PATTERNS AND CAUSES OF ELEPHANT MORTALITY IN NAROK COUNTY, KENYA

BY

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN WILDLIFE MANAGEMENT, DEPARTMENT OF WILDLIFE MANAGEMENT, SCHOOL OF NATURAL RESOURCE MANAGEMENT UNIVERSITY OF ELDORET

2013

DECLARATIONS

Declaration by the Candidate

I declare that this thesis is my original work and has never been submitted to any other academic institution.

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DEDICATION

This study is dedicated to my parents Mr. and Mrs. Camily Wakoli, brothers, sisters and my loving daughter Erin Amanda

ABSTRACT

The increasing trend in elephant mortality pauses challenges to their conservation and management globally. Attempts to mitigate the causes of mortality have not recorded a lot of success in recent years. This study was carried out in Narok County (NC) and aimed at assessing the patterns and causes of elephant mortality. Specific objectives included: determining the spatial and temporal patterns of elephant mortality; determining the trend of elephant mortality over the last 12 years; establishing the causes of elephant mortality; and lastly, assessing the attitudes and perceptions of the local community towards elephant conservation. The study utilized the descriptive research design. The trend in elephant mortality was determined using data from Kenya Wildlife Service (KWS) and World Wide Fund for Nature - Human-elephant Conflict (WWF-HEC) project compiled for a period of 11 years. Field monitoring was carried out for one year and any dead elephant seen was examined and details recorded on causes of mortality and distribution. Attitudes and perceptions of the local community towards elephants were determined through questionnaire surveys, focus group discussions and interviews. Respondents were grouped into three clusters depending on their economic activities in relation to benefits from conservation. The clusters were farmers not benefiting from conservation activities (FNB), pastoralists not benefiting (PNB) and pastoralists benefiting (PB). Spatial and temporal patterns data were entered in an Excel spreadsheet and then converted into dBASE IV format and imported to ArcGIS to create a point shape file of elephant mortality and associated attributes data. Graphs and maps were generated linking mortality with other aspects such as distance to rivers, roads, human settlement and rain season. The Proportion of Illegally Killed Elephants (PIKE) was calculated for the 12 years. Data obtained using qualitative research method was analysed using the chi-square test and regression. Frequencies were calculated, and where appropriate, a chi-square test was used to determine existing relationships between data categories and drawing conclusions about the study. Results indicated that illegal killing has been a major cause of elephant mortality over the past 12 years, ($\chi^2 = 65$, df = 11, p = 0.05). The total number of elephants that died between 2000 and 2011 due to trophy poaching, human-elephant (HEC), unknown reasons, euthanasia, natural cause, problem animal control and accidents were significantly different ($\chi^2 = 118$, df = 6, $p < 0.002$). The attitudes and perceptions of the local community towards elephant conservation were significantly different among the different clusters of respondents ($\chi^2 = 74.157$, df =8, p=0.000). Various mitigation measures to curb the high rate of mortality were identified among them equitable benefit sharing and education and extension. It is evident from the results that elephant conservation faces many challenges among them poaching and human-elephant conflict. There is need to address issues such as benefit sharing, HEC, and increase in law enforcement by KWS to control the increasing mortality.

LIST OF ACRONYMS

AC	Accident
AESR	African Elephant Status Report
AfESG	African Elephant Special Group
AsESG	Asian Elephant Special Group
CBOs	Community Based Organization
CF	Conflict
CITES	Convention on International Trade in Endangered Species
CNN	Cable News Network
CoP	Conference of Parties
CT	Control
CWS	Community Wildlife Service
DDP	District Development Plan
DNA	Deoxyribonucleic acid
DRC	Democratic Republic of Congo
ESA	Endangered Species Act
ERTF	Elephant Research Trust Fund
FGD	Focus Group Discussion
FNB	Farmers Not Benefiting
FOC	Friends of Conservation
EU	Euthanasia
HEC	Human-Elephant Conflict
HWC	Human-Wildlife conflict

GDP	Gross Domestic Product
GOK	Government of Kenya
GPS	Global Positioning System
IFAW	International Fund for Animal Welfare
IUCN	International Union for the Conservation of Nature and Natural Resources (The World Conservation Union)
KWS	Kenya Wildlife Service
MMNR	Maasai Mara National Reserve
NA	Natural
NC	Narok County
NCC	Narok County Council
NCST	National Council for Science and Technology
NGOs	Non-Governmental Organizations
OB	Occurrence Book
PA	Protected Area
PAC	Problem Animal Control
PB	Pastoralists Benefiting
PIKE	Proportion of Illegally Killed Elephants
PNB	Pastoralists Not Benefiting
SGR	Serengeti Game Reserve
ST&I	Science, Technology and Innovation grant
SPSS	Statistical Package for Social Sciences
SSC	Species Survival Commission of IUCN

TCC	Transmara County Council
TM	Transmara
TP	Trophy Poaching
UN	Unknown
UTM	Universal Transverse Mercator
WWF	World Wide Fund for Nature
WWF-HEC	World Wide Fund for Nature-Human Elephant Conflict Project
WWF-ESARPO	World Wide Fund for Nature-Eastern and South African Regional Programme Office

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ACKNOWLEDGEMENT

The successful completion of this work involved valuable contributions from many people and institutions. I wish to express my sincere gratitude to everyone who has been involved in the completion of this work. First and foremost, I would like to thank the Almighty God for giving me good health and sound mind throughout the academic sessions which have enabled me to achieve my goals and objectives. Secondly, I wish to acknowledge my supervisors Prof. Hellen Ipara, Prof. Noah Sitati and Dr. Paul Odwori for their technical advice, support, encouragement and contributions.

Thanks to Kenya Wildlife Service (KWS) Elephant Research Trust Fund (ERTF) who supported the entire field study. I would also wish to express my sincere and profound gratitude to KWS staff particularly Mr Patrick Omondi, Dr. Shadrack Ngene, Maurice Adek, Ben Mugavi, Brenda Oyaro, Dominic Nashu, Moses Omurambi, Peter Hongo, Joseph Mukeka, Jackyline Mutwiri and Carolyne Gatheru for their commitment which ensured the smooth running of the project.

Special thanks go to the National Council for Science and Technology (NCST) for financial support, World Wide Fund for Nature for financial support for field work, office space and accommodation in the field, and Prof. Noah Sitati WWF Species Program Co-ordinator for his intellectual contribution, support, technical advice and encouragement throughout the study. Many thanks go to households in Ang'ata, Masurura, Olalui, Olmotonyi, Sitoka, Olesentu, Kawai, Emarti, Majimoto, Olontoto, Ntuka, Ntulele, Siyaipei Nkoilale, Lemek and Naikara for taking the time to answer the numerous questions asked, and my field assistants in Narok County.

