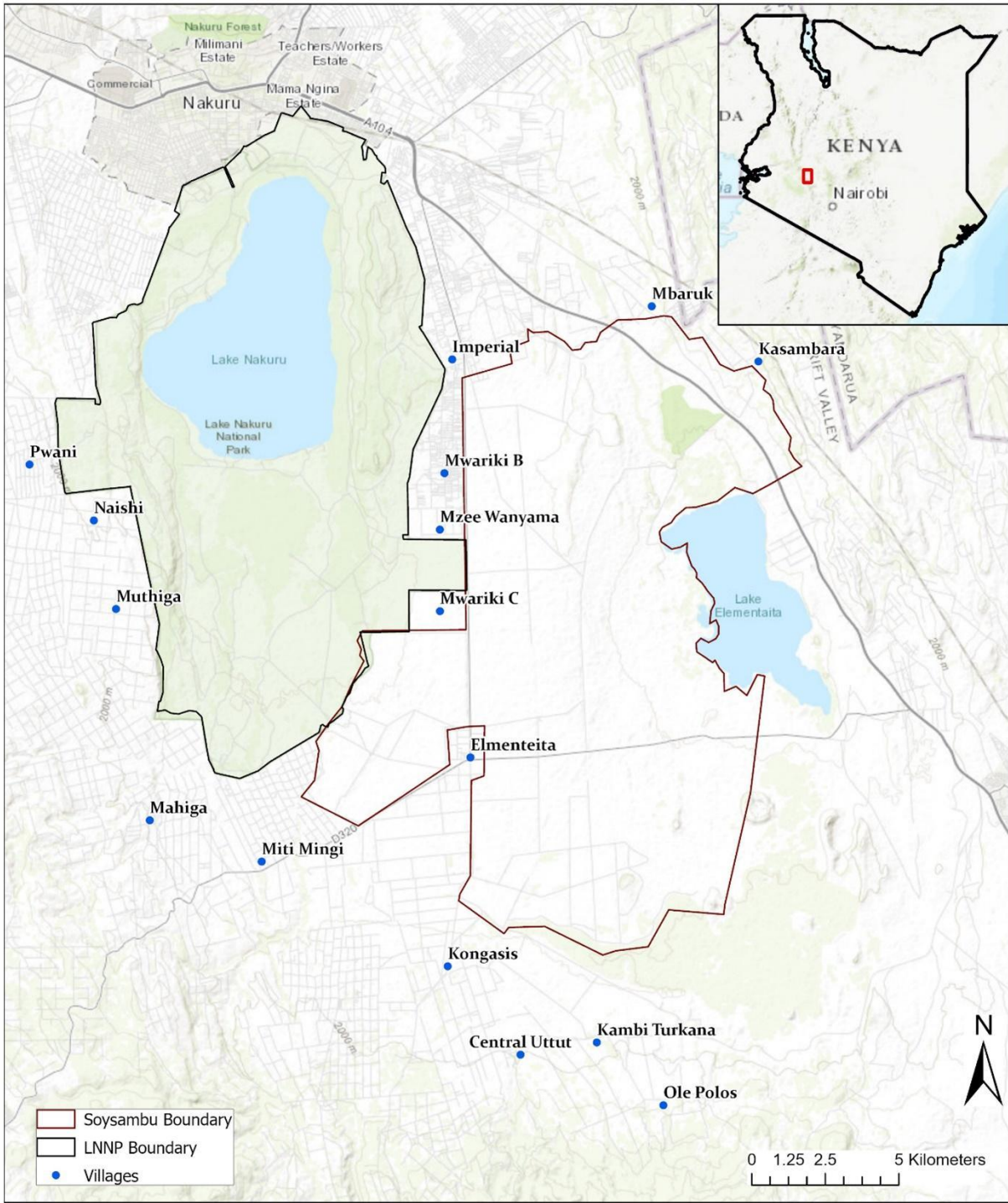


Figure 3: Sampling sites of the study showing various villages that are adjacent to the two sites of interest "Reproduced with permission from Wilkinson et al. 2021".

### 3.1.2 Climate and Hydrology

Lake Nakuru is one of the highest points in central rift valley dome and lies at 1,759m above sea level. It is one of the major basins in Kenya. Its hydrological conditions dictate that

its water levels are dependent on the catchment supply through rivers and also on the wastewater from the Nakuru municipality. Lake Nakuru is fed by 4 seasonal rivers and the permanent Ngosur River. The seasonal rivers are the River Njoro, Nderit, Makalia and Lamundiak, all of which originate in the Eastern Mau Forest (Mavura & Wangila, 2003).

### **3.1.3 Conservation status (Management interventions)**

Lake Nakuru is one of a series of endorheic, hyper- eutrophic and alkaline-saline lakes in the eastern arm of the Rift Valley in Kenya (Odada *et al.*, 2004). The catchment has multiple land use types that is from pastoralism to large-scale commercial farms and ranches which are associated with increasing human population that has increased pressure on the available resources in the area. The developments of urban centers in Nakuru town have affected negatively on the catchment area and more so Lake Nakuru ecosystem (Gichuhi, 2007). These impacts have been manifested through erosion, and pollution from industrial and domestic wastes, agro-chemicals, urbanization and degradation, encroachment into sensitive habitats. On the management interventions, the government has introduced stringent measures on water and waste management targeting polluters in private and public institutions (Gichuhi, 2014). Soysambu conservancy on the other hand involves other partners like Projects Abroad to help them in conservation and management interventions.

### **3.1.4 Biodiversity (Fauna and Flora)**

Lake Nakuru National Park is periodically home for 1.5 million flamingoes and 450 different species of birds (Daniels & Bassett, 2002). The Park supports around fifty other species of mammals including White Rhino, Black Rhino (*Diceros bicornis*), Rothschild giraffe (*Giraffa camelopardalis rothschildi*), warthog (*Phacochoerus africanus*), Elands (*Taurotragus oryx*), different types of gazelles (*Gazella sp*), Lion (*Panthera leo*),Buffaloes (*Bubalus bubalis*), leopard (*Panthera pardus*), spotted hyena(*Crocuta crocuta*) and stripped hyena (*Hyaena hyaena*) (Bird Life International, 2020). It has been recognized as an important area for wildlife conservation, Important Bird Area and a Ramsar site and a UNESCO World Heritage Site. On the other hand, Soysambu also has different kinds of wildlife species that include the warthogs, giraffes, buffaloes, leopards, jackals, hyena, pythons, eland, and gazelles. Additionally, there are a variety of bird species including water birds in Lake Elementaita which is within Soysambu Conservancy. The Conservancy has over 50 mammal species. At the lower part of the Basin there are yellow bark Acacia (*Acacia xanthophloea*), as well as grassland and scrublands which are also found along the lake shores and flood plains. In

addition to this, the moist upland forests cover the upper reaches of the highland and the Riverine vegetation along the river courses gives way to dry upland forests cover (Kimanzi & Mbau, 2019). On the other hand, Soysambu Conservancy is known to be a home to colobus monkeys (*Colobus guereza*), Rothschild's giraffes (*Giraffa camelopardalis rothschildi*), hyenas and about 450 species of birdlife pelicans (*Pelecanus occidentalis*) being the most famous birds (Conservancy, 2012; Kimanzi & Mbau, 2019).

### **3.1.5 Population and socio-economic activities**

Nakuru County is categorized as one of the most populated counties with a total population of about 1,603,325. Twenty percent of the population is residing in urban areas, and the rest reside in rural areas. The county is made up of 11 sub counties: Naivasha, Nakuru Town West, Nakuru Town East, Kuresoi South, Kuresoi North, Molo, Subukia, Rongai, Njoro, Gilgil, and Bahati. The main economic activities are agriculture and tourism. Crops grown in the county vary depending on the ecological zones, precipitation, temperatures, and soils. Maize, beans, Irish potatoes and wheat are among the main cash crops which are grown in the villages around Lake Nakuru National Park and Soysambu Conservation. Furthermore, people living in this area keep livestock especially those adjacent to the park (Personal observation) and perhaps is the reason why predation by large carnivores is still felt.

## **3.2 Research Design**

Research design is the procedure for collecting, analyzing, interpreting, and reporting information (Creswell & Creswell, 2017; Maxwell, 2012). Moreover, Bordens and Abbott (2002) and Janesick (1994) defines research design as a road map to carry out research or else a master plan that specifies the methods and procedures for collecting and analyzing the information needed. The study employed cross-sectional survey design which involved a social survey. This was conducted to obtain data on the main causes of conflicts between the spotted hyena and the local community, drivers of the conflict and the perception of conflict and spotted hyenas by the local community. It was also necessary to determine the mitigation measures of conflict in the area. The study design was ideal to undertake the research in assessing socio-economic impacts of hyena predation on livestock, and how the conflict is between hyena and the adjacent community living near LNNP and Soysambu Conservancy are supposed to be mitigated.

### 3.3 Study population and Sampling unit

The target population consisted of the local community living adjacent to LNNP and Soysambu Conservancy and for KIIs staff of Kenya Wildlife Service working in LNNP and staff of Conservancy. The respondents were interviewed to on the socio-economic impacts of hyena predation on livestock and the perceptions of spotted hyena and the mitigation measures to address human-hyena conflict. Both genders from various households and selected villages were selected at random using a purposive sampling and sampled. The respondents were 18 years and above.

### 3.4 Sampling Procedure

The study employed purposive sampling technique which was used to select respondents from the study area. The population was then selected purposively from villages which were Pwani, Naishi, Muthiga, Mahiga, Miti Mingi, Elmenteita, Mwariki C, Mzee Wanyama, Mwariki B, Imperial, Mbaruk, Kasambara, Central Uttut, Kambi Turkana, Ole Polos consistent with the sampling effort undertaken in Wilkinson *et al.* (2021) which are the villages between Soysambu Conservancy and the Lake Nakuru National Park. The individuals within the groups were chosen by picking them randomly with the help of chiefs, assistant chiefs and the village elders.

### 3.5 Sample size calculation

The sample size was determined by following what Conroy (2006) documented about sample size calculation. Before calculating the sample size, there are two factors to be considered; degree of precision and also the uncertainty of the sample. A larger sample size is better for an unknown population size. In such cases, when using a large population of more than 5000 people 384 people are to be sampled in order to attain the 95% power of the data which is  $\pm 5\%$  Confidence Interval (CI). Additionally, according to Israel (1992) on sample size determination for a large unknown population should adapt the following formula.

$$n_o = \frac{Z^2PQ}{e^2} = 384$$

Where

$n_o$  is the sample size

$Z^2$  is abscissa of the normal curve

P is estimated proportion

Q is (1-P)

e is the desired level of precision

Additionally, the subgroups, which are men and women, at different ages with different educational levels, are represented by 10% of sample, when calculated it results to 38 respondents under  $\pm 20\%$  CI. . The result from the calculation is 432 people sampled across the 16 major villages located within 5km of LNNP and Soysambu Conservancy.

$384+38+10=432$  respondents.

### **3.6 Data collection**

The study used interview schedule (Appendix 1) containing closed and open questions, with two sections: Section A giving the demographic description of the respondent and the Section B, was related to the research variables, which were related to the objectives of the study and observation in the field. Open Data Kit (ODK), software was used to conduct the interviews for the local community. For the Key Informant Interview (KIIs), staffs from Lake Nakuru National Park and Soysambu Conservancy were involved to confirm the information from the local community. Head of each household was randomly selected, both male and female with 18 years and above from different villages Pwani, Naishi, Muthiga, Mahiga, Miti Mingi, Elmenteita, Mwariki C, Mzee Wanyama, Mwariki B, Imperial, Mbaruk, Kasambara, Central Uttut, Kambi Turkana, Ole Polos, because the villages are adjacent to the park. Informal interviews were used also to the get the information from LNNP and also Soysambu Conservancy staff concerning human-hyena conflict. Secondary data were also used and were sourced from LNNP and SC.

### **3.7 Data Validity and Reliability**

An instrument is said to be valid when it measures what was intended to quantify and accurately achieves the intention for which it was designed (Golafshani, 2003; Musimbi, 2013; Wallen, and Fraenkel, 2013). Validity constructs are not about a property of tests but it should be about the property of test score interpretations (Wallen & Fraenkel, 2013). Additionally, they are not about the simple, factual question of whether a test measures an attribute but about the complex question of whether test score interpretations are consistent with a homological network involving theoretical and observational terms (Borsboom *et al.*, 2004). Cook and Beckman (2006) emphasizes that validity is a matter of degree, discussion and should not focus on how valid or not a test is, but how valid a test is. No test instrument is perfectly valid (Cronbach & Meehl, 1955; Musimbi, 2013). The researcher needs assurance that the instrument being used will result in accurate conclusions (Wallen & Fraenkel, 2013). Validity involves

the appropriateness, meaningfulness, and usefulness of inferences made by the researcher on the basis of the data collected (Wallen & Fraenkel, 2013). It can frequently be thought of as judgmental. According to Patten (2004) content validity is determined by judgments on the appropriateness of the instrument's content.

This study relied on advice from experts to determine if the items were representative sample of the skills and traits which comprised the areas to be measured. The language that was used in the instruments for collection of data was simple and of ease for the respondents to understand. Upon the expert's advice, the study improved the structure and content of the instruments. The instruments for this study, interview schedule and the checklist were validated by use of content validation to be determined by an expert judgment as well as consultation with the supervisors.

### **3.8 Reliability**

The staff from Soysambu Conservancy and Lake Nakuru National Park who were also residents in the area, participated in testing the reliability of the tools. All the critical questions were addressed and corrected.

### **3.9 Ethical consideration**

According to Davies (2008) and Musimbi (2013) there are five ethical concerns to be considered when conducting survey research. These guiding principles deals with voluntary participation, anonymity and confidentiality, no harm to respondents, identifying purpose and sponsor, and analysis and reporting. In this study each guideline was addressed individually with explanations to help eliminate or control any ethical concerns. Firstly, in this study, the respondents voluntarily participated without undue influence or coercion. Avoidance of possible harm to respondents is the second ethical guideline principle. This could include humiliation or feeling uncomfortable about questions and this study adhered to this guideline. This study did not include insightful questions or sensitive questions that might cause embarrassment or discomfort to the respondents. Initially, a pilot study was carried out in the two study areas with the staffs from Lake LNNP and Soysambu Conservancy which helped in omitting the sensitive questions. Harm to the respondents may also arise in data analysis or in the study findings, solutions to these harms will be discussed under high level of confidentiality and report writing guidelines. A third ethical guideline was to protect a respondent's identity. This was accomplished by exercising anonymity and confidentiality. A survey is anonymous when a respondent cannot be identified based on a response. A survey is

confidential when a response can be identified with a subject, but the researcher promises not to disclose the individual's identity (Sarantakos, 2012). Participant identification was kept confidential and was used in determining who had not responded for follow-up purposes. Musimbi (2013) fourth ethical guideline used was to let all prospective respondents know the purpose of the survey and the organization that is sponsoring it of which it was done. The purpose of this study was to assess the socio-economic impacts of hyena predation on livestock around Lake Nakuru National Park and Soysambu Conservancy. The fifth ethical guideline, as described by Oldendick (2012) is to accurately report both the methods and the results of the surveys to professional colleagues in the educational community. All respondents were informed that their participation is voluntary and that the information collected from the respondents was anonymous and treated as private and only for research work. A research permit and ethical clearance was also applied for through NACOSTI and ethical clearance committee respectively to give a go ahead for a project to be conducted.