I would like to extend my appreciation for the encouragement, love and tireless assistance offered by my parents Mr and Mrs Camily Wakoli and for their self-dedication in financial support and assistance throughout my studies. Lastly, my appreciation goes to my daughter Erin for her patience and understanding during my absence, and my friend Dorothy Syallow for encouragement and advice. God bless all who have contributed to the success of my studies.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

More than twenty years have passed since the international ban on ivory trade took effect, yet poachers are still slaughtering more than 100 elephants a day, (International Fund for Animal Welfare (IFAW), 2010). The ban on ivory trade by the United Nations Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) took effect on October 17, 1989. At that time an average of 200 elephants were being killed every day in Africa. Poaching almost ceased after the ban, but it is now on the increase once again, felling an average of 104 elephants per day (IFAW, 2010).

Elephant populations fell from 17,620 to 1,438 in Uganda between 1973 and1989; 190,720 to 49,112 in Tanzania between 1977 and 1989 and from 129,570 to 15,279 in Kenya between 1973 and 1989 (Douglas-Hamilton, 1989). These three core elephant range states in East Africa lost around 185,000 elephants in just 16 years. The excessive ivory harvesting saw the 1973 elephant population fall from approximately 130,000 to under 16,000 before the trade ban came into effect in 1989 (Douglas-Hamilton, 1989), and the establishment of Kenya Wildlife Service led to the evolution of an approach aimed at promoting more rigorous anti-poaching methods. It took some time for the decimated remnant populations to recover but by 2007 elephant numbers had risen to 23,353 with a further 6,262 listed as probable or possible (Blanc *et al.,* 2007). Although this is a mere fraction of the original 1973 elephant population, this recovering population

has had to expand into a new world, one densely populated with humans, infrastructure, agriculture and livestock.

Although Kenya has an impressive protected area network, this only covers 8% of the country and at present the elephant range is estimated at 19% of the country's area (Blanc *et al.,* 2007). The migratory behaviour of elephants means they spend a significant proportion of their time outside protected areas in the search for food and water (Douglas- Hamilton *et al.,* 2005) bringing them into direct conflict with people over the increasingly scarce land resources (Hoare, 2000; Sitati, 2003).

With Kenya's human population having tripled to 36.3 million (GOK 2010) from 12 million in 1970, the recovery of the local elephant populations has caused a well-documented escalation in human-elephant conflict (HEC) (Thouless, 1994; Sindiga, 1995; Omondi *et al.*, 2004; Graham, 2007).

Narok County (NC) supports a large number of elephants both in the protected area and the adjacent dispersal areas (Maasai Mara National Reserve Management Plan, 2009). Despite this, this ecosystem is undergoing a tremendous transformation that may be detrimental to the survival and conservation of elephants. Incidences of death to the free ranging African elephant (*Loxodonta africana africana*) are common. The ecosystem also borders the Republic of Tanzania and thus the Mara-Serengeti elephant ranges are shared. Tanzania allows consumptive use of wildlife in Game management areas and therefore, Tanzania and Zambia wanted to sell the stockpiles of ivory that had built up

over the past few decades (African Conservation Foundation, 2010). At the time of the proposed sale, they had as much as 90,000 kilograms of elephant tusks. Kenya was against the relaxation of the ban on the ivory trade as such an action could increase the illegal trade, which would be a serious threat to elephant numbers. Any experiments to allow the partial lifting of international ban in ivory trade could stimulate elephant poaching. In spite of these concerted efforts, there has been an increase in poaching across the entire continent, with some countries losing their entire population (Blanc *et al*., 2007).

Elephant poaching has risen seven-fold in Kenya since 2007 (Kenya Wildlife Service, 2010). In 2009, 271 Kenyan elephants were killed by poachers, compared with 37 two years earlier. A pair of elephant tusks can sell on the black market for up to USD 2,000 in Kenya. This is a huge sum of money for poor farmers living with elephants, majority of whom are living below the poverty line. The temptation to poach has increased in recent years because of the lack of rain which has led to massive crop failure and there is widespread hunger across much of the country. Another reason for the increase in poaching is due to elephants competing for land and food with humans. Human-elephant conflicts are growing and the view of the communities is that elephants are a pest (Moses *et al*., 2012). Likewise, Tanzania's position which also allows hunting is a threat to elephants that cross the Kenya-Tanzania border freely.

Human-elephant conflict (HEC) is a contemporary conservation and management problem in all elephant ranges not only in Kenya but other parts of the world. This

problem has far reaching implications on elephant populations as they are killed or injured by the local community in revenge for conflicts that they cause and also due to the antagonistic attitudes and perceptions of local communities towards conservation of elephants (Sitati and Walpole, 2006). HEC and elephant mortality in Kenya have become increasingly significant as human population expands and encroaches on elephant habitat (Hoare, 2000; Sitati *et al.,* 2003), and as elephant population expands from protected refuges into unprotected historical range (Walpole *et al.*, 2003). HEC is therefore highly recognized by the IUCN/SSC African Elephant Specialist Group (AFESG) as one of the most significant threat to the future of the African elephant.

Kenya relies heavily on tourism to earn foreign exchange and many visitors come to the country to visit its game parks, and see its animals, among them a 35,000-strong heavily protected elephant population (KWS, 2010). The sector is seen as one of the drivers of the economy, bringing in millions of dollars. According to statistics by the Ministry of Tourism, in 2011, Kenya recorded the highest number of tourist arrivals ever at 1.26 million tourists thus earning Kshs. 98 billion compared to 2010 with 1,095,945 tourists. In 2010, Kenya earned Kshs. 73.68 billion in terms of revenue earnings from tourism giving an 18% growth compared to the 952,481 experienced in 2009. In 2009, tourism earned Kshs. 62.5 billion, up from Kshs. 52.71 billion in 2008 from the 950,000 visitors who came into the country (Ministry of Tourism, 2011). Wildlife based tourism is a significant component of the country's product appeal. Kenya's loss of key species such as elephants predicts loss of customer appeal, if poaching, which has significant negative impacts on elephants and wildlife in general, continuous to be on the increase.

The elephant is a charismatic as well as a flagship species. It is also one of the "big five" and has been marketed as a great attraction by Kenya's tourism sector (Moses *et al*., 2012). Increased elephant deaths and/or injuries could lead to high mortalities if not controlled and this can have profound implications on biodiversity as well as tourism. Studies have identified various causes of elephant mortality. Notable among these are human attacks, infectious diseases, inter-species fights, predatory attacks and rough terrain leading to leg fracture and dislocation among others (Thouless *et al.,* 2008). Against this background, this study gives an insight on patterns, causes, trends and distribution of elephant mortality as well as the attitudes and perceptions of the local community towards elephant mortality in NC.

1.2 Statement of the problem

The African elephant, which once roamed most of the African continent, is today only found in 37 scattered ranges, with fragmented populations south of the Sahara desert (Cumming *et al.,* 1990). This decline is due to changing land use patterns, increasing human populations, poaching, desertification, habitat destruction and divergent approaches to tourism some of which include consumptive use (Blanc *et al.,* 2003). Many African elephants live inside protected areas (PAs), which alone cannot sustain elephant populations. Therefore, elephants depend on areas outside PAs often on a seasonal basis. It is in these unprotected areas, dominated by humans, where a lot of poaching activities and HEC cases occur. A lot of research has been carried out on diverse elephant issues in NC by various organizations, but there has been no proper monitoring and data collection on patterns and causes of elephant death, which is necessary for the development of

innovative and sustainable mitigation measures that can reduce elephant mortality and increase their population. This study aimed at doing this with a view of generating data that can assist in planning for elephant conservation and sound management in NC.

Although literature review has pointed to a number of causes of elephant mortality worldwide, no comprehensive and conclusive study has been done to address the elephant mortality issues and questions this study attempts to answer in NC. Therefore, a knowledge gap exists, and the aim of this study was to generate the knowledge to fill the gap by establishing patterns and causes of elephant mortality in the study area over the last 12 years (2000 to 2011).

Cases of elephant deaths due to HEC and natural death have been reported in NC. From literature reviews, it has been found out that this could be due to scarcity of resources and reduced elephant home ranges in MMNR making elephants to migrate to the nearby dispersal areas. Increased interaction between elephants and humans has had a negative effect on elephants as well as conservation and management of wildlife outside protected areas. Therefore, appropriate measures should be instituted to avert further mortalities. Against this backdrop, there was a need for an in-depth study to identify factors leading to elephant deaths with a view of proposing mitigation measures as well as possible long-term solutions to enable the local community co-exist with elephants. It is envisaged that these measures will also help change the attitudes and perceptions of the local residents towards the conservation of elephants in NC.

1.3 Objectives of the study

1.3.1 Broad objective

To assess elephant mortality in Narok County, assess its trends and spatial distribution pattern and suggest possible strategies to reduce the mortality rate.

1.3.2 Specific objectives

The specific objectives are:

a) To determine the trend of elephant mortality in Narok County from the year 2000 to 2011.

b) To determine the spatial and temporal patterns of elephant mortality in Narok County.

c) To determine the causes of elephant mortality in Narok County.

d) To assess the attitudes and perceptions of the local community towards elephant conservation in Narok County.

e) To propose strategies to reduce elephant mortality in Narok County.

1.4 Research Questions

a) What is the trend in elephant mortality in Narok County from the year 2000 to 2011?

b) Do elephant mortalities in Narok County have a spatial and temporal pattern?

c) What are the main causes of elephant deaths in Narok County?

d) What are the attitudes and perceptions of the local community towards elephant conservation in Narok County?

e) What strategies can be put in place to reduce elephant mortality in Narok County?

1.5 Justification and significance of the study

In 1989, CITES moved the African elephant to Appendix I (CITES, 1989). Despite this, some African countries with strong elephant conservation programmes in place did not support the CITES decision (Stiles, 2004). They argued that a total ban on selling confiscated ivory would hurt their abilities to fund conservation (Cumming, 2000). Few studies support the effectiveness of the ban to reduce the illegal trade, the intensity of poaching or the bush meat trade (Martin and Stiles, 2000; Courouble *et al.*, 2003; Martin and Stiles, 2003; IFAW, 2004; Stiles, 2004). Consequently, CITES Conference Resolution 7.9 allowed the elephant populations of certain countries to be given an Appendix II listing at a later date if deemed necessary (Kiyono, 2002).

At the 10th Conference of Parties (CoP) in 1997, Botswana, Namibia and Zimbabwe were allowed to transfer their elephant populations from Appendix I to Appendix II under a series of restrictions and precautionary measures, and were permitted by international bodies to an experimental sell of 50 tonnes of raw ivory to Japanese traders (CITES, 1997; Stiles, 2004). Many African countries opposed this sale because they believed it would provide a loophole for poached ivory to enter the international market once again. Despite this, the 12th CoP in 2002 gave conditional approval to Botswana, Namibia and South Africa to sell 60 tonnes of stockpiled ivory (Stiles, 2004). The conditions were that an adequate system to monitor poaching be put in place, and that Japan the only designated buyer, provide assurances that it would control the use of the ivory and

prevent its re-export. It was not until the 14th CoP in 2007 that CITES member countries gave their full support to the auction (USA Today, 2007).

Elephant species score highly on the criteria value of animal species in social, economic and ecological aspects (WWF, 1997). These criteria include wildlife species that are highly visible nationally and internationally, highly attractive to tourists; potentially dangerous to life and property; mobile and require large areas to satisfy their needs and, compete directly for space with other land uses; occur in large numbers outside protected areas; and present management challenges to wildlife managers and agencies (Sitati, 2003).

Kenya Wildlife Service (KWS) and World Wide Fund for Nature as well as other conservation organizations have undertaken research on HEC and assisted the local community to mitigate emerging conflicts through the provision of thunder flushes, torches, torch batteries, chilly ropes, training community scouts on how to mitigate conflicts, having community meetings to sensitize communities, supporting Community Based organizations (CBOs), and conducting education and extension activities in primary schools and among communities at large through various channels. All these initiatives and activities have aimed at ensuring that local communities in NC coexist with elephants and have a positive attitude towards its conservation. Despite the efforts, elephant mortalities have been on the increase in recent years. There is a need for continuous monitoring of elephant mortality cases in NC with a view of developing better

ways of reducing mortality cases, and at the same time increase the population of elephants and enhance their co-existence with humans.

The current conservation policy, law and regulations in Kenya have not managed to harmonize wildlife conservation and other land use activities like agriculture due to lack of a clear land use policy. There is also a gap on details on the extent, distribution and factors that influence elephant death and injury in relation to HEC in the study area. It is crucial to obtain these details to understand the important aspect of human-elephant coexistence and how it affects the conservation and protection of elephants as well as the welfare of people. This study aimed at generating information that is critical to planners, conservationists and managers involved in designing HEC mitigation strategies and measures that can reduce elephant mortality, improve elephant population and promote co-existence between humans and elephants.

Findings of this study have important implications on the future of elephant conservation in the face of competition with human needs, both in NC and elsewhere in Kenya. The study also provides essential information on the management of elephants in NC and to wildlife managers in guiding them on how to make decisions on reducing elephant mortality. The findings provide information upon which further studies can be based on and the results will be useful as data base for scholars and researchers interested with strategies to mitigate elephant mortality.