### **3.10 Data Analysis**

Data analysis means to organize, provide structure and elicit meaning; analysis of qualitative data is an interactive process (Musimbi, 2013; Polit *et al.*, 2001). Research findings were studied, and dominant themes and conclusions made. Data that were generated were cleaned to detect errors and omissions. Data from interviews (Open Data Kit questions) were analyzed using SPSS software (Statistical Package for Social Sciences) version 24 and Microsoft Excel, and the results were displayed in charts, frequency distribution diagrams, statistical tables and descriptive statements basing on the research objectives.

Table 2: Summary of Data Analysis

<b>OBJECTIVES</b>	<b>VARIABLES</b>	<b>STATISTICAL TOOL</b>
To document perceived causes of human hyena conflicts in the areas around Soysambu landscape and Lake Nakuru National Park	Causes of human spotted hyena conflict	Descriptive statistics
To evaluate the severity of the human-hyena conflicts including retaliation against spotted hyena	Severity of the conflict caused by spotted hyena	Descriptive statistic
To assess the socio-economic impacts of hyena predation on local livelihoods	Social impacts of spotted hyena predation Economic impacts of spotted hyena predation	Descriptive statistics
To document the local community's perceptions towards hyena conservation	How people perceive hyena	Inferential Statistics (Chi square) Relationship between Gender, education, age occupation and the perception of hyena
To assess the effectiveness of strategies used to mitigate human-hyena conflict for communities living around the conservancy and LNNP	Management strategies to reduce the conflicts	Descriptive statistics

## CHAPTER FOUR

### RESULTS

#### 4.1 Introduction

This chapter presents results of analyzed data as per the study objectives. It presents analysis of data with various statistical tools for various constructs and variables (independent and dependent variables) in the study.

#### 4.2 Response Rate

In this study, 432 respondents were targeted for the interview schedule. A total of 378 respondents turned up for the interview (Table 3). 54 respondents did not turn up for the interview because they needed some tokens which were not provided. As showed in the table 3 below, an 87.5% response rate was achieved. According to Mingaine (2013) and Kepha *et al.* (2014) a response rate of above 50% is adequate for a descriptive study. In additional to this, the return rates of above 50% are acceptable to analyze and publish, 60% is good and 70% is very good (Muthiani & Wanjau, 2012). Therefore, a response rate of 87.5% was adequate in all cases mentioned.

Table 3: Response rate

<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
Interviewed	378	87.5
Unreturned	54	12.5
<b>Total</b>	<b>432</b>	<b>100.0</b>

#### 4.3 Characterization of the population

##### 4.3.1 Gender of the respondents

Of all the people interviewed 53 % of them were men, while 47% were women (Figure 4). Most men interviewed were aged between 36-45 years which constitute 23.7% of the total respondents. Most women were aged 36-45(30.6%), with small percent of 5% being within the age bracket of 66-75 years.

Majority of the respondents who turned up for the interview were men 198 (53%) followed by women with a representation of 47% (180).

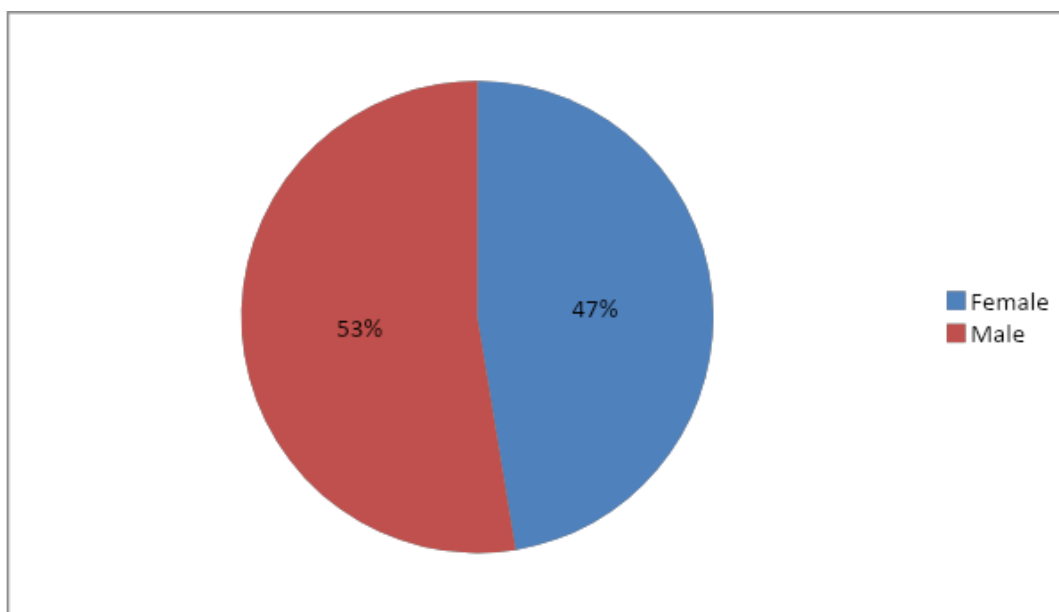


Figure 4: Gender of the respondents who turned up for the interviews

#### 4.3.2 Age of the respondents

The age ranged between 36 and 45 formed the highest portion of the respondent that were interviewed (Table 5) in the study which portrayed the most active members of the community. This was then followed by age group 46-55(19.6%), 26-35(18.5%), 56-65(15.9%), 18-25(9.5%), 66-75(8.7%) and 3(0.8%) were over 75 years which represented the lowest number of respondents who turned up for the interview.

Table 4: Age of the respondents

Age range	Frequency	Percentage
18-25	36	9.5
26-35	70	18.5
36-45	102	27.0
46-55	74	19.6
56-65	60	15.9
66-75	33	8.7
Over 75	3	0.8

#### 4.3.3 Education level of the respondents

The data obtained from the respondents regarding education showed that 149 respondents (39.4%) attained Secondary school level of education, followed by those who finished primary school represented by 137 (36.2%), no formal education 52(13.8%), college 30(7.9%),

vocation/technical school 6(1.6%). The least group on education level were university graduates and students represented by 2(0.5%).

Table 5: Education level of the respondents

<b>Educational Level</b>	<b>Frequency</b>	<b>Percentage</b>
No formal education	52	13.8
Finished primary school	137	36.2
Secondary school graduate	149	39.4
Vocation/technical school	6	1.6
College	30	7.9
Graduate degree	2	0.5
Presently a university student	2	0.5

#### **4.3.4 Occupation level of the respondents**

Most of the respondents were farmers (222) followed by unskilled labour (66), entrepreneur (45), skilled labour (26) and the least represented occupation was the white-collar jobs (19). This representation is true because during the data collection most of the respondents preferred early morning hours so that in the afternoon they get back to their farms.



Figure 5: Occupation of the respondents

#### 4.3.5 Ethnicity of the respondents

The data obtained from the respondents on ethnicity was that 245 (64.8%) were kikuyu and the least tribe represented were Somali at 1 (0.3%)

Table 6: Ethnicity of the respondents

<b>Ethnic Group</b>	<b>Frequency</b>	<b>Percentage</b>
Kikuyu	245	64.8
Maasai	39	10.3
Kisii	29	7.7
Turkana	26	6.9
Kalenjin	16	4.2
Kamba	7	1.9
Luhya	6	1.6
Boran	4	1.1
Samburu	3	0.8
Luo	2	0.5
Somali	1	0.3
<b>Total</b>	<b>378</b>	<b>100.0</b>

#### 4.3.6 Religion of the respondents

Religion is an important entity as far as hyena conservation is concerned. There was a need to know the religion of the respondents to document if religion has an effect on hyena conservation. Majority of the respondents were Christians 356 (94%), 4% were Pagans and 2% were Muslims.

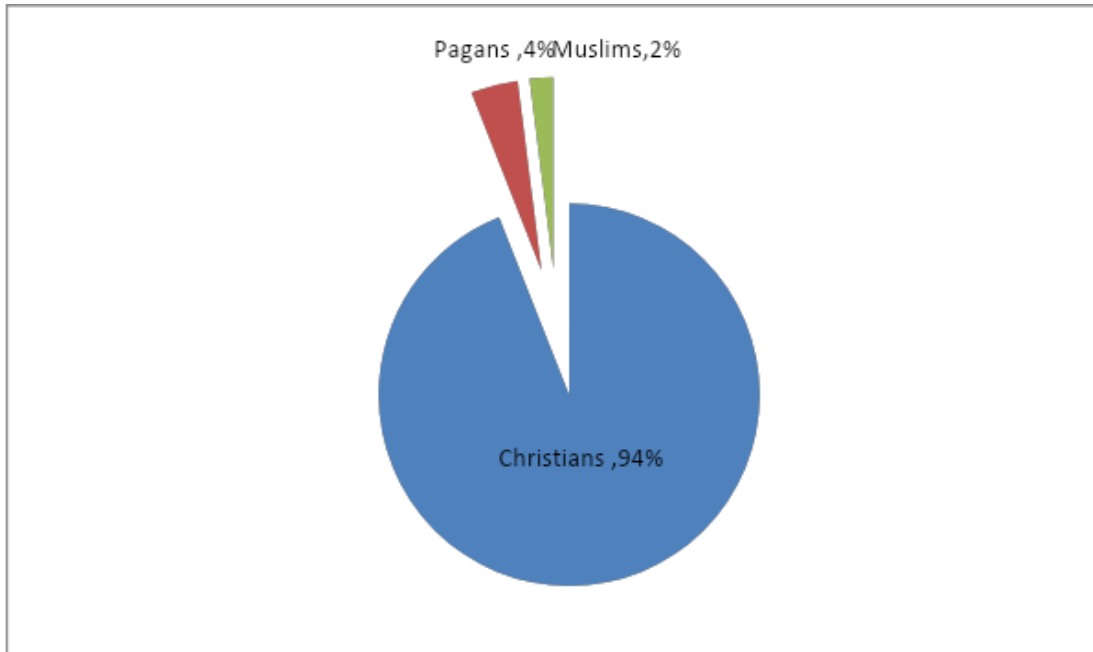


Figure 6: Distribution of respondents by religion

#### 4.4 Causes of human hyena conflict

The causes of conflicts were categorized into four categories namely; hyena food shortage, poor park fencing, poor boma fencing and human encroachment into wildlife space. Most of the respondents reported that poor park fencing is the major cause of attack with a representation of 40% (125 respondents). At least 80% of LNNP is fenced. Even though LNNP is fenced, the community still raise complaints about the park being poorly fenced. This is because fences can be actively sabotaged, broken down for snare wire or exposed to harsh conditions and deteriorate quickly. They may also be simply not adequately and comprehensively maintained. On the other hand, 80% of Soysambu Conservancy is not fenced, giving hyenas freedom to move from the conservancy to the community. The respondents suggested the second cause of HHC was hyena food shortage with a representation of 36 % (221 respondents). Human encroachment was also another cause of HHC whereby only 52 respondents (8%) commented on the same.

Apart from the four categories of causes of HHC, respondents noted other causes namely; poor security from KWS in terms of the number of rangers being less therefore cannot offer

the required security to the hyenas as well as the local community. They also mentioned that hyenas have a nature to always cause attacks especially to livestock. Additionally, the respondents reported that most of their livestock get to their bomas late and on their way home they are attacked by hyenas. According to the respondents, hyenas are known to be so greedy animals and they always hide in the nearby bushes that are near their homesteads giving them an advantage to attack their livestock. Finally, the respondents reported that hyenas have a very high population and due to this they compete for the scarce resources in the park and the conservancy forcing them to get out of the park to find food by attacking the livestock.

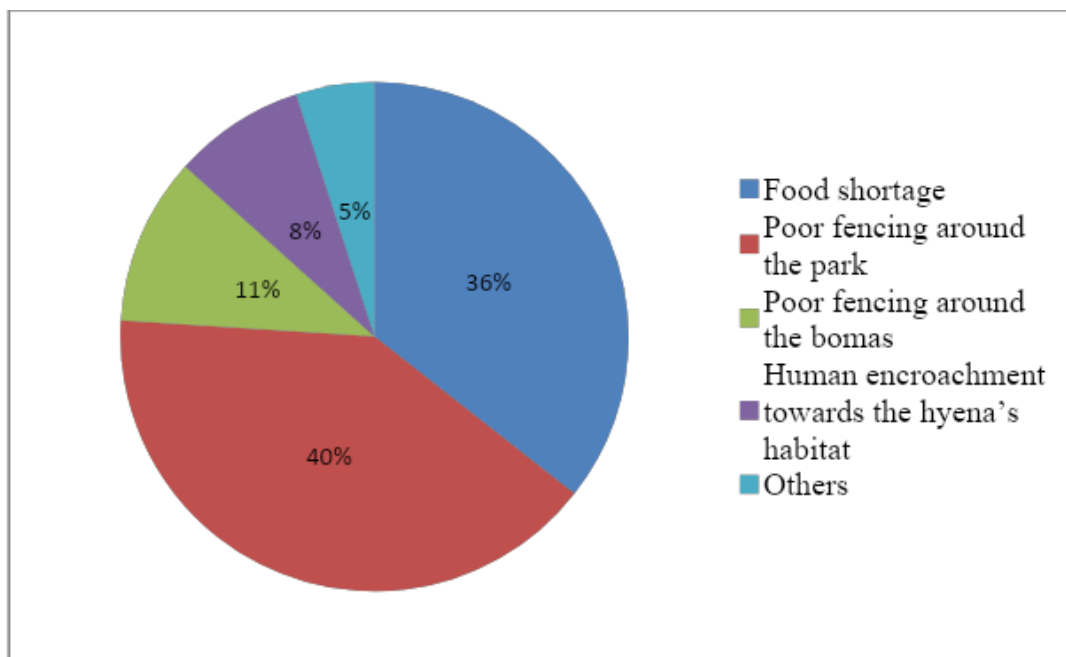


Figure 7: Major causes of hyena attacks on livestock

#### 4.4.1 Season of attack

Many respondents 94 (42%) reported that the attacks happen during the dry season at night and 72 (33%) respondents said that it happens during the wet season. This is because during the dry seasons, prey is not easily spotted due to decrease in number as they are as well affected by drought forcing the hyenas to attack the livestock. Additionally, 55 respondents were not sure of the season of attack. On the other hand, the key informants from Lake Nakuru National Park and Soysambu Conservancy said that most hyena attacks happen during the rainy seasons because of the bushes around the homesteads and around the park.