1.6 Conceptual framework for the study

The conceptual framework for the study encompasses various inter-linked variables having an impact on elephant mortalities. The dependent variable was elephant mortality while the independent variables included causes of elephant mortality among them natural death due to diseases and old age, poaching for ivory and meat, accidents, sport hunting, electrocution, and HEC which results in problem animal control, poisoning, and spearing. The independent variables, such as HEC, could lead to negative attitudes and perceptions towards elephant conservation if not taken into account. The study therefore, comes up with some possible mitigation measures like elephant translocation, education and awareness, proportional benefit sharing, and compensation to HEC cases. The mitigation measures will promote positive perception of the local community towards elephant conservation and other wildlife species, which in return can lead to increase in elephant population. Figure 1.1 gives a summary of the key elements of the conceptual framework for this study.

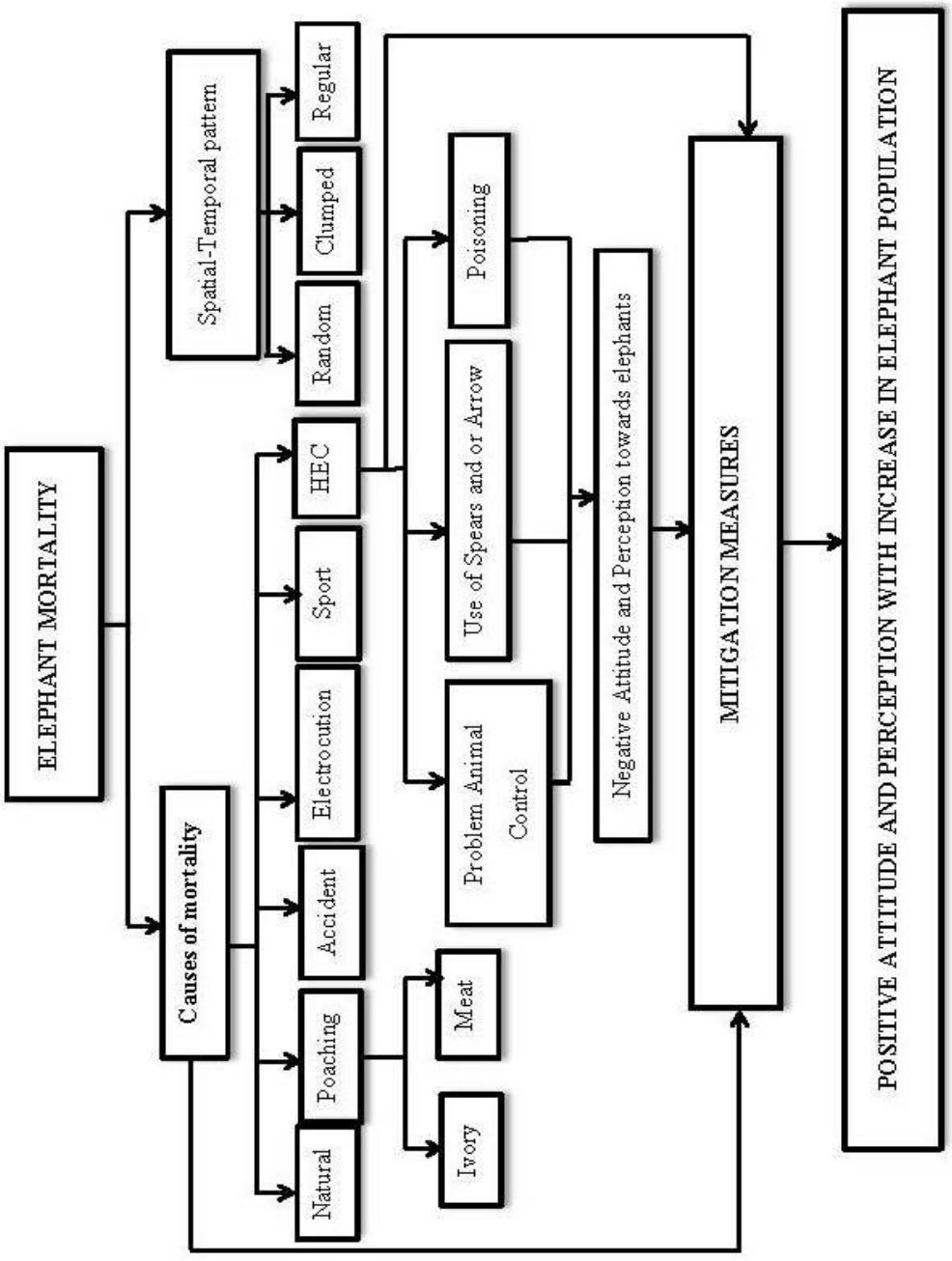

Figure 1.1: Conceptual framework for the study

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The elephant is the world's largest terrestrial mammal. It is a species of considerable economic, ecological, cultural and aesthetic value to many people and societies, and arguably the world's most charismatic mega-herbivore (Blanc *et al.,* 2007). Elephant represent strength and power for many cultures on the African continent and, is also a flagship species for visitors from across the globe.

Elephants possess extraordinary intelligence, complex social structures and remarkable abilities to adapt to their surroundings. They play a pivotal role in ecosystems as unique 'keystone' species and natural habitat engineers or agents of change, while providing a focus for fundraising, awareness building and stimulating action for broader conservation efforts as 'flagship' and 'umbrella' species (Leuthold and Sale, 1973).

2.2 Elephant ecology and ethology

Historically, African elephants inhabited large areas south of the Sahara Desert, although they are now restricted to forest, bush and savanna landscapes in parks and preserves due to human encroachment and agricultural expansion (Blanc *et al.,* 2003). Elephants live in matriarchal societies where females live in cohesive groups with strong social bonds, and males are solitary but interact with other males and females within their home range (Moss and Poole, 1983). Genetic studies done by Fernando and Lande (2000) indicate that females in a group are normally related. A population or sub-population could be composed of several clans with independent males. Clans have well defined home ranges

and show strong fidelity to it; and all clan members' show coordinated movement within the clan's home range (Moss and Poole, 1983). Clans may also have well defined seasonal ranges within their home range, and here too they show strong fidelity to these seasonal ranges and to the routes they use to move between them. Home ranges of different clans may overlap partially or totally, but there is temporal separation in resource use which is governed both by availability of resources and dominance hierarchies (Baskaran *et al*., 1995).

While elephants are extreme generalists, having adapted to habitats that range from dry thorn forests to wet evergreen forests, they are finely tuned to the spatial-temporal variations in the resource availability within their home ranges and have very specific strategies to exploit them (Blake and Hedges, 2004). Even when there is 80% overlap between the home ranges of different clans, the use of different vegetation types and food plant species varies significantly (Baskaran and Desai, 2000).

Clans are likely to leave their home ranges only when exposed to severe stress like extreme droughts, severe poaching, overpopulation, severe human disturbance or when the habitat within a home range is lost or highly degraded (Milner-Gulland and Beddington, 1993). The entire clan or a part of it may break away and wander in search of better habitat; and such movement is an indication that there are serious problems (Milner-Gulland and Beddington, 1993). Studies conducted in south India indicated home range sizes as large as 600 km^2 for females and 350 km^2 for males (Baskaran *et al*., 1995), while a study done in north India indicated home range sizes of 184 to 327 km^2 for

females and 188 to 408 km^2 for males (Williams *et al*., 2001). In Sri Lanka, home ranges sizes of up to 29 to 160 km^2 for females and 53 to 345 km^2 for males have been reported (Fernando *et al*., 2005). While some smaller home ranges have been observed in some areas, it must be noted that these smaller sizes are likely to be representative of clans with compressed home ranges due to habitat loss or competition. This would indicate that habitat patches less than 250-300 km^2, even when having suitable shape/structure would be barely enough to hold an undisturbed home range (Omondi, 1994).

Elephants have various attributes that make them notable agents of habitat change. Some of these attributes include their longevity, body size, feeding habits, dispersal, spacing and social organization (Moss, 2001). Due to their large body size and voracious appetite, elephants cover large areas and travel long distances in order to satisfy their requirement for food and water. It has been estimated than an adult elephant requires 100-300kg of food and around 250 litres of water each day. Elephants greatly prefer secondary re-growth and are strongly associated with wet habitats such as swamps, marshes and seasonally inundated forests (Lahm, 1993). Elephants spend dry seasons in woodland and forests where they congregate near water points or streams and rest under trees during the hottest hour of the day. When the rains begin, new grasses sprout and elephants move back to their wet season habitats (Buss, 1961).

The survival of elephants depends on their ability to disperse seasonally across artificial boundaries (Omondi, 1994) since most protected areas are not ecologically capable of supporting and providing adequate food and water for the elephant populations. Around

80% and 60% of elephants in Africa and Kenya respectively, are found outside protected areas where they face a lot of threats and also cause conflict to people living in the same elephant dispersal areas which in turn may affect their population (Sitati *et al.*, 2003).

Elephants within a herd are usually related, and all members of the tightly knit female group participate in the care and protection of the young (Osborn, 1998). After the initial excitement, the mother will usually select several full-time baby-sitters, or "allomothers", from her group (Moss, 2001). An elephant is considered an allomother when she is not able to have her own baby. The more allomothers, the better the calf's chances of survival and the more free time its mother has to feed. Providing a calf with nutritious milk means the mother has to eat more nutritious food herself, a benefit of being an allomother is that she can gain experience or receive assistance when caring for her own calf (Moss, 2001). According to Moss (2001), these allomothers will help in all aspects of raising the calf. They walk with the young as the herd travels, helping the calves along if they fall or get stuck in the mud.

2.3 Elephant range and distribution

Historically, P*roboscideans* occupied Africa, Europe, Asia and America, but today wild elephants are found in sub-Saharan Africa and parts of Asia only (Blanc *et al,* 2007). Asian Elephant (*Elephas maximus)* populations are in serious decline throughout their range. Elephant range and numbers have contracted dramatically over the last century, and now only a fraction of the original population remains scattered in highly fragmented bands (Kempf and Santiapillai, 2000). This progressive decline is largely due to

unrelenting human–elephant conflict, habitat loss and fragmentation, as well as ongoing illegal capture, killing and trade. The Asian elephant has been listed in CITES Appendix I since 1975, and as Endangered (Choudhury, 2008) in the IUCN Red List. The rationale behind the endangered status is an inferred population size reduction of at least 50% over the last three generations, based on a reduction in the species' area of occupancy and the quality of its habitat.

African elephants (*Loxodonta africana*) are currently the largest land-dwelling mammal of the order Probocidea and one of only two living representative genera from the family Elephantidae: *Loxodonta* and *Elephas* (Gray, 1821). African Elephants currently occur in 37 countries in sub-Saharan Africa (Blanc *et al*., 2007). They are known to have become extinct in Burundi in the 1970s, Gambia in 1913, Mauritania in 1980s and in Swaziland in 1920, where they were reintroduced in the 1980s and 1990s. According to the most recent assessment of elephant range in the African Elephant Status Report of 2007 the continental range in Africa is approximately 3,335,827 Km^2 of continent surface area (Blanc *et al.*, 2007). Only 31 % of this range is protected and only 51 % has been surveyed.

African elephants are native in Angola; Benin; Botswana; Burkina Faso; Cameroon; Central African Republic; Chad; The Democratic Republic of Congo; Côte d'Ivoire; Equatorial Guinea; Eritrea; Ethiopia; Gabon; Ghana; Guinea; Guinea-Bissau; Kenya; Liberia; Malawi; Mali; Mozambique; Namibia; Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; South Africa; Sudan; Tanzania, Togo; Uganda; Zambia; Zimbabwe.

Although large tracts of continuous elephant range remain in parts of Central, Eastern and Southern Africa their continued presence in two of these countries namely Senegal and Somalia is uncertain. Consequently, elephant distribution is becoming increasingly fragmented across the continent (Figure 2.1).

2.4 Status of elephant population

Estimates of the global population size of the Asian elephant were between 41,410 and 52,345 animals (Sukumar, 2003). The Asian elephant was and is still a target for poachers today, since only the males have tusks and are the target, this has interfered with breeding patterns. In some places, there are as few as 1 male for every 100 females, which results in limited genetic interchange and low birth rates. In better-protected areas, birth rates are high with up to 90 percent of adult cows being accompanied by calves, as compared with 30 percent in areas of intense poaching (Choudhury, 2008). Females as well as males are also killed for their hides and meat.

An estimated 5-10 million African elephants existed in 1930. Less than 1% of that number (approximately 600,000) remained when they were added to the international list of the most endangered species in 1989 (Cumming *et al*., 1990). Demand for ivory combined with loss of habitat from human settlement led to huge declines in population.