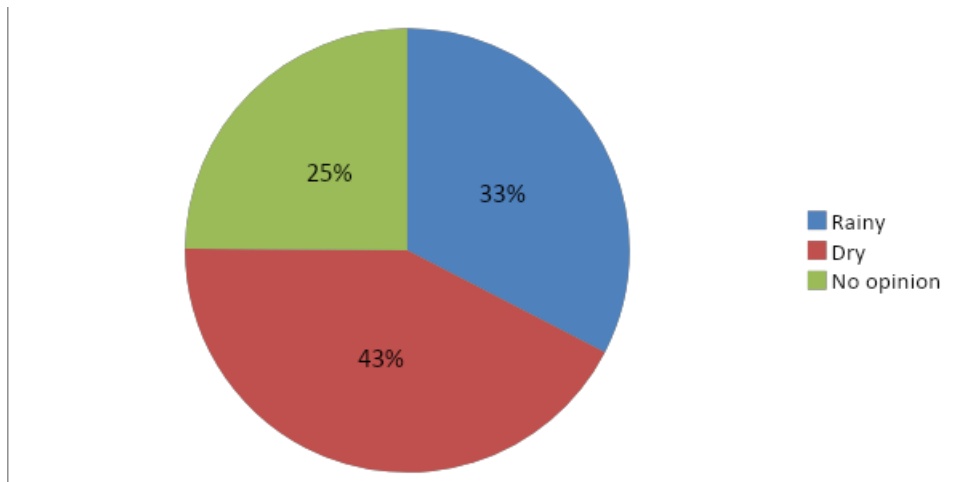


Figure 8: Season of hyena attacks

#### 4.5 Socio-economic impacts of hyena predation

The impact of hyena predation in the villages around Lake Nakuru National Park and Soysambu Conservancy is as shown in the figure below. Sheep and goats had a higher number compared to cattle and donkeys. A total of 1,020 were either wounded or killed. Of these, 777 sheep and goats were killed by hyenas, 75 were injured and 7 sheep and goats were killed by unknown animals. The respondents were not sure of the animal that killed them. The total estimated cost of hyena predation as per the respondents in LLNP and Soysambu Conservancy is approximately USD 74,740 annually.

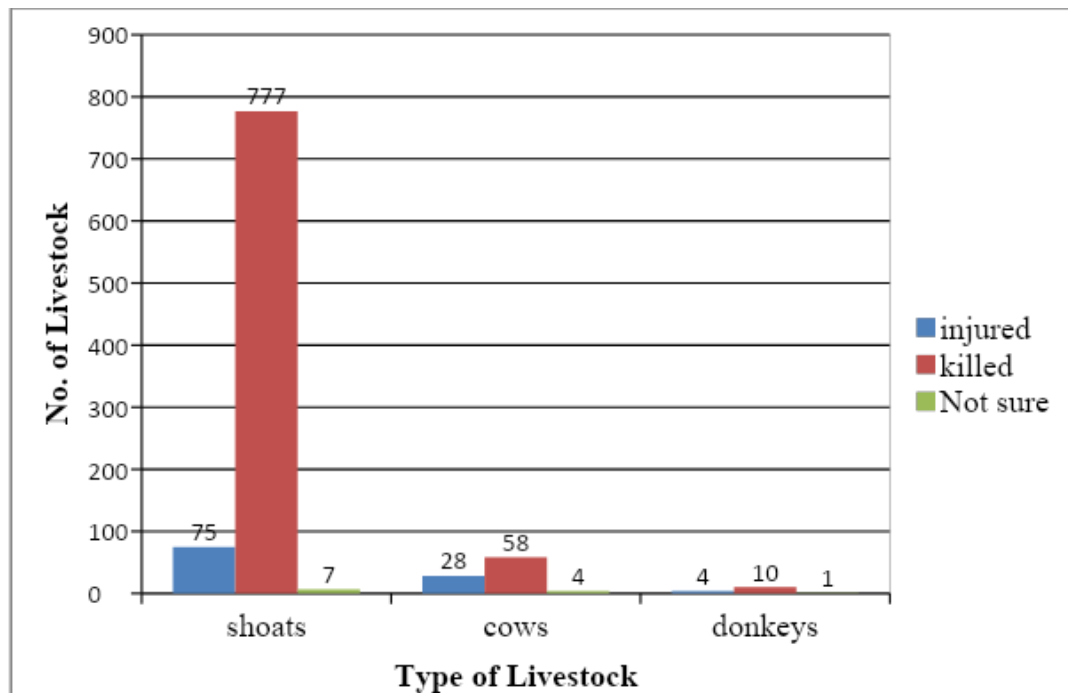


Figure 9: Number of livestock injured and killed by hyenas in the study area

The total number of livestock lost to hyena predation between June and December 2018 was 1020. Majority of the livestock were shoats (sheep and goats) (777) while donkey (14) were least preyed by the hyena. The number of dogs lost to hyena predation were 68, 39 were injured and 29 were killed. Unfortunately, according to KWS there is no compensation for the loss of dogs to wildlife. The table below summarized the number and the cost of livestock lost to hyena predation.

Table 7: Total loss to hyena predation

<b>Livestock</b>	<b>Injured</b>	<b>Killed</b>	<b>Total</b>	<b>Price (USD)</b>	<b>Total cost lost(USD)</b>
Dogs	39	29	68	-	
Shoats	75	777	852	60	52,120
Cattle	28	58	86	250	21, 500
Donkey	4	10	14	80	1,120
<b>Total</b>	<b>146</b>	<b>874</b>	<b>1020</b>		<b>74,740</b>

The prices for these livestock were determined using the current market price as per what the respondents reported.

## **4.6 Local community’s perception towards hyena conservation**

### **4.6.1 Conservation of hyena**

The perception for hyena conservation in these villages is positive because the respondents who support hyena conservation are more than those who are against the conservation. Those who supported (244) gave different reasons for hyena conservation, such as money from ecotourism, ecological reasons, cultural reasons and others. Among the other reasons that the respondents gave out were witchcraft. This is because the hyenas are used by certain cultures in practicing witchcraft. Additionally, they are also used as totems, therefore should be conserved. Besides, the respondents indicated that hyena should be conserved for sustainability, educational research, ecosystem balance and for future generations to see and identify its behaviour and importance. Moreover, hyena conservation creates job opportunities for youths as tour guides and also wildlife rangers. Furthermore, hyenas are considered to be beautiful therefore adding up to the aesthetic value of nature. Others stated that hyenas are God’s creation and therefore should be conserved. They also pointed out that hyenas provide security and helps in controlling conflict arising from herbivores and humans as they help in

predating on herbivores. On the other hand, 112 respondents said that there is no need to conserve the hyena giving the following reasons: hyenas are a sign of bad omen, they attack livestock, attack people, are noisy animals with bad sounds and of no importance, they are dangerous and worst enemies of the people, they are ugly, thieves with no manners and brings about losses which cannot be compensated. Even though there were those for conservation and those who were against the conservation, 4 respondents had no opinion about the conservation.

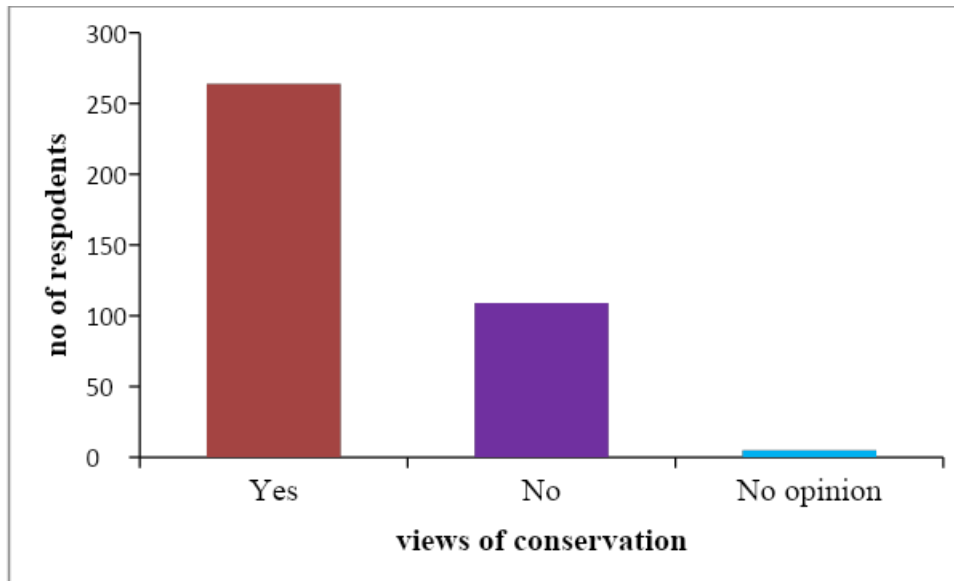


Figure 10: Local community’s perceptions towards hyena conservation in LNNP and Soysambu Conservancy

#### 4.6.2 Reasons for conserving the hyenas

The respondents who were for the conservation gave different reasons for the conservation. 219 respondents said that it is good to conserve hyenas for money from ecotourism, 115 were for ecological reasons and 39 respondents said that it is good to conserve hyenas for cultural reasons. In addition to this, 28 respondents gave other reasons for conserving hyenas. They said that it is good to conserve hyenas for education, conflict control, and aesthetic value, sustainability for the next generation and for job opportunities.

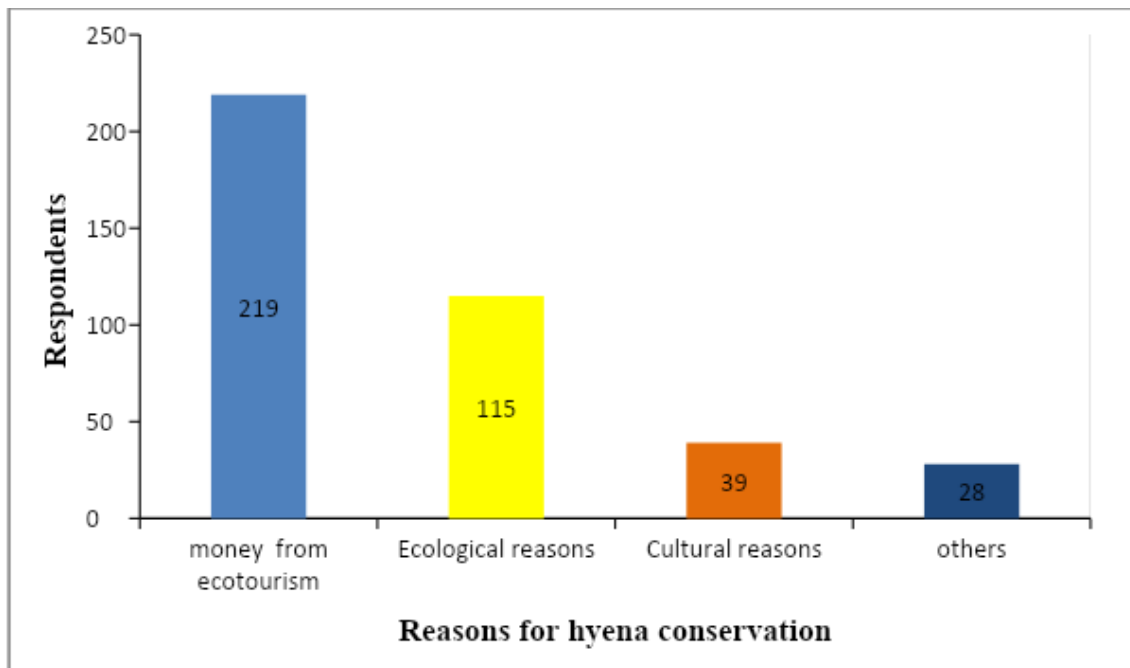


Figure 11: Reasons for hyena conservation

#### 4.6.3 Reasons for not conserving hyenas

Fifty percent (50%) of the respondents suggested that there was no need to conserve hyenas. These respondents said that spotted hyenas (*Crocuta crocuta*) attack their livestock and that is the main reason why they did not like hyenas to be conserved in the park and the conservancy. Local communities suggested that hyenas should be transferred to other parks where human population is a bit low. Among the 50% respondents, 9% gave more other reasons showing why hyenas should not be conserved. The reasons were; hyenas are very noisy, and they have bad sound that disturbs the whole village and it is hard to sleep unless you are used to. They also said that hyenas have no importance therefore, there is no need for conservation. Hyenas being enemies, dangerous, disturbing animals, ugly animals, thieves and animals with no manners were also among the other reasons that were highlighted by the local community.

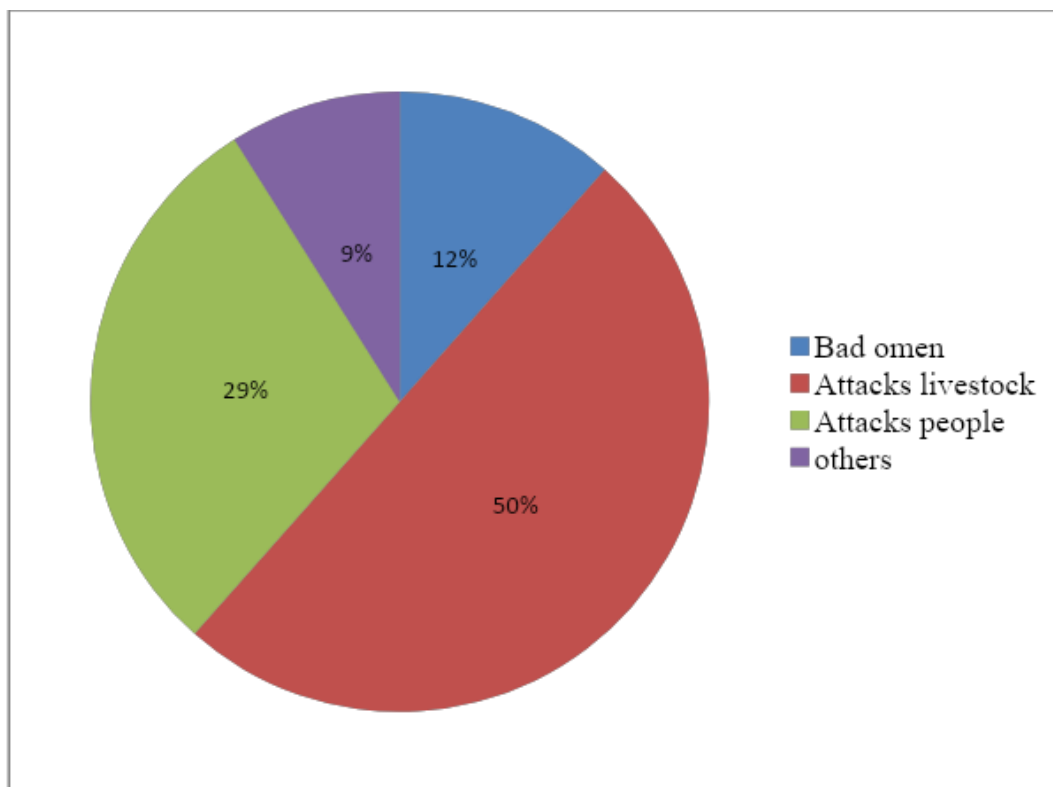


Figure 12: Reason against hyena conservation

#### 4.6.4 Demographic variables and relationship with hyena conservation

To test whether there were differences in each group, chi square test was used with  $\alpha=0.05$  as criterion for significance. Conservation of hyena also depended on the demographic characteristics of the respondents, education, age, occupation and ethnicity. According to the results from the analysis of the collected data showed that there is a significance in hyena conservation with the education (chi square 44.961,  $p=0.000$ ), occupation (chi square 77.473,  $p=0.000$ ) and ethnicity (chi square 45.171,  $p=0.001$ ). On the other hand, conservation of hyena corresponding to gender (chi square, 2.140,  $p=0.343$ ), age (chi square 12.294,  $p=0.422$ ), and religion (chi square, 0.743,  $p=0.994$ ) are not significant therefore conservation of hyena may not be based on gender, age nor religion in villages around Lake Nakuru National Park and Soysambu Conservancy.

Table 8: Chi-square interpretation

Attribute	Response and null hypothesis	Chi – square goodness of fit	Conclusion
Gender	The response on the type of fatal impact of hyena inflicted on livestock (injury or death) was independent of gender	( $\chi^2 = 3.5$ df = 2 And p = 0.07)	Failed to reject null hypothesis.  Conclude that gender does not influence response on the type of impact hyena inflict on livestock.
Level of education	The response on whether hyena should be conserved or not was independent of the level of education	( $\chi^2 = 21.45$ And p = 0.002)	Rejected the null hypothesis. Conclude that the level of education influences community opinions on conservation of hyena. Those who were more educated supported conservation of hyena than those not educated
Occupation	The response on whether hyena should be conserved or not was independent of the level of Occupation	( $\chi^2 = 77.473$ , p=0.000)	Rejected the null hypothesis. Conclude that the level of occupation influences community opinions on conservation of hyena. Farmers supported conservation of hyena than those with white collared jobs
Ethnicity	The response on whether hyena should be conserved or not was independent of the ethnicity	( $\chi^2 = 45.171$ , p=0.001).	Rejected the null hypothesis. Conclude that ethnicity influences community opinions on conservation of hyena. Christians highly supported the conservation of hyena

Age	The response on whether hyena should be conserved or not was independent of the age	( $\chi^2$ 12.294, p=0.422)	Failed to reject null hypothesis.  Conclude that gender does not influence response on the type of impact hyena inflict on livestock.  conservation with age of the respondents
Religion	The response on whether hyena should be conserved or not was independent of the region	$\chi^2$ , 0.743, p=0.994	Failed to reject the null hypothesis.  Conclude that religion influences has no influence on the community opinions on conservation of hyena.

Table 9: Demographic relationships and hyena conservation

	age		Education		Occupation		Ethnicity		Religion		Gender	
	Value	Asymp. Sig. (2-sided)	Value	Asymp. Sig. (2-sided)	Value	Asymp. Sig. (2-sided)	Value	Asymp. Sig. (2-sided)	Value	Asymp. Sig. (2-sided)	Value	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.294 <sup>a</sup>	.422	44.961 <sup>a</sup>	.000	77.473 <sup>a</sup>	.000	45.171 <sup>a</sup>	.001	.738 <sup>a</sup>	.994	2.140 <sup>a</sup>	.343
Likelihood Ratio	12.149	.434	41.047	.001	38.028	.060	38.325	.008	1.30	.972	2.263	.323

#### 4.7 Severity of human hyena conflict

Fifty-three percent (53 %) of the respondents did not have livestock or they did not experience attacks from hyenas. On the other hand, 24% of the respondents stated that they reported the attacks to KWS and 23% did not report the attacks. They indicated that no actions are being taken to mitigate the hyena attacks on livestock and hence they found no need to report such attacks whenever they occurred. A lot of livestock have been injured and killed in the villages around Lake Nakuru National Park and Soysambu Conservancy which leads to a total cost of 74,740 USD (Table 6). Majority of the respondents (53%) had no livestock and have never experienced attack from the hyenas. Twenty-four percent of the respondents who experienced the hyena attacks reported the attacks to KWS while 23% indicated that they did not report the attack. The respondents said that the reason as to why they were not reporting the attacks was that there is no action taken after reporting to the relevant conservation institution. Additionally, even if compensation forms are filled, it takes a long time for KWS to respond and eventually no compensations are made.

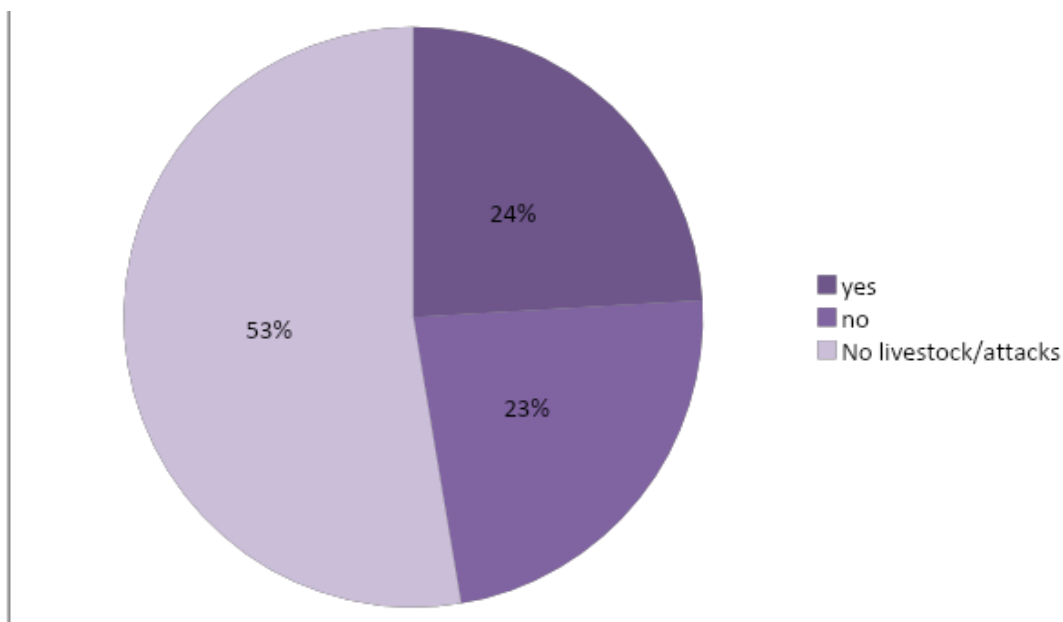


Figure 13: Reports of hyena attacks on livestock

Many of the respondents (25) reported the hyena attacks through the village elders while only one respondent used a family member in reporting. Other methods used were demonstrations by the local communities, through rangers, assistant chief, and chief and village elders

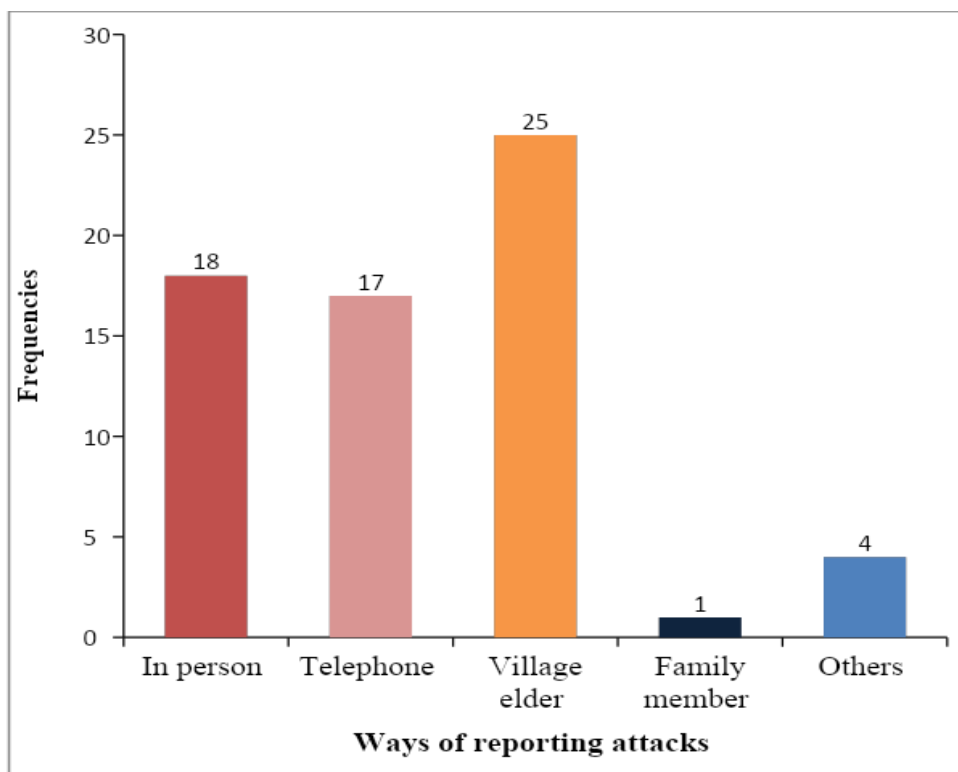


Figure 14: Ways of reporting hyena attacks

#### 4.7.1 Level of compensation for hyena attacks in the study area

Only 0.3 % ( 1) of the respondents got compensated and there was no information on the amount given. A total of 36.5% (138) of the respondents said that they did not receive compensation and 63.2 % (239) said that for them it was not applicable since many people used to report them but no action were undertaken.

Table 10: Compensation for the livestock preyed on by hyenas

Response	Frequency	Percentage
Yes	1	0.3
No	138	36.5
No opinion	239	63.2
Total	378	100.0

#### 4.7.2 Community response to hyena attacks

Among the 378 respondents only 12% (44) of the respondents disclosed that they have ever killed or injured a hyena and 88% of the respondents said that they have never injured/ killed a hyena.

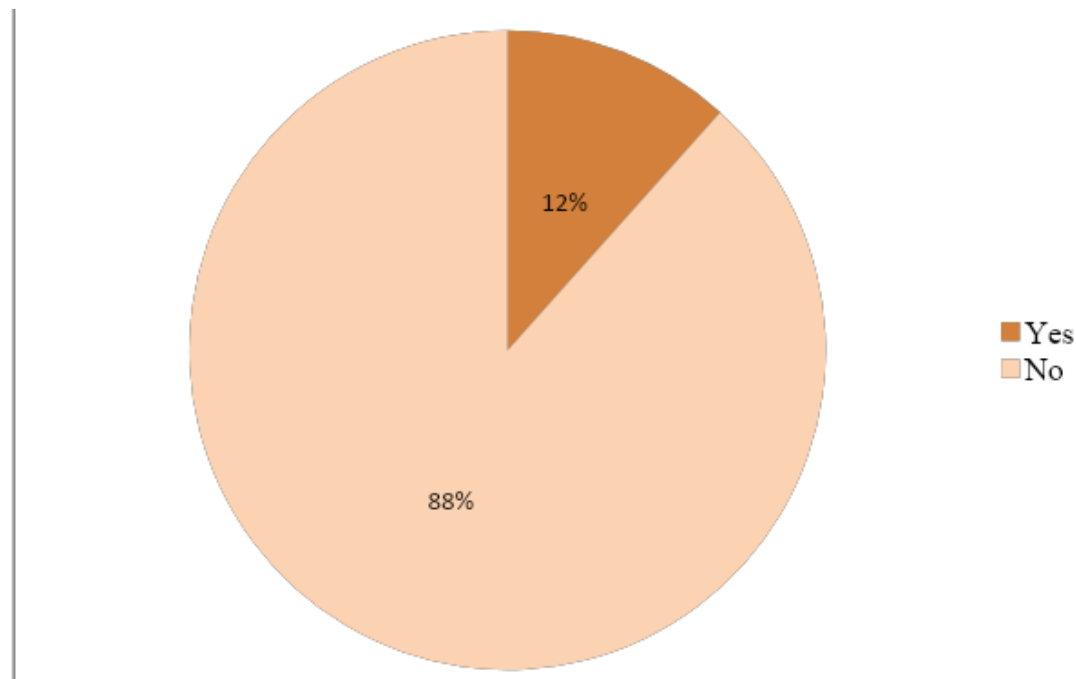


Figure 15: Community response to hyena attacks

Several ways were mentioned by the respondents as to how they kill hyenas. 42% of the respondents reported on the other methods they use in killing hyenas which were not listed in the questionnaire. These methods are use of machetes/pangas, traps, mob justice or snares. They added that most of the hyenas were killed by the vehicle as they try to move from the

park to the conservancy and vice versa. The least method mentioned was the use of guns represented by 2% (1 respondent).

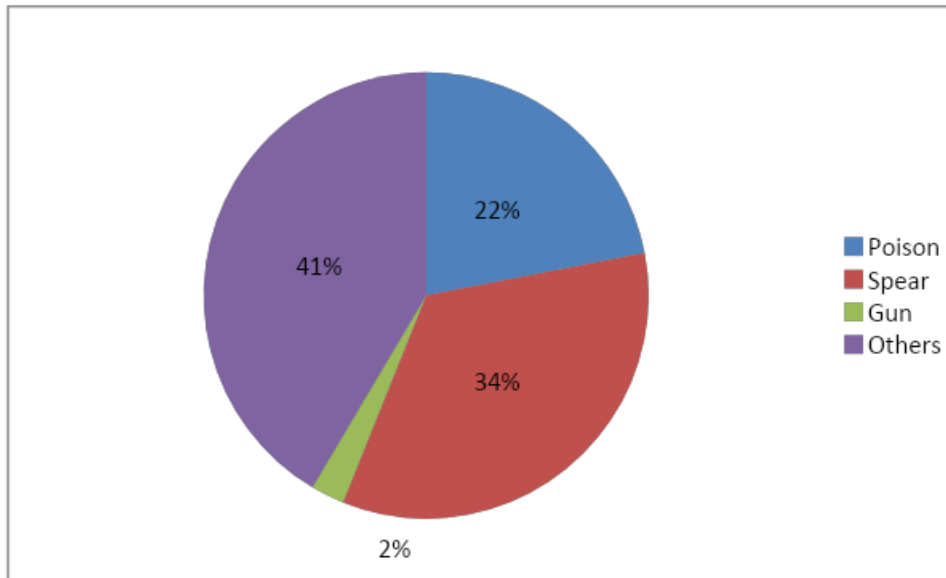


Figure 16: Different ways of killing hyenas

#### **4.8 Effective mitigation measures proposed by the local communities to mitigate the human -hyena conflicts**

According to the results on the causes of human hyena conflict, 40% of the respondents proposed that an electric fence should be erected around the two study areas (Lake Nakuru National Park and Soysambu Conservancy) to reduce the movement of hyena to the bomas and also to restrict the community from driving their livestock to the protected areas. Even though LNNP is fenced, still hyenas get out of the park because some parts of the fence are regularly vandalized by the community to access firewood. Additionally, they proposed that the electric fence should be frequently supervised to respond to any faults in the shortest time. On the other hand, 36% of the respondents proposed that the KWS, Conservancy, and the government should be responsible for feeding the hyenas so that they may not prey on livestock especially during the dry season.