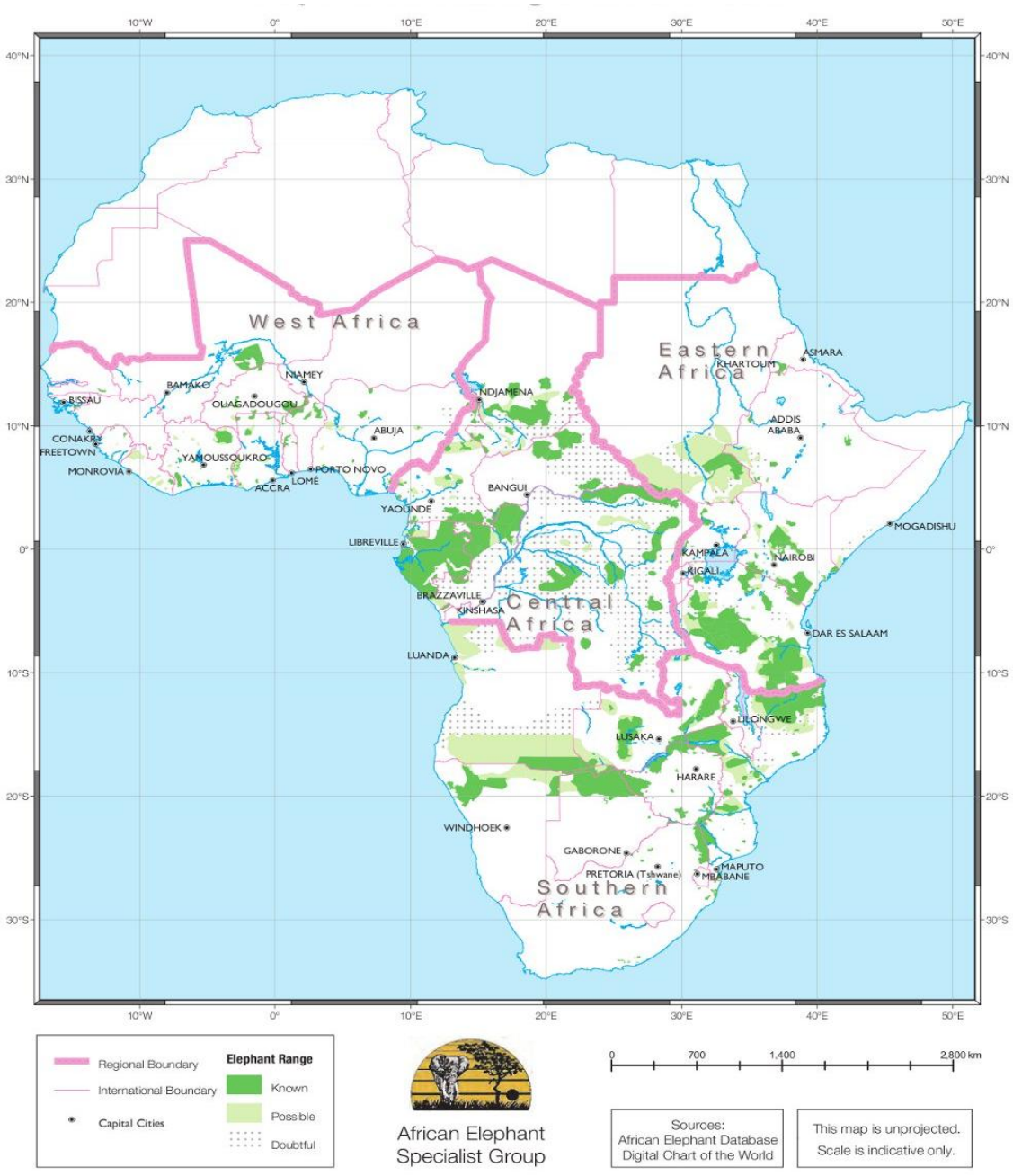

Figure 2.1: Elephant range in Africa

(Source: Blanc *et al.*, 2007)

According to the African Elephant Status Report (AESR) by Blanc *et al* (2007), which is the most recent comprehensive assessment of elephant numbers, there may be between 472,269 and 689,671 elephants on the African continent. Even though, these figures only

relate to approximately 50% of the estimated range, the actual total is not likely to differ significantly from these totals.

Southern Africa holds the largest known number of elephants in any sub-region, followed by Eastern Africa and Central Africa. Although elephant populations may at present be declining in parts of their range, major populations in Eastern and Southern Africa, accounting for over two thirds of all known elephants on the continent have been surveyed, and are currently increasing at an average annual rate of 4.0% per annum (Blanc *et al*., 2005, 2007). As a result, more than 15,000 elephants are estimated to have been recruited into the population in 2006 and, if current rates of increase continue the number of elephants born in these populations between 2005 and 2010 is larger than the currently estimated total number of elephants in Central and West Africa combined (Blanc *et al*., 2005). Most countries in West Africa count their elephants in tens or hundreds, with animals scattered in small blocks of isolated forest, and only three countries in this region have more than 1,000 animals (Martin and Stiles, 2003).

In Kenya the excessive ivory harvesting saw the 1973 elephant population approximately 160,000 drop to under 16,000 in 1988 (Figure 2.2) before the trade ban came into effect in 1989 (Douglas-Hamilton, 1989) and the establishment of Kenya Wildlife Service saw an approach towards more rigorous anti-poaching methods It took some time for the decimated remnant populations to recover but by 2007 the elephant numbers had risen to 23,353 (Figure 2.2) with a further 6,262 listed as probable or possible (Blanc *et al.*, 2007). Although this is a mere fraction of the original 1973 elephant population, this

recovering population has had to expand into a new world, one densely populated with humans, infrastructure, agriculture and livestock. In NC, the population of elephants has also increased (Figure 2.3) despite the many challenges facing conservation.