## CHAPTER FIVE

### DISCUSSION

#### 5.1 Introduction

The aim of this chapter is to discuss the results of analyzed data as per the research objectives.

#### 5.2 Discussion of the results

##### 5.2.1 Response rate

It is evident that human-wildlife conflict is an issue at the study site. This study on the socio- economic impacts of hyena predation in LNNP and SC, was undertaken using a questionnaire that was used to document the causes of human hyena conflict and its mitigation measures. In the villages around LNNP and SC, Majority of the respondents who turned up for the interview were men 198 (53%). An explanation was given out that most men are not involved in domestic chores and that is the reason of turning up in a larger number unlike women who were 180 (47%).

##### 5.2.2 Economic loss due to livestock predation

According to Yirga and Bauer (2010) in a study they undertook on livestock depredation of the spotted hyena (*Crocuta crocuta*) in Southern Tigray, Northern Ethiopia the most affected group among the livestock are the donkeys, represented by 67.8% followed by goats (16.7%) and sheep (10.5%). This is so contrary to what the respondents said in the villages around Lake Nakuru National Park and Soysambu Conservancy whereby hyenas preferred shoats (sheep and goats) unlike donkeys. The reason is that most of the donkeys do the home duties like carrying water therefore they are not exposed to many risks. Additionally, most of the respondents reported that their livestock getting home late perhaps the reason why they are being attacked. This is evidently shown by Abay *et al.* (2011) a total of 1,200 hyena scats were analyzed to determine prey species; in Ethiopia the diet contained only domestic species, with sheep being by far the most common prey species. Moreover, approximately 5.5% of fecal analysis contained human hairs. It was then concluded that hyenas depended entirely on domestic prey species, partly through depredation.

Livestock predation can cause significant economic losses among pastoralists and the local communities living adjacent to the protected areas. The total estimated loss of livestock predation to hyenas were USD 74,740 annually (and Table 6 confirms the observation) compared to the Northern conflict in the year 2009 which was USD 229,104. According to

Patterson *et al.*, (2004), 2.4 % of the livestock are attacked by wildlife annually in Tsavo National Park. This is similar to what is experienced in LNNP. In addition to this, at least 8,749 USD is lost to livestock predation annually in Kenya. Furthermore, the Indian-trans Himalayan communities reported an economic loss of \$15,418 due to predation which is equivalent to \$128 loss per family per year (Kissui, 2008; Lichtenfeld, 2005) and Zimbabwe as well recorded economic loss averaging \$13 or 12% of each household's net annual income (Butler, 2000). In addition to this, in Ethiopia in the year 2005 to 2009, livestock losses due to predation amounted to 492 heads over 5 years; an annual mean of 0.6% worth US\$ 7,042. (Abay *et al.*, 2011). Livestock predation is a major cause of human-wildlife conflict (Yirga & Bauer, 2010). In addition to this, Spotted hyena killed 1578 domestic animals for the past ten years in the Himalaya district in eastern Ethiopia, of which 3337.4% (n=590) were sheep and 34.4% (n=559) were goat(The economic loss of cattle and sheep, because of hyena accounted for a loss of US\$ 25257.73 (33.55%) and 24329.90 (32.3%) (Dejene *et al.*, 2016). According to Kissui (2008) and Patterson *et al.* (2004) livestock predation causes a weighty economic losses among pastoralists. For example, 2.6% of the herd's economic value in a Kenyan ranch incurred a loss of \$8749 per annum. In Serengeti national park in Tanzania, Holmern *et al.* (2007) 67.4% of respondents owned livestock and 27.4% of all the households surveyed reported losses of a total of 4.5% of their livestock to wild predators over a period of one month. This loss averaged to 19.2% (US \$26.8) of their cash income. It was reported that spotted hyena (*Crocuta crocuta*) caused most of the livestock depredation (97.7%), leopard (*Panthera pardus*) (1.6%), baboon (*Papio cynocephalus*) (0.4%), lion (*Panthera leo*) (0.1%) and black-backed jackal (*Canis mesomelas*) (0.1%). Total reported losses during 2003 amounted to US \$12,846 of which spotted hyena kills were reported to account for 98.2%. Hyenas are known to cause a lot of the killings unlike other carnivores like lions, leopard and jackals.

### **5.2.3 Causes of livestock attacks**

Most of the people who live adjacent to Lake Nakuru National Park and Soysambu conservancy suggested that poor park fencing is the major cause of human hyena conflict. This statement is in contrast to Ocholla *et al.* (2013) in whose study documented that the major cause of human wildlife conflict generally is the human population growth and transformation of land use. The reason as to why people of Lake Nakuru National Park and Soysambu conservancy gave the suggestion of poor park fencing is that even though Lake Nakuru National Park is fenced, there are still some weak spots that can allow the hyenas to go through. Additionally, where the rivers flow into Lake Nakuru National Park is also another point especially during

the dry season because the water levels will have reduced and the hyenas will sneak out of the park to the villages. Hyenas are found to have a strange behavior like that of cercopithecine primates since fencing does not deter them completely (Drea & Carter, 2009). In such cases where there is a fence, they do excavation on the ground that gives them a way out to the community or local people bordering the protected areas. These raise the issue of how the effective measures in place are working. Still, the community complains that a fence is a major contributing factor towards human-hyena conflicts.

On the other hand, Soysambu Conservancy is open especially to the east side and some places in the southern part. This explains why human -hyena conflicts are still rampant. On top of this, people kill and injure hyenas because they freely move out of the park. This has prompted the community members near Soysambu Conservancy to put up snares to either kill or injure the hyenas. Fences highly help in protecting both wildlife and livestock. Boma fences and park fences have a positive impact in terms of conflict reduction. According to Papworth *et al.* (2014) in Tibetan Autonomous Region, China, A total of three animals were lost by households within the fenced areas in 2009 a 98% decrease from 2008 losses. Despite the predation and huge number of losses that are faced by the communities adjacent to Lake Nakuru National Park and Soysambu Conservancy, most of the respondents said that they do not receive compensation. It is not only in Nakuru County that they do not receive the compensation fee but also in Tsavo Amboseli areas where wildlife ranges outside the park causing a lot of destruction which is not compensated (Kolowski & Holekamp, 2006). In Kenya, the establishment of a compensation scheme was for the benefit of the people who are claiming for human death or injury, or crop and property damage caused by wildlife. According to Wildlife Conservation and Management (Compensation) Regulations, 2016 under The Wildlife Conservation and Management Act (No. 47 of 2013), the eligibility of the compensation fee will be done if it relates to human injury or death by any wildlife listed under the Third Schedule to the Act or loss or damage to crops, livestock or other property from wildlife specified in the Seventh Schedule to the Act. Therefore, a person seeking to obtain compensation for loss or damage to crops, livestock or other property must demonstrate to the satisfaction of the Committee that the crop, livestock, or other property, which is the subject of the claim, was (1) under care and control in accordance with generally reasonable agricultural practices or livestock control. (2) where the payment is claimed in relation to the death of livestock, the carcass of each head of livestock for which payment is claimed must be available for investigation and assessment by an officer of the Service and (3) where payment is claimed

for livestock death or injury, that the death or injury resulted directly from a predatory attack by any of the animals listed under the Third Schedule to the Act.

#### **5.2.4 Severity of attacks**

Severity of human hyena conflict in the villages around Lake Nakuru National Park and Soysambu Conservancy is not that pronounced in terms of retaliation against hyena. Although some hyenas were killed, the majority of the respondents reported that they participated in killing the hyenas because of their ecotourism value. This statement is supported by Inskip and Zimmermann (2009) wherein the general attacks of human, livestock and even retaliation wildlife is reducing over time. Additionally, livestock predation is so high in the sense that many people lost their livestock to hyenas, especially sheep. The reason as to why the hyenas liked predated on sheep is that the sheep are left to graze in the wild and were tied near the park or the conservancy. On the other hand, goats were rarely grazed in the wild because they are important in milk production. Donkeys were also used in transportation and other domestic works and that is why the number of attacks was low. Many of the attacks in the villages around Lake Nakuru National Park and Soysambu Conservancy happened during the dry seasons. This is also experienced in Zimbabwe where most of the attacks happened during the dry season (Butler, 2000). The respondents reported that this is the season where the prey would have decreased and the predators especially the hyenas would start predated on livestock. During the rainy seasons as reported by the key informants, hyenas still attacked livestock but not that much as compared to the dry season. This is contrary to what is happening in Tsavo National Park, whereby most of the attacks were reported in the wet season at night. During the wet season most lions preferred to attack livestock because this is the season where most of the prey are difficult to kill (Frank *et al.*, 2006; Patterson *et al.*, 2004). Additionally according to Kissui (2008) in Maasai steppe in Tanzania, hyenas and leopards mostly attacked livestock at night, whereas lions often attacked grazing livestock during the daytime making some of the villages to target hyenas with poison. In Northern Tanzania, Conflict with large carnivores was mainly predominant during the wet season, and was spatially highly heterogeneous. Hyenas were the predominant conflict species, followed by leopards (Koziarski *et al.*, 2016).

#### **5.2.5 Perception on hyena conservation**

How people perceive hyena conservation in the study area was positive even though they caused a lot of destruction especially to livestock. Many of the respondents were reporting that

failure to conserve hyenas may lead to poor ecology and the next generation may not be able to see the hyenas. According to de Pinho *et al.* (2014) and Oli *et al.* (1994) people in Nepal and Kenya have a negative attitude towards carnivore conservation (hyena and leopards) to the extent that they would wish to eradicate or minimize their number. According to Liu, *et al.* (2011) different people have different perceptions on wildlife. In China only 6.5% indicated that they liked bears, whereas 50.2% disliked bears and 43.2% offered no clear opinion. The liking of bears depended significantly on the presence of bears near their village, villagers' age, knowledge level about bears, and profession. This is also depicted in the results of the perception of communities around Lake Nakuru National Park that hyena conservation depends on age, occupation, educational level, and ethnicity.

### **5.2.6 Mitigation measures of human hyena attacks**

Majority of the respondents indicated that the most appropriate solution strategy for human hyena conflict resolution is erecting an electric fence all-round the park and conservancy. This was a result of poor fencing around the park and the conservancy being the cause of conflict. In Kenya, Laikipia County is surrounded by several game reserves. Farmers in that places suggested that it is necessary to erect an electric fence to minimize the human wildlife conflict. As a result, the fence has helped in reducing conflicts especially for the crop raiding animals (Redpath *et al.*, 2013). Additionally, according to Lamarque *et al.* (2009) the mitigation of human-wildlife conflict is an important issue in the management of biodiversity and protected areas. Human Wildlife Conflict management strategies earlier comprised lethal control, translocation, and regulation of population and conservation of endangered species (Masago, 2018). According to Karanth and Kudalkar (2017) management responses to wildlife conflict incidents range from reactive strategies (for example modification of human and/or wildlife behavior, post hoc compensation payments) to proactive strategies such as insurance schemes or relocation of affected communities from wildlife reserves. Direct reactive mitigation strategies employ interventions (for example fencing, guarding) that protect crops, livestock, and property, whereas indirect reactive measures are targeted toward improving tolerance of affected communities through compensation schemes (Dickman, 2010; Morzillo & Needham, 2015). Direct mitigation measures can be species specific and may impose significant financial costs on people.

## CHAPTER SIX

### CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Conclusions

The study sought to document causes of human hyena conflicts, evaluate the severity of human-hyena conflict, assess the socio-economic impacts of hyena predation on local livelihoods document the local community's perceptions towards hyena conservation around the two study areas and assess the effectiveness of strategies used to mitigate human-hyena conflict for communities living around the two study areas. In view of the objectives which were the focus of this study and the results, it is evident that human-wildlife conflict with focus on hyena is rampant in the study area. This study therefore makes the following conclusions:

- i. Fencing is a major cause of hyena attacks which later leads to hyena-human conflicts and concomitant livestock predation. The other causes were; hyena food shortage, human encroachment towards hyena's habitat. In this view, the effective mitigation measure on human-hyena conflict is proper reinforcement of fence which was highly suggested by the respondents and also seconded by the key informants. The effective mitigation measure on human-hyena conflict is proper reinforcement of fences which was highly suggested by the respondents and also seconded by the key informants. Human-hyena conflict around LNNP and Soysambu Conservancy notwithstanding, a large number of respondents still supported the need to conserve hyena.
- ii. The total cost lost due to hyena predation was estimated to USD 74,740 in the villages around Lake Nakuru National Park and Soysambu Conservancy. Sheep and goats were highly preyed on by hyena unlike cows and donkey. Although cows were few their economic loss is high compared to shoats and dogs.
- iii. The human-hyena conflict is severe in the areas around Lake Nakuru National Park and Soysambu conservancy.

#### 6.2 Recommendations

##### 6.2.1 Recommendations for management

- i. Electric fences should be erected all-round the park and the conservancy and monitoring should be done at least once in a month to check the possible loopholes that can allow the hyenas to sneak through the fence to the communities. This will minimize human-hyena conflicts and reduce the socio-economic losses. Camera traps should also be installed around the park to help in monitoring the park and conservancies to help in showing the loopholes for hyena to get out of the park. Local communities should also

erect the modern bomas to deter hyenas and other carnivores. This will help in reducing conflict especially during the night.

- ii. Creation of awareness about the importance of wildlife should be done frequently and that locals should be educated on the tactics of managing HWC. Awareness raising to sensitize the community on conservation and compensation rights and procedures
- iii. Need for wildlife surveillance and monitoring including long-term radio tracking to understand dispersal movements, corridors within the larger landscape.

### **6.2.2 Recommendations for Further Research**

- i. More research on other carnivores their contribution to HWC including segregating the damage by hyena and other species
- ii. Constant monitoring through radio tracking of a few hyenas to understand the movement spatially and temporally

## REFERENCES

- Abay, G. Y., Bauer, H., Gebrihiwot, K. & Deckers, J. (2011). Peri-urban spotted hyena (*Crocuta crocuta*) in northern Ethiopia: diet, economic impact, and abundance. *European Journal of Wildlife Research*, 57(4), 759-765.
- Abraham, R. T., & Kumar, A. S. (2017). Wildlife Conservation and Management System. International Journal of Emerging Technologies in Engineering Research. Volume 5
- An, L. (2012). Modeling human decisions in coupled human and natural systems: Review of agent-based models. *Ecological Modelling*, 229, 25-36.
- Anand, S., & Radhakrishna, S. (2017). Investigating trends in human-wildlife conflict: is conflict escalation real or imagined? *Journal of Asia-Pacific Biodiversity*, 10(2), 154-161.
- Atickem, A., Williams, S., Bekele, A., & Thirgood, S. (2010). Livestock predation in the Bale Mountains, Ethiopia. *African Journal of Ecology*, 48(4), 1076-1082.
- Bagchi, S., & Mishra, C. (2006). Living with large carnivores: predation on livestock by the snow leopard (*Uncia uncia*). *Journal of zoology*, 268(3), 217-224.
- Baqa, H. (2010). *Wildlife Protection Laws: A Study of Legal and Administrative Aspects* (Doctoral dissertation, Aligarh Muslim University).
- Barua, M., Bhagwat, S. A., & Jadhav, S. (2013). The hidden dimensions of human-wildlife conflict: health impacts, opportunity, and transaction costs. *Biological Conservation*, 157, 309-316.
- Bateman, P. W., & Fleming, P. A. (2012). Big city life: carnivores in urban environments. *Journal of Zoology*, 287(1), 1-23.
- Bearder, S. K. (1977). Feeding habits of spotted hyaenas in a woodland habitat. *African Journal of Ecology*, 15(4), 263-280.
- Bedelian, C. E. (2014). *Conservation, tourism, and pastoral livelihoods: wildlife conservancies in the Maasai Mara, Kenya* (Doctoral dissertation, UCL (University College London)).
- Bennett, N. J., & Dearden, P. (2014). Why local people do not support conservation: Community perceptions of marine protected area livelihood impacts, governance and management in Thailand. *Marine policy*, 44, 107-116.
- Berger, L. R. (2006). Brief communication: Predatory bird damage to the Taung type-skull of *Australopithecus africanus* Dart 1925. *American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Anthropologists*, 131(2), 166-168.

- BirdLife International (2020) Important Bird Areas factsheet: Lake Nakuru National Park. Downloaded from <http://www.birdlife.org> on 31/01/2020.
- Bordens, K. S., & Abbott, B. B. (2002). *Research design and methods: A process approach*. McGraw-Hill.
- Borsboom, D., Mellenbergh, G. J., & van Heerden, J. (2004). The concept of validity. *Psychological review*, *111*(4), 1061.
- Brandon, K. E., & Wells, M. (1992). Planning for people and parks: design dilemmas. *World development*, *20*(4), 557-570.
- Brown, R. D. (2007). The History of Wildlife Conservation and Research in the United States— and Implications for the Future. In *Proceedings of the Taiwan Wildlife Association Congress* (pp. 1-30).
- Butler, J. R. (2000). The economic costs of wildlife predation on livestock in Gokwe communal land, Zimbabwe. *African journal of Ecology*, *38*(1), 23-30.
- Carter, N. H., Shrestha, B. K., Karki, J. B., Pradhan, N. M. B., & Liu, J. (2012). Coexistence between wildlife and humans at fine spatial scales. *Proceedings of the National Academy of Sciences*, 201210490.
- Chardonnet, P., Clers, B. D., Fischer, J., Gerhold, R., Jori, F., & Lamarque, F. (2002). The value of wildlife. *Revue scientifique et technique-Office international des épizooties*, *21*(1), 15-52.
- Conover, M. R. (2001). *Resolving human-wildlife conflicts: the science of wildlife damage management*. CRC press.
- Conover, M. R., Pitt, W. C., Kessler, K. K., DuBow, T. J., & Sanborn, W. A. (1995). Review of human injuries, illnesses, and economic losses caused by wildlife in the United States. *Wildlife Society Bulletin (1973-2006)*, *23*(3), 407-414.
- Conroy, R. (2006). Sample size: a rough guide. [www.beaumontethics.ie/docs/applications/samplesizecalculation](http://www.beaumontethics.ie/docs/applications/samplesizecalculation). Pdf. Accessed 12/4/2018
- Conservancy, S. (2012). Soysambu dry season wildlife census. URL: <http://soysambuconservancy.wildlifedirect.org/2012/10/14/soysambu-dry-season-wildlife-census/>(Citirano 3.3. 2018).
- Cook, D. A., & Beckman, T. J. (2006). Current concepts in validity and reliability for psychometric instruments: theory and application. *The American journal of medicine*, *119*(2), 166-e7.

- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approach*. Sage publications
- Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological bulletin*, 52(4), 281.
- Daniels, R., & Bassett, T. J. (2002). The spaces of conservation and development around Lake Nakuru National Park, Kenya. *The Professional Geographer*, 54(4), 481-490.
- Davies, A. (2008). Ethics, professionalism, rights and codes. *Encyclopedia of language and education*, 2555-2569.
- Davies, T. E., Wilson, S., Hazarika, N., Chakrabarty, J., Das, D., Hodgson, D. J., & Zimmermann, A. (2011). Effectiveness of intervention methods against crop-raiding elephants. *Conservation Letters*, 4(5), 346-354
- de Pinho, J. R., Grilo, C., Boone, R. B., Galvin, K. A., & Snodgrass, J. G. (2014). Influence of aesthetic appreciation of wildlife species on attitudes towards their conservation in Kenyan agropastoralist communities. *PloS one*, 9(2), e88842.
- Decker, D. J., Lauber, T. B., & Siemer, W. F. (2002). Human-wildlife conflict management.
- Dejene, S. W., Dechassa, N., & Reddy, R. U. (2016). Coexistence of human and hyena and associated impacts in Haramaya district of Eastern Ethiopia. *International Journal of Biodiversity and Conservation*, 8(1), 1-7.
- Dhakal, B., & Thapa, B. (2019). Residents' perceptions of human–elephant conflict: case study in Bahundangi, Nepal. *Environment, development and sustainability*, 21(1), 461-481
- Dickman, A. J. (2010). Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. *Animal conservation*, 13(5), 458-466.
- Dickman, A. J., Hazzah, L., Carbone, C., & Durant, S. M. (2014). Carnivores, culture and 'contagious conflict': Multiple factors influence perceived problems with carnivores in Tanzania's Ruaha landscape. *Biological Conservation*, 178, 19-27.
- Didi, W. F. (2013). Devolution of Wildlife Management in Kenya to Enhance Community Participation: An Assessment of Kenyan Legal Frameworks. *University of Nairobi*.
- Distefano, E. (2005). Human-Wildlife Conflict worldwide: collection of case studies, analysis of management strategies and good practices. *Food and Agricultural Organization of the United Nations (FAO), Sustainable Agriculture and Rural Development Initiative (SARDI), Rome, Italy. Available from: FAO Corporate Document repository <http://www.fao.org/documents>*.
- Drea, C. M., & Carter, A. N. (2009). Cooperative problem solving in a social carnivore. *Animal Behaviour*, 78(4), 967-977.

- Ebua, V. B., Agwafo, T. E., & Fonkwo, S. N. (2011). Attitudes and perceptions as threats to wildlife conservation in the Bakossi area, Southwest Cameroon. *International Journal of Biodiversity and Conservation*, 3(12), 631-636.
- Engh, A. L., Esch, K., Smale, L., & Holekamp, K. E. (2000). Mechanisms of maternal rank 'inheritance' in the spotted hyaena, *Crocuta crocuta*. *Animal Behaviour*, 60(3), 323-332.
- Frank, L., Hemson, G., Kushnir, H., & Packer, C. (2006, January). Lions, conflict and conservation in Eastern and Southern Africa. In *The eastern and southern African lion conservation workshop* (pp. 11-13). Johannesburg.
- Gade, D. W. (2006). Hyenas and humans in the Horn of Africa. *Geographical Review*, 96(4), 609-632.
- Gandiwa, E., Heitkönig, I., Lokhorst, A., Prins, H., & Leeuwis, C. (2013). CAMPFIRE and human-wildlife conflicts in local communities bordering northern Gonarezhou National Park, Zimbabwe. *Ecology and Society*, 18(4).
- Gichuhi, M. (2014). Ecological Management of the Mau Catchment Area and Its Impact on Lake Nakuru National Park. *Journal of Agriculture, Science and Technology*, 15(1).
- Gichuhi, M. W. (2007). Ecological Management of Lake Nakuru Catchment Area. *Sengupta, M and Dalwani, R. Proceedings of Taal*, 960-964.
- Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The qualitative report*, 8(4), 597-606.
- Gordon, I. J. (2009). What is the future for wild, large herbivores in human-modified agricultural landscapes?. *Wildlife Biology*, 15(1), 1-9.
- Graham, K., Beckerman, A. P., & Thirgood, S. (2005). Human–predator–prey conflicts: ecological correlates, prey losses and patterns of management. *Biological conservation*, 122(2), 159-171.
- Graham, M., & Musyoki, C. (2012). Wildlife Conservation Strategy for Laikipia County 2012–2030. *Nanyuki, Kenya*.
- Gross, E. M., Lahkar, B. P., Subedi, N., Nyirenda, V. R., Lichtenfeld, L. L., & Jakoby, O. (2018). Seasonality, crop type and crop phenology influence crop damage by wildlife herbivores in Africa and Asia. *Biodiversity and conservation*, 27(8), 2029-2050.
- Gurung, B. B. (2008). Ecological and sociological aspects of human-tiger conflicts in Chitwan National Park, Nepal.
- Hall, C. M. (2015). Loving nature to death: tourism consumption, biodiversity loss and the Anthropocene. *Tourism and the Anthropocene*. Routledge, New York, 52-74.

- Hazzah, L., Mulder, M. B., & Frank, L. (2009). Lions and warriors: social factors underlying declining African lion populations and the effect of incentive-based management in Kenya. *Biological Conservation*, 142(11), 2428-2437.
- Hill, C. M., & Webber, A. D. (2010). Perceptions of nonhuman primates in human–wildlife conflict scenarios. *American journal of primatology*, 72(10), 919-924.
- Hill, C., Osborn, F., & Plumptre, A. J. (2002). Human-wildlife conflict: identifying the problem and possible solutions.
- Hockings, K. (2009). *Best practice guidelines for the prevention and mitigation of conflict between humans and great apes* (No. 37). IUCN.
- Holekamp, K. E., Sakai, S. T., & Lundrigan, B. L. (2007). Social intelligence in the spotted hyena (*Crocuta crocuta*). *Philosophical Transactions of the Royal Society B: Biological Sciences*, 362(1480), 523-538.
- Holmern, T., Nyahongo, J., & Røskaft, E. (2007). Livestock loss caused by predators outside the Serengeti National Park, Tanzania. *Biological conservation*, 135(4), 518-526.
- Höner, O. P., Wachter, B., East, M. L., & Hofer, H. (2002). The response of spotted hyenas to long-term changes in prey populations: functional response and interspecific kleptoparasitism. *Journal of Animal Ecology*, 71(2), 236-246.
- Hooke, R. L., Martín-Duque, J. F., & Pedraza, J. (2012). Land transformation by humans: a review. *GSA today*, 22(12), 4-10.
- [https://nature.berkeley.edu/classes/es196/projects/2019final/FrederickA\\_2019.pdf](https://nature.berkeley.edu/classes/es196/projects/2019final/FrederickA_2019.pdf), accessed 18<sup>th</sup> April 2020
- Hughes, M., & Carlsen, J. (2008). Human–wildlife interaction guidelines in Western Australia. *Journal of Ecotourism*, 7(2-3), 147-159.
- Hulbert, I. A., & French, J. (2001). The accuracy of GPS for wildlife telemetry and habitat mapping. *Journal of Applied Ecology*, 38(4), 869-878.
- Inskip, C., & Zimmermann, A. (2009). Human-felid conflict: a review of patterns and priorities worldwide. *Oryx*, 43(1), 18-34.
- Israel, G. D. (1992). Determining sample size.
- Janesick, V. J. (1994). The dance of qualitative research design: Metaphor, methodolatry, and meaning.
- Jumba, I. O., Kisia, S. M., & Kock, R. (2007). Animal health problems attributed to environmental contamination in Lake Nakuru National Park, Kenya: a case study on heavy metal poisoning in the waterbuck *Kobus ellipsiprymnus defassa* (Ruppel 1835). *Archives of environmental contamination and toxicology*, 52(2), 270-281.

- Kala, C. P., & Kothari, K. K. (2013). Livestock predation by common leopard in Binsar Wildlife Sanctuary, India: human-wildlife conflicts and conservation issues. *Human–Wildlife Interactions*, 7(2), 10.
- Kamau, P. K., Mbaria, J. G., & Koichi, K. (2012). Human-Wildlife Conflict in Kenya.
- Kansky, R., & Knight, A. T. (2014). Key factors driving attitudes towards large mammals in conflict with humans. *Biological Conservation*, 179, 93-105.
- Kanyamibwa, S. (1998). Impact of war on conservation: Rwandan environment and wildlife in agony. *Biodiversity & Conservation*, 7(11), 1399-1406.
- Karanja, D. (2012, January). The role of the Kenya Wildlife Service in protecting Kenya's wildlife. In *The George Wright Forum* (Vol. 29, No. 1, pp. 74-80). George Wright Society.
- Karant, K. K., & Kudalkar, S. (2017). History, location, and species matter: insights for human–wildlife conflict mitigation from India. *Human dimensions of wildlife*, 22(4), 331-346.
- Karant, K. K., & Nepal, S. K. (2012). Local residents' perception of benefits and losses from protected areas in India and Nepal. *Environmental management*, 49(2), 372-386.
- Kassily, F. N., Tsingalia, H. M., & Gossow, H. (2008). Mitigating human-wildlife conflicts through wildlife fencing: a Kenyan case study.
- Kenya Wildlife Service. (2008). Wildlife Policy Review. Kenya Wildlife Service, Nairobi
- Kepha, O., Mukulu, E., & Waititu, G. A. (2014). The influence of recruitment and selection on the performance of employees in research institutes in Kenya. *International Journal of Science and Research*, 3 (5), 132, 138.
- Kimanzi, J. K., & Mbau, C. W. (2019). Influence of Rainfall Fluctuations on Population Trends of Eleven Wild Herbivores in Soysambu Conservancy, Kenya. *African Journal of Education, Science and Technology*, 5(2), 1-11.
- Kinnaird, M. F., Sanderson, E. W., O'Brien, T. G., Wibisono, H. T., & Woolmer, G. (2003). Deforestation trends in a tropical landscape and implications for endangered large mammals. *Conservation Biology*, 17(1), 245-257.
- Kioko, J., Muruthi, P., Omondi, P., & Chiyo, P. I. (2008). The performance of electric fences as elephant barriers in Amboseli, Kenya. *African Journal of Wildlife Research*, 38(1), 52-59.
- Kissui, B. M. (2008). Livestock predation by lions, leopards, spotted hyenas, and their vulnerability to retaliatory killing in the Maasai steppe, Tanzania. *Animal Conservation*, 11(5), 422-432.