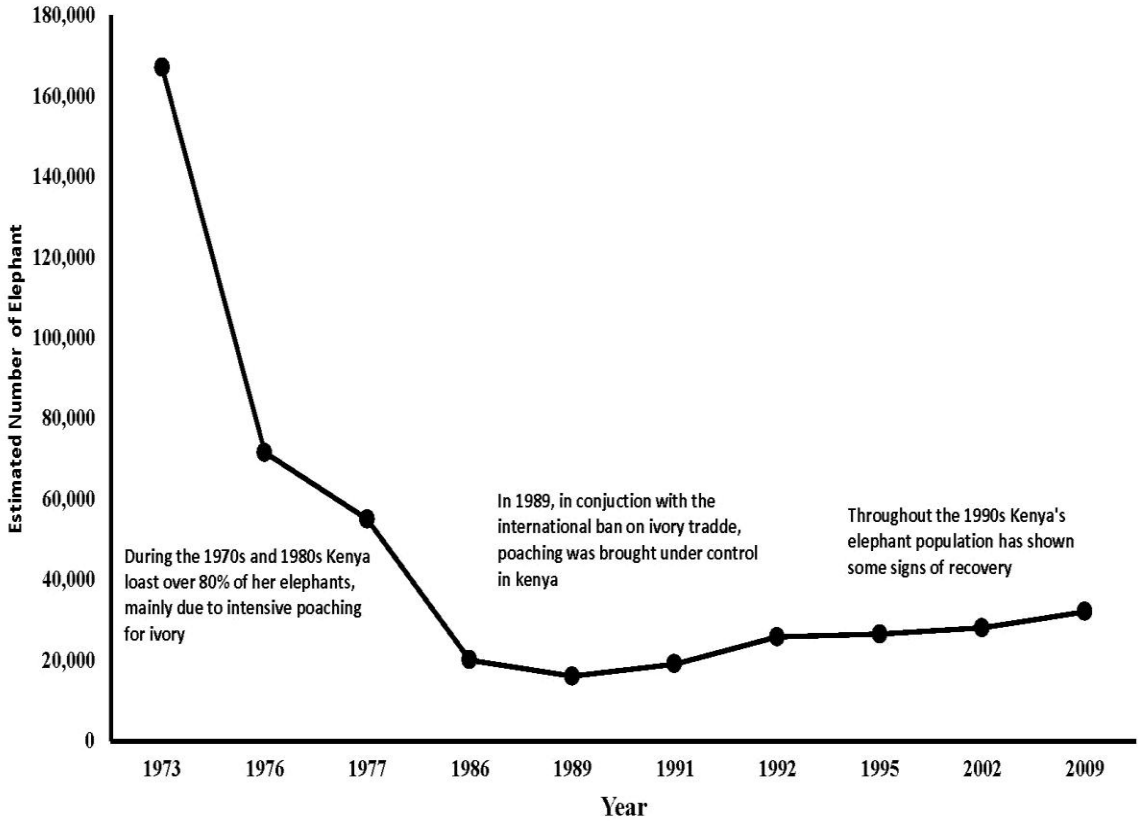

Figure 2. 2: Kenya's elephant population estimates from 1973 to 2009

(Source: KWS, 2010)

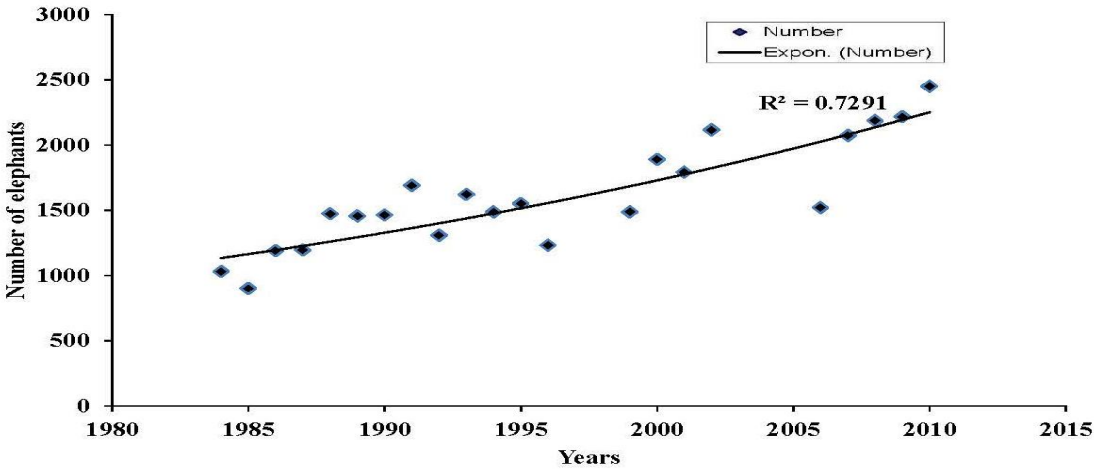

Figure 2 3: Trend of elephant population in Narok County from 1984 to 2010 based on aerial survey

(Source: KWS, 2010)

The population of elephants inside MMNR has been declining while increasing in dispersal areas (community land) which has led to increased HEC (Figure 2.4).

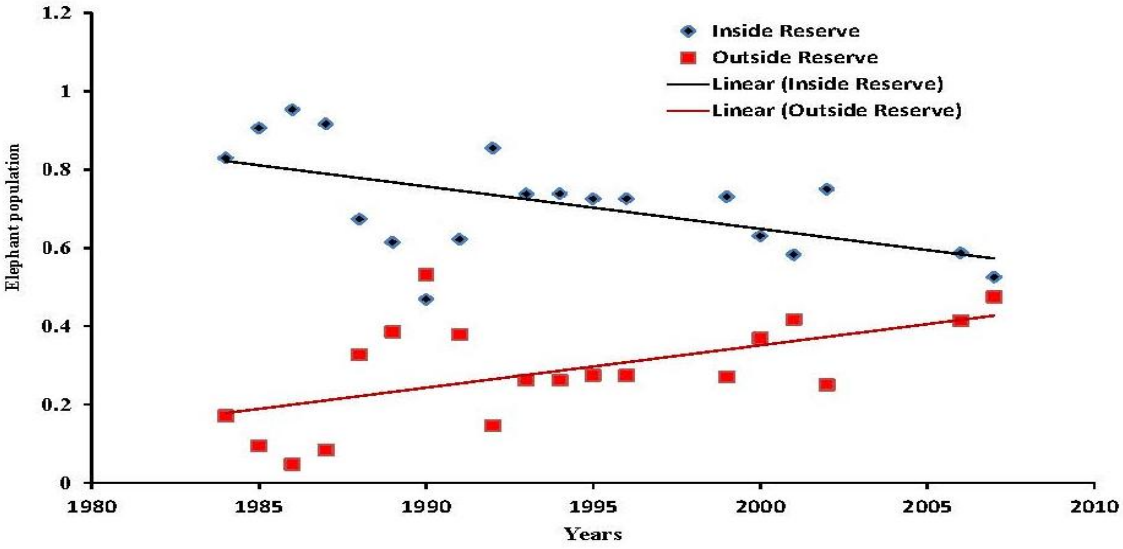

Figure 2.4: Population trend of elephants within Maasai Mara National Reserve and dispersal area from 1984 to 2010 based on aerial survey

(Source: KWS, 2010)

2.5 Overview of elephant mortality

Deforestation and human encroachment among other factors have led to loss of elephant habitats, while drought has resulted in the deaths of young ones. However, the main reason for the increasing decline in elephant population is poaching, which led to the flourishing ivory trade across the globe (Chepkwony, 2001). In 1989, an ivory ban was implemented, and with strict anti-poaching measures, there was an improvement in the situation (Sunday Times, 2010). Countries like Zimbabwe, Botswana and Namibia, experienced difficulties like agricultural loss resulting from the rising number of elephants. Hence, elephants in these countries were down listed from Appendix I to Appendix II of the CITES, which controls, regulates and manages trade in elephant parts and products (CITES, 2009).

Besides the foregoing other factors that have led to increased elephant mortality include natural causes manifested through old age, accident due to rough terrains, diseases and predation (Sitati, 2003).

2.6 Spatial and temporal patterns of elephant mortality

Spatial aspects of elephant mortality as well as other wildlife species are not well documented, and the available literature is little. Nielsen *et al.*, (2004) used GIS to model the spatial distribution of human-caused grizzly bear mortality in the Central Rockies ecosystem of Canada. A bear's relative risk to death was found to be related to landscape biophysical and human factors that described human accessible habitats in those locations bears were likely to frequent. These biophysical and human factors included access to

water, roads, slope, elevation, terrain ruggedness and vegetation. The relationship between bear mortality and the biophysical and human factors explains why bear deaths were found to be localized around Lake Louise, the city of Banff and the Red Deer River northwest of Calgary, rather than being random or dispersed within the study area.