- Kolowski, J. M., & Holekamp, K. E. (2006). Spatial, temporal, and physical characteristics of livestock depredations by large carnivores along a Kenyan reserve border. *Biological conservation*, 128(4), 529-541.
- Koziarski, A., Kissui, B., & Kiffner, C. (2016). Patterns and correlates of perceived conflict between humans and large carnivores in Northern Tanzania. *Biological Conservation*, 199, 41-50.
- Kristjanson, P. (2002). *Valuing alternative land-use options in the Kitengela wildlife dispersal area of Kenya* (Vol. 10). ILRI (aka ILCA and ILRAD).
- Kruuk, H. (2002). *Hunter and hunted: relationships between carnivores and people*. Cambridge University Press.
- Kutatoi, S. K., & Waweru, A. (2017). The causes of human and wildlife conflict within kajiado south sub county. *Journal of Conflict Management*, 1(1), 23-33.
- KWS (1992) Kenya Wildlife Service: Report of the Proceedings of Strategic Planning Workshop for the Community Wildlife Service Department, 29th June 1 st July 1992. Nairobi Kenya.
- KWS Annual report for (2012). KWS Annual Report - Lake Nakuru Station
- Lamarque, F., Anderson, J., Fergusson, R., Lagrange, M., Osei-Owusu, Y., & Bakker, L. (2009). *Human-wildlife conflict in Africa: causes, consequences and management strategies* (No. 157). Food and Agriculture Organization of the United Nations (FAO).
- Le Bel, S., Murwira, A., Mukamuri, B., Czudek, R., Taylor, R., & La Grange, M. (2011). Human wildlife conflicts in southern Africa: riding the whirl wind in Mozambique and in Zimbabwe. In *The importance of biological interactions in the study of biodiversity*. InTech.
- Leibold, M. A. (1995). The niche concept revisited: mechanistic models and community context. *Ecology*, 76(5), 1371-1382.
- Li, J., Yin, H., Wang, D., Jiagong, Z., & Lu, Z. (2013). Human-snow leopard conflicts in the Sanjiangyuan Region of the Tibetan Plateau. *Biological Conservation*, 166, 118-123.
- Lichtenfeld, L. L. (2005). *Our shared kingdom at risk: Human-lion relationships in the 21st century*. Yale University.
- Lischka, S. A., Teel, T. L., Johnson, H. E., Reed, S. E., Breck, S., Carlos, A. D., & Crooks, K. R. (2018). A conceptual model for the integration of social and ecological information to understand human-wildlife interactions. *Biological Conservation*, 225, 80-87.

- Liu, F., McShea, W. J., Garshelis, D. L., Zhu, X., Wang, D., & Shao, L. (2011). Human-wildlife conflicts influence attitudes but not necessarily behaviors: Factors driving the poaching of bears in China. *Biological Conservation*, *144*(1), 538-547.
- Liu, J., Dietz, T., Carpenter, S. R., Folke, C., Alberti, M., Redman, C. L & Taylor, W. W. (2007). Coupled human and natural systems. *AMBIO: a journal of the human environment*, *36*(8), 639-649.
- Macdonald, D. W. (2004). Conservation: from theory to practice without bluster. In 'The Biology and Conservation of Wild Canids'.(Eds DW Macdonald and C. Sillero-Zubiri.) pp. 353–372.
- Madden, F. (2004). Creating coexistence between humans and wildlife: global perspectives on local efforts to address human–wildlife conflict. *Human dimensions of wildlife*, *9*(4), 247-257.
- Makindi, S. M., Mutinda, M. N., Olekaikai, N. K., Olelebo, W. L., &Aboud, A. A. (2014). Human-wildlife conflicts: causes and mitigation measures in Tsavo Conservation Area, Kenya.
- Manfredo, M. J., &Dayer, A. A. (2004). Concepts for exploring the social aspects of human–wildlife conflict in a global context. *Human Dimensions of Wildlife*, *9*(4), 1-20.
- Manfredo, M. J., Teel, T. L., & Henry, K. L. (2009). Linking society and environment: A multilevel model of shifting wildlife value orientations in the western United States. *Social Science Quarterly*, *90*(2), 407-427.
- Manyara, G., & Jones, E. (2007). Community-based tourism enterprises development in Kenya: An exploration of their potential as avenues of poverty reduction. *Journal of sustainable tourism*, *15*(6), 628-644.
- Masago, J. M. O. (2018). The impact of human wildlife conflict on acquisition of quality education in Narok West Sub County, Kenya.
- Mavura, W. J., &Wangila, P. T. (2003). The pollution status of Lake Nakuru, Kenya: heavy metals and pesticide residues, 1999/2000. *African Journal of Aquatic Science*, *28*(1), 13-18.
- Maxwell, J. A. (2012). *Qualitative research design: An interactive approach* (Vol. 41). Sage publications.
- Messmer, T. A. (2000). The emergence of human–wildlife conflict management: turning challenges into opportunities. *International Biodeterioration & Biodegradation*, *45*(3-4), 97-102.

- Michalski, F., Boulhosa, R. L. P., Faria, A., & Peres, C. A. (2006). Human–wildlife conflicts in a fragmented Amazonian forest landscape: determinants of large felid depredation on livestock. *Animal Conservation*, 9(2), 179-188.
- Mingaine, L. (2013). Leadership Challenges in the Implementation of ICT in Public Secondary Schools, Kenya. *Journal of education and learning*, 2(1), 32-43.
- Mollel, T. L. (2017). *Assessment of Human-Wildlife Conflicts in Wildlife Management Areas: A Case of Burunge WMA* (Doctoral dissertation, The Open University of Tanzania)
- Morzillo, A. T., & Needham, M. D. (2015). Landowner incentives and normative tolerances for managing beaver impacts. *Human Dimensions of Wildlife*, 20(6), 514-530.
- Mosse, M. N. (2003). *Resolving resource use conflicts in Chyulu Hills National Park and its environs* (Doctoral dissertation, . Nakuru, Kenya: Egerton University).
- Mtango, N., & Spinach, N. T. (2007). IUCN–The World Conservation Union, or the Rufford Maurice Laing Foundation. The designations of geographical entities in this publication, and the presentation of material, do not imply the expression of any opinion whatsoever on the part of TRAFFIC or its.
- Mugo, M. J., Mutiso, F. M., Cheboiwo, J. K., Sang, F., Tarus, G. K., & Chemitei, G. K. (2013). The challenges of wild game on forest plantations management objectives in forest ecosystems in Kenya.
- Muller, Z. (2018). Population structure of giraffes is affected by management in the Great Rift Valley, Kenya. *PloS one*, 13(1), e0189678.
- Munthali, S. M., Smart, N., Siamudaala, V., Mtsambiwa, M., & Harvie, E. (2018). Integration of Ecological and Socioeconomic Factors in Securing Wildlife Dispersal Corridors in the Kavango-Zambezi Transfrontier Conservation Area, Southern Africa. *Selected Studies in Biodiversity*, 181.
- Muruthi, P.M. (2005) Human-wildlife conflicts: Lessons learnt from AWF’s African Heartlands. AWF Working Papers, July 2005, African Wildlife Foundation: Nairobi.
- Musiani, M., Mamo, C., Boitani, L., Callaghan, C., Gates, C. C., Mattei, L., & Volpi, G. (2003). Wolf depredation trends and the use of fladry barriers to protect livestock in western North America. *Conservation Biology*, 17(6), 1538-1547.
- Musimbi, M. (2013). *Factors Influencing Human-wildlife Conflict in Communities around the Park: A Case of Lake Nakuru National Park, Kenya* (Doctoral dissertation, Masters’ thesis, University of Nairobi, Kenya).

- Muthiani, M., &Wanjau, K. (2012). Factors influencing the influx of counterfeit medicines in Kenya: A survey of pharmaceutical importing small and medium enterprises within Nairobi. *International Journal of Business and Social Science*, 3(11).
- Mwamidi, D., Nunow, A., &Mwasi, S. H. (2012). The Use of indigenous knowledge in minimizing human-wildlife conflict: the case of Taita Community, Kenya. *International Journal of Current Research*, 4(02), 026-030.
- Mysterud, A. (2006). The concept of overgrazing and its role in management of large herbivores. *Wildlife Biology*, 12(2), 129-141.
- Newmark, W. D., Manyanza, D. N., Gamassa, D. G. M., &Sariko, H. I. (1994). The conflict between wildlife and local people living adjacent to protected areas in Tanzania: human density as a predictor. *Conservation Biology*, 8(1), 249-255.
- Newsome, D., Dowling, R. K., & Moore, S. A. (2005). *Wildlife tourism* (Vol. 24). Channel View Publications.
- Noe, C. (2003). The Dynamics of land use changes and their impacts on the wildlife corridor between Mt. Kilimanjaro and Amboseli National Parks.
- Noss, R. F., Quigley, H. B., Hornocker, M. G., Merrill, T., & Paquet, P. C. (1996). Conservation biology and carnivore conservation in the Rocky Mountains. *Conservation Biology*, 10(4), 949-963.
- Nyaligu, M. O., & Weeks, S. (2013). An elephant corridor in a fragmented conservation landscape: preventing the isolation of Mount Kenya National Park and National Reserve. *Parks*, 19(1), 91-101.
- Nyhus, P. J. (2016). Human–wildlife conflict and coexistence. *Annual Review of Environment and Resources*, 41.
- Nyhus, P. J., &Tilson, R. (2000).Crop-raiding elephants and conservation implications at Way Kambas National Park, Sumatra, Indonesia. *Oryx*, 34(4), 262-274
- Nyhus, P. J., Osofsky, S. A., Ferraro, P., Madden, F., & Fischer, H. (2005). Bearing the costs of human-wildlife conflict: the challenges of compensation schemes. *Conservation Biology Series-Cambridge-*, 9, 107.
- Nyhus, P., & Tilson, R. (2004). Agroforestry, elephants, and tigers: balancing conservation theory and practice in human-dominated landscapes of Southeast Asia. *Agriculture, ecosystems & environment*, 104(1), 87-97.
- Ocholla, G. O., Koske, J., Asoka, G. W., Bunyasi, M. M., Pacha, O., Omondi, S. H., &Mireri, C. (2013). Assessment of traditional methods used by the Samburu pastoral community

- in human wildlife conflict management. *International Journal of Humanities and Social Science*, 3(11), 292-302.
- Odada, E., Raini, J., & Ndeti, R. (2004). Experiences and lessons learned brief, Lake Nakuru. accessed 19.04.2020
- Odino, M., & Ogada, D. L. (2008). Furadan use in Kenya and its impacts on birds and other wildlife: a survey of the regulatory agency, distributors, and end-users of this highly toxic pesticide. *Report to the Bird Committee of Nature Kenya*, 17.
- Odwori, P. O., Ipara, H., & Obare, D. F. (2014). An analysis of land use options in Kitengela and its effect on conservation and management of Nairobi National Park. *African Journal of Education, Science and Technology*, 1(4), 135-141.
- Ogutu, J. O., Kuloba, B., Piepho, H. P., & Kanga, E. (2017). Wildlife population dynamics in human-dominated landscapes under community-based conservation: the example of Nakuru Wildlife Conservancy, Kenya. *PloS one*, 12(1), e0169730.
- Ogutu, J. O., Piepho, H. P., Said, M. Y., & Kifugo, S. C. (2014). Herbivore dynamics and range contraction in Kajiado County Kenya: Climate and land use changes, population pressures, governance, policy and human-wildlife conflicts. *The Open Ecology Journal*, 7(1).
- Ogutu, J. O., Piepho, H. P., Said, M. Y., Ojwang, G. O., Njino, L. W., Kifugo, S. C., & Wargute, P. W. (2016). Extreme wildlife declines and concurrent increase in livestock numbers in Kenya: What are the causes?. *PloS one*, 11(9), e0163249.
- Okello, M. M. (2005). Land use changes and human-wildlife conflicts in the Amboseli Area, Kenya. *Human Dimensions of Wildlife*, 10(1), 19-28.
- Oldendick, R. W. (2012). Survey research ethics. In *Handbook of survey methodology for the social sciences* (pp. 23-35). Springer, New York, NY.
- Oli, M. K., Taylor, I. R., & Rogers, M. E. (1994). Snow leopard *Panthera uncia* predation of livestock: an assessment of local perceptions in the Annapurna Conservation Area, Nepal. *Biological Conservation*, 68(1), 63-68.
- Osborn, F. V., & Hill, C. M. (2005). Techniques to reduce crop loss: human and technical dimensions in Africa. *Conservation Biology Series-Cambridge-*, 9, 72.
- Ottichilo, W. K., de Leeuw, J., & Prins, H. H. (2001). Population trends of resident wildebeest [*Connochaetastaurinushecki* (Neumann)] and factors influencing them in the Masai Mara ecosystem, Kenya. *Biological conservation*, 97(3), 271-282.
- Owino, A. O., Kenana, M. L., Webala, P., Andanje, S., & Omondi, P. O. (2011). Patterns of variation of herbivore assemblages at Nairobi National Park, Kenya, 1990-2008.

- Pack, S., Golden, R., & Walker, A. (2013). Comparison of national wildlife management strategies: What works where, and why? *Heinz Center for Science, Economics and the Environment. University of Maryland*, 100.
- Papworth, S. K., Kang, A., Rao, M., Chin, S. T., Zhao, H., Zhao, X., & Carrasco, L. R. (2014). Bear-proof fences reduce livestock losses in the Tibetan Autonomous Region, China.
- Parker, G. E., & Osborn, F. V. (2006). Investigating the potential for chilli *Capsicum* spp. to reduce human-wildlife conflict in Zimbabwe. *Oryx*, 40(3), 343-346.
- Patterson, B. D., Kasiki, S. M., Selempo, E., & Kays, R. W. (2004). Livestock predation by lions (*Panthera leo*) and other carnivores on ranches neighboring Tsavo National Parks, Kenya. *Biological Conservation*, 119(4), 507-516.
- Pérez, E., & Pacheco, L. F. (2006). Damage by large mammals to subsistence crops within a protected area in a montane forest of Bolivia. *Crop protection*, 25(9), 933-939.
- Peterson, M. N., Birckhead, J. L., Leong, K., Peterson, M. J., & Peterson, T. R. (2010). Rearticulating the myth of human-wildlife conflict. *Conservation Letters*, 3(2), 74-82.
- Polit, D. F., Beck, C. T., & Hungler, B. P. (2001). Evaluating measurements and data quality. *Essentials of Nursing Research: Methods, Appraisal, and Utilization*, 301-24.
- Povinelli, E. A. (2001). Radical worlds: the anthropology of incommensurability and inconceivability. *Annual Review of Anthropology*, 30(1), 319-334.
- Raini, J. A. (2009). Impact of land use changes on water resources and biodiversity of Lake Nakuru catchment basin, Kenya. *African Journal of Ecology*, 47(s1), 39-45.
- Red path, S. M., Young, J., Evely, A., Adams, W. M., Sutherland, W. J., Whitehouse, A., ... & Gutierrez, R. J. (2013). Understanding and managing conservation conflicts. *Trends in ecology & evolution*, 28(2), 100-109.
- Riley, S., Siemer, W., Decker, D., Carpenter, L., Organ, J., & Berchielli, L. (2003). Adaptive impact management: an integrative approach to wildlife management. *Human Dimensions of Wildlife*, 8(2), 081-095.
- Rodgers, W. A. (2000). Wildlife protected area network in India: A review executive summary.
- Rodriguez, L. C., Henson, D., Herrero, M., Nkedianye, D., & Reid, R. (2012). Private farmers' compensation and viability of protected areas: the case of Nairobi National Park and Kitengela dispersal corridor. *International Journal of Sustainable Development & World Ecology*, 19(1), 34-43.
- Rohrbach, B., Anderson, S., & Laube, P. (2016). The effects of sample size on data quality in participatory mapping of past land use. *Environment and Planning B: Planning and Design*, 43(4), 681-697.

- Romanach, S. S., Lindsey, P. A., & Woodroffe, R. (2007). Determinants of attitudes towards predators in central Kenya and suggestions for increasing tolerance in livestock dominated landscapes. *Oryx*, *41*(2), 185-195.
- Roy, S. (2013). Wildlife Protection. Available at SSRN 2207254.
- Sarantakos, S. (2012). *Social research*. Macmillan International Higher Education.
- SARPO, W. (2005). Human wildlife conflict manual. Harare, Zimbabwe, WWF Southern African Regional Programme Office (SARPO).
- Schüßler, D., Lee, P. C., & Stadtmann, R. (2018). Analyzing land use change to identify migration corridors of African elephants (*Loxodonta africana*) in the Kenyan-Tanzanian borderlands. *Landscape ecology*, *33*(12), 2121-2136.
- Sillero-Zubiri, C., & Switzer, D. (2001). Crop raiding primates: searching for alternative, humane ways to resolve conflict with farmers in Africa. *Wildlife Conservation Research Unit, Oxford University, Oxford*
- Sillero-Zubiri, C., & Laurenson, M. K. (2001). Interactions between carnivores and local communities: Conflict or co-existence?. *Conservation Biology Series-Cambridge-*, 282-312.
- Sindiga, I. (1995). Wildlife based tourism in Kenya: Land use conflicts and government compensation policies over protected areas. *Journal of Tourism Studies*, *6*(2), 45.
- Sitati, N. W., Walpole, M. J., Smith, R. J., & Leader-Williams, N. (2003). Predicting spatial aspects of human–elephant conflict. *Journal of Applied Ecology*, *40*(4), 667-677.
- Songorwa, A. N., Buhrs, T., & Hughey, K. F. (2000). Community-based wildlife management in Africa: a critical assessment of the literature. *Nat. Resources J.*, *40*, 603.
- Soulsbury, C. D., & White, P. C. (2016). Human–wildlife interactions in urban areas: a review of conflicts, benefits and opportunities. *Wildlife Research*, *42*(7), 541-553.
- Stachowicz, J. J. (2001). Mutualism, facilitation, and the structure of ecological communities: positive interactions play a critical, but underappreciated, role in ecological communities by reducing physical or biotic stresses in existing habitats and by creating new habitats on which many species depend. *Bioscience*, *51*(3), 235-246.
- Stevens, S. F. (1997). *Conservation through cultural survival: Indigenous peoples and protected areas*. Island Press.
- Thirgood, S., Woodroffe, R., & Rabinowitz, A. (2005). The impact of human-wildlife conflict on human lives and livelihoods. *Conservation Biology Series-Cambridge-*, *9*, 13.
- Treves, A. (2009). The human dimensions of conflicts with wildlife around protected areas. *Wildlife and society: The science of human dimensions*, 214-228.

- Treves, A. D. R. I. A. N., & Naughton-Treves, L. I. S. A. (2005). Evaluating lethal control in the management of human-wildlife conflict. *Conservation Biology Series-Cambridge*, 9, 86.
- Wallen, N. E., & Fraenkel, J. R. (2013). *Educational research: A guide to the process*. Routledge.
- Wang, S. W., & Macdonald, D. W. (2006). Livestock predation by carnivores in Jigme Singye Wangchuck National Park, Bhutan. *Biological Conservation*, 129(4), 558-565.
- Watts, H. E., & Holekamp, K. E. (2007). Hyena societies. *Current Biology*, 17(16), R657-R660.
- Webber, A. D., Hill, C. M., & Reynolds, V. (2007). Assessing the failure of a community-based human-wildlife conflict mitigation project in Budongo Forest Reserve, Uganda. *Oryx*, 41(2), 177-184.
- Western, D., & Waithaka, J. (2005). Policies for reducing human-wildlife conflict: a Kenya case study. *Conservation Biology Series-Cambridge*, 9, 357.
- Western, D., Russell, S., & Cuthill, I. (2009). The status of wildlife in protected areas compared to non-protected areas of Kenya. *PloS one*, 4(7).
- Wildlife Conservation Society (2018). "Human/wildlife conflict: Social and ecological theory: Researchers apply social and ecological theory to understand human/black bear conflicts in Colorado." ScienceDaily. ScienceDaily, 22 August 2018.
- Woodroffe, R., Thirgood, S., & Rabinowitz, A. (Eds.). (2005). *People and wildlife, conflict or co-existence?* (No. 9). Cambridge University Press.
- Yirga, G., & Bauer, H. (2010). Livestock depredation of the spotted hyena (*Crocuta crocuta*) in southern Tigray, northern Ethiopia. *International Journal of Ecology and Environmental Sciences*, 36(1), 67-73.
- Yirga, G., Ersino, W., De Iongh, H. H., Leirs, H., Gebrehiwot, K., Deckers, J., & Bauer, H. (2013). Spotted hyena (*Crocuta crocuta*) coexisting at high density with people in Wukro district, northern Ethiopia. *Mammalian Biology-Zeitschrift für Säugetierkunde*, 78(3), 193-197
- Yirga, G., Gebresenbet, F., Deckers, J., & Bauer, H. (2014). Status of Lion (*Panthera leo*) and Spotted Hyena (*Crocuta crocuta*) in Nechisar National Park, Ethiopia. *Momona Ethiopian Journal of Science*, 6(2), 127-137
- Yirga, G., Leirs, H., De Iongh, H. H., Asmelash, T., Gebrehiwot, K., Deckers, J., & Bauer, H. (2016). Spotted hyena (*Crocuta crocuta*) concentrate around urban waste dumps across Tigray, northern Ethiopia. *Wildlife Research*, 42(7), 563-569.

## APPENDICES

### Appendix 1: Household Questionnaire

I am Christine Chepngeno Koskey, a Master of Science student at Egerton University pursuing a Master's Degree course Natural Resources Management. I am carrying out a study on the **socio-economic impacts of hyena predation on livelihood and the hyena perception among the locals in Lake Nakuru National Park**. Your answers will remain strictly confidential and they will be used only for research purposes.

### Background information

Questionnaire No. \_\_\_\_\_

Sub-  
county \_\_\_\_\_

Ward \_\_\_\_\_  
\_\_\_\_\_

Village \_\_\_\_\_  
\_\_\_\_\_

Date \_\_\_\_\_  
\_\_\_\_\_

Enumerator's name: \_\_\_\_\_

### SECTION A: RESPONDENT INFORMATION

1. Gender (*CHOOSE ONE*)

- 1 Female
- 2 Male

2. If male, how many wives do you have? (*CHOOSE ONE*)

**0 1 2 3 4 5 6 Other** \_\_\_\_\_

3. If female, are you the first wife? (*CHOOSE ONE*)

- 1 Yes
- 2 No
- 3 Not married

3. How many children do you have? (*CHOOSE ONE*)

- 0 1 2 3 4 5 6 More than 6**

5. How old are you? (*CHOOSE ONE*)

- 1** 18-25
- 2** 26-35
- 3** 36-45
- 4** 46-55
- 5** 56-65
- 6** 66-75
- 7** Over 75

6. What is your occupation? If retired or unemployed, what was your primary occupation?

---

7. What is the highest level of education you have received? (*CHOOSE ONE*)

- 1** No school
- 2** Some primary school (8<sup>th</sup> grade or less)
- 3** Finished primary school
- 4** Some secondary school (some high school)
- 5** Secondary school graduates (high school graduate)
- 6** Vocational/Technical school
- 7** Some College/University
- 8** College/University graduate
- 9** Graduate degree
- 10** Presently a student- What grade or level \_\_\_\_\_

8. What is/are your ethnicity or tribal affiliation(s)?

---

---

9. What is/are your religious affiliation(s)?

---

10. How many domestic animals do your household own?

**10a. Cattle**

- 1 0
- 2 1-10
- 3 11-20
- 4 21-49
- 5 50-100
- 6 100-499
- 7 500+
- 8 Decline to state

**10b. Sheep and Goats**

- 1 0
- 2 1-10
- 3 11-20
- 4 21-49
- 5 50-100
- 6 100-499
- 7 500+
- 8 Decline to state

**10c. Donkeys**

- 1 0
- 2 1-5
- 3 6-10
- 4 11-15
- 5 16+
- 6 Decline to state

**SECTION B: GEOGRAPHIC EXTENT AND DRIVERS OF CONFLICT**

1a) In the last 12 months how many animals have you personally lost to spotted hyena attacks?

Animal	Injured	Death
Dogs		

Sheep		
Goats		
Cows		
Donkeys		

1b) Did most of the attacks occur during the rainy season or the dry season?

1. Rainy
2. Dry
3. Not sure

2a.) what do you think are the major causes of attacks on livestock by spotted hyena? (Check all that apply)

1	Food shortage for hyena
2	Poor fencing around the park
3	Poor fencing around the bomas
4	Human encroachment and habitat loss for spotted hyena
5	Other

2b) If other, please explain

### **SECTION C: SEVERITY**

3a. Have you ever reported an attack on your livestock by spotted hyena to KWS?

(Choose one)

1. Yes
2. No

3. I have not had an attack on my livestock by spotted hyena

3b. If yes, how did you report the most recent attack? (Check all that apply)

In person	Telephone	Through village chairperson	Family member	Other

3c. If you have ever reported a spotted hyena attack on livestock, did you get any compensation? (Choose one)

1. Yes
2. No
3. Not applicable

4a. Do you know of someone who has killed or injured a spotted hyena? (Choose one)

- 1 Yes
- 2 No

4b. If yes, how? (Check all that apply)

1. Poison
2. Spear
3. Gun

4. Other methods

4c. If other, please explain.

**SECTION D: CONSERVATION**

1a. Do you think it is important to conserve the spotted hyena? (Choose One)

1 Yes

2 No

3 I have no opinion on this

1b. If yes, why? (Check all that apply)

Ecotourism	
Ecological reason	
Cultural reasons (totem??	
Any other	

1c. If no, why not? (Check all that apply)

Bad omen	
Kills livestock	
Injures people	

**Thanks**

## **Appendix 2: KWS and Soysambu Conservancy Checklist**

### **SECTION A: RESPONDENT INFORMATION**

1. Gender (*CHOOSE ONE*)

**1** Female

**2** Male

2. Occupation rank

1. How severe is the conflict between the wildlife and the adjacent community?
2. How do the local communities adjacent to the park report such conflicts?
3. How does the community report the conflict on hyena?
4. Where do you get reports on livestock that are injured or killed by the hyena around Lake Nakuru National Park and Soysambu Conservancy?
5. If you have been having the human- hyena conflicts, how severe is it around Lake Nakuru National Park and Soysambu Conservancy?
6. What do you do when you get such information?
7. Under what circumstances do you give out compensation to the affected people?
8. Which criteria do you use for compensating the affected people?
9. Why do you think it is important to conserve hyenas?
10. What do you think are the perceptions of community towards hyena conservation?
11. What do you think are the management strategies of human hyena conflict?

**Thanks a lot**

**Appendix 3: Data collection through Open Data Kit (ODK)**



## Appendix 4: Abstract of the publication



Open Journal of Social Sciences, 2021, 9, 411-425  
<https://www.iiste.org/Journals>  
ISSN Online: 2227-5960  
ISSN Print: 2227-5952

# Socio-Economic Impacts of Hyena Predation on Livestock around Lake Nakuru National Park and Soysambu Conservancy, Kenya

Christine Chepngeno Koskey<sup>1\*</sup>, Dickson L. Makenji<sup>2\*</sup>, Christine E. Wilkinson<sup>3</sup>, George W. Eshiamwata<sup>4</sup>

<sup>1</sup>Department of Natural Resources, Egerton University, Egerton, Kenya

<sup>2</sup>Department of Environmental Sciences, Policy, and Management, University of California, Berkeley, CA, USA

<sup>3</sup>Natural Sciences, Kenya National Commission for UNESCO, Nairobi, Kenya

Email: \*[chepngeno2011@gmail.com](mailto:chepngeno2011@gmail.com), \*[d.makenji@egerton.ac.ke](mailto:d.makenji@egerton.ac.ke)

**How to cite this paper:** Koskey, C. C., Makenji, D. L., Wilkinson, C. E., & Eshiamwata, G. W. (2021). Socio-Economic Impacts of Hyena Predation on Livestock around Lake Nakuru National Park and Soysambu Conservancy, Kenya. *Open Journal of Social Sciences*, 9, 411-425.  
<https://doi.org/10.21829/ojs.2021.090219>

**Received:** June 24, 2021

**Accepted:** September 14, 2021

**Published:** September 17, 2021

Copyright © 2021 by author(s) and Scientific Research Publishing Inc.  
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).






<https://www.scopus.com/authors/detail>



## Abstract

Human-wildlife conflicts (HWCs) may arise when expanding human populations and activities overlap or compete for space and resources with wildlife. They may also be due to growing wildlife populations that encroach on human settlements or other areas of human development. Forms of human-wildlife conflict include livestock predation, harassment, property damage, habitat loss due to human activities, and interpersonal conflict over wildlife issues resulting in injuries or mortalities. The spotted hyena (*Crucrota crocata*) is among animals involved in livestock predation for many reasons thus leading to conflicts with livestock owners. This study focused on the causes of human-hyena conflict and the socio-economic impacts of hyena predation on livestock. The study adopted a survey research design. Data were collected using an interview schedule and key informant meetings, targeting different segments of the community. Purposive sampling was employed in data collection. Data were analyzed using descriptive and inferential statistics. The results showed that poor park fencing is the major cause of human hyena conflict with a representation of 40% (125 respondents). Despite the fact that LNNP is fenced, community members still raise complaints about poosity. On the other hand, 60% of Soysambu Conservancy is not fenced, potentially giving hyenas freedom to move from the conservancy to the community. The total estimated cost that is lost to hyena predation in this region as per the responses received in the surveys is approximately 374,740 USD annually. A total of 1020 sheeps were either wounded or killed. Our results suggest that one potential solution is to completely fence both protected areas and maintain the fences to reduce if not halt human-hyena conflicts and perceptions of hyenas as a conflict-

## Appendix 5: Research Permit

 <p>REPUBLIC OF KENYA</p>	 <p><b>NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY &amp; INNOVATION.</b></p>
Ref No: <b>143641</b>	Date of Issue: <b>10/March/2020</b>
<b>RESEARCH LICENSE</b>	
	
<p><b>This is to Certify that Miss. Christine Chepengo Koskey of Egerton University, has been licensed to conduct research in Nakuru on the topic: socio-economic impacts of hyena predation on livestock around Lake Nakuru National Park and Soysambu Conservancy for the period ending : 10/March/2021.</b></p>	
License No: <b>NACOSTI/P/20/4138 Ammended</b>	
143641 Applicant Identification Number	 Director General <b>NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY &amp; INNOVATION</b>
Verification QR Code	
	
<p><b>NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.</b></p>	