Biophysical and human factors influence distribution and habitat preferences for different animal species in their natural habitats (Musiega and Kazadi, 2004). As such, an animal will select a habitat that enhances its chances of survival and reproduction. Unfortunately, not all the preferred habitats enhance an animal's survival and reproduction success, but can instead become mortality zones if they are located where wildlife and human interests are bound to clash (Delibes *et al*., 2001), or at worse are targeted by poachers.

Various studies have been conducted on spatial aspects of elephants ecology including population size and distribution (Barnes *et al*., 1995; Omullo *et al*,. 1998), home range estimation and habitat preferences (Douglas-Hamilton, 1998), and human-elephant conflicts (Hoare, 2000; Smith and Kasiki, 2000; Sitati *et al.*, 2003). However, little has been done to study elephant mortality in appreciable depth. Despite this, available literature provides invaluable information about biophysical and human factors that tend to influence elephant distribution and by extension may influence patterns of elephant mortality.

De Boer *et al.*, (2000) studied diet and distribution of elephants in Maputo Elephant Reserve in Mozambique and established that elephants preferred denser forested patches

and proximity to fresh water during the dry season. Study results also showed that elephants preferred to feed on grass during the rainy season, while in the dry season, they concentrated on the few available browse plants. Babaasa (2000) studied habitat preferences by elephants in Bwindi Impenetrable National Park in Uganda and also concluded that elephant occurrence coincided with seasonal changes in rainfall and food availability. In another study carried out in northern Botswana, (Verlindern and Gavor, 1998) established that distribution of elephants was influenced by habitat type and proximity to permanent surface water during the dry season and food nutrition during the wet season. Khaemba and Stein (2000) found that elephant occurrence in Maasai Mara National Reserve was positively correlated with tall grass and proximity to water, but was negatively correlated with proximity to roads. Elephants tended to avoid areas of steep slopes and higher elevation, and remained in close proximity to permanent water (Smith and Kasiki, 2000). From the foregoing studies, it can be inferred that various factors influence the distribution of elephants in a spatial and temporal context.

Elephant' diet consisted of 60% grass and 40% woody plants (Ben-Shahar, 1999). The proximity to surface water during the dry season determines the distribution of elephants (Ben-Shahar 1999). Demeke and Bekele (2000) examined elephants of Mago National Park in Ethiopia using interviews and dung counts along transects. The study revealed that elephants remained in the patchy forest bush habitats and opted to move along foothills dominated by bush vegetation, a maneuver suggesting that elephants avoided human contact. The authors also established that elephant carcasses occurred mainly in riverine and forest areas during the dry season. Key factors responsible for elephant

movements were water, food, and to some extent human disturbance (Mpanduji *et al.*, 2002).

A study on population and distribution of elephants in the central sector of Virunga National Park in the Democratic Republic of Congo revealed that elephants preferred thick-bushed grassland and forest with easy access to water, and avoided steep slopes (Mubalama, 2000). The study also established that elephants exhibited compressed distribution preferring to aggregate in localized places, a characteristic reminiscent of elephant populations that had experienced heavy effect of poaching (Ruggiero, 1990). Pilgram and Western (1986) and Leader-Williams *et a.* (1990) hypothesized that poaching occurs in remote areas with abundant elephants logically because remote areas are difficult for patrol rangers to access due to inadequate routes. Inaccessibility to remote areas can thus enable poachers to poach elephants without their activities being detected by patrol rangers.

From the literature reviewed, it is clear that proximity to surface water (Ben-Shahar, 1999) and food availability (Babaasa, 2000) influence elephant distribution. In addition, elephant distribution varies with land cover (Verlinden and Gavor, 1998; De Boer *et al*., 2000), slope and elevation (Smith and Kasiki, 2000; Mubalama, 2000) and is also influenced by human factors. These human factors include distance from roads and proximity to human habitation (Douglas-Hamilton, 1998; Khaemba and Stein, 2000; Mpanduji *et al.*, 2002).

Elephants can spread widely during the dry season (Bhima, 1998) or during the wet season but aggregate near artificial water points during the dry season (Glover and Sheldrick, 1964; Laws, 1969; Leuthold and Sale, 1973; Cobb, 1976; Leuthold, 1977; McKnight, 1996; Kasiki, 1998) and respond to sporadic rainfall (Low, 2000). Based on the foraging observation, it can be argued that the temporal and spatial distribution of elephants is influenced by both human and natural factors. The spatial and temporal pattern of elephant mortality can also be influenced by the season of the year as poachers may take advantage of elephant aggregation at water points during the dry season, increase in conflict due to competition over scarce resources among other factors.

2.7 Causes of elephant mortality

2.7.1 Human-elephant conflict

HEC is a perennial problem in both Africa and Asia. In Sri Lanka "The conflict has escalated in the recent past: during the last decade alone, a total of 1,369 elephants were killed of which the largest numbers (526 animals or 38.4%) perished in the north-west" (Hendavitharana *et al*., 2004). HEC also poses a threat to elephants in India. In 2002-03, a total of 46 elephants were electrocuted, and a further 7 poisoned. These deaths are likely to be HEC related, and they account for 36% of all elephant mortality recorded during that period. In the same period, poaching for ivory was responsible for 29% of the mortality recorded (Ministry of Environment and Forest, 2006).

In Africa, human populations expand and encroach on elephant habitat (Hoare, 2000), and as elephant populations expand from protected refuges into unprotected historical

range conflicts continue to accelerate. Although not a new problem, its apparent increase in recent years threaten the future of elephant conservation efforts in all elephant ranges (Smith and Kasiki, 2000). HEC is especially prevalent in areas of cultivation where crop raiding is the most widespread problem, for example in NC.

Although Kenya has an impressive protected area network it only covers 8% of the country, and at present, the elephant range cover at least 19% of the country (Blanc *et al.,* 2007). As noted earlier, the migratory behaviour of elephants means that they spend a significant proportion of their time outside protected areas in search of food and water (Douglas- Hamilton *et al.,* 2005) bringing them into direct conflict with people over increasingly scarce land resources (Hoare, 2000; Sitati, 2003).

In Kenya human-wildlife conflict and HEC hot spot areas include Tsavo East and West, Lamu, Laikipia, Narok and Transmara (TM) (Moses *et al.,* 2012) (Figure 2.6). In NC HEC has become increasingly significant as human populations expand and encroach on elephant habitats (Omondi, 1994; Sitati, 2003; Sitati *et al.,* 2003).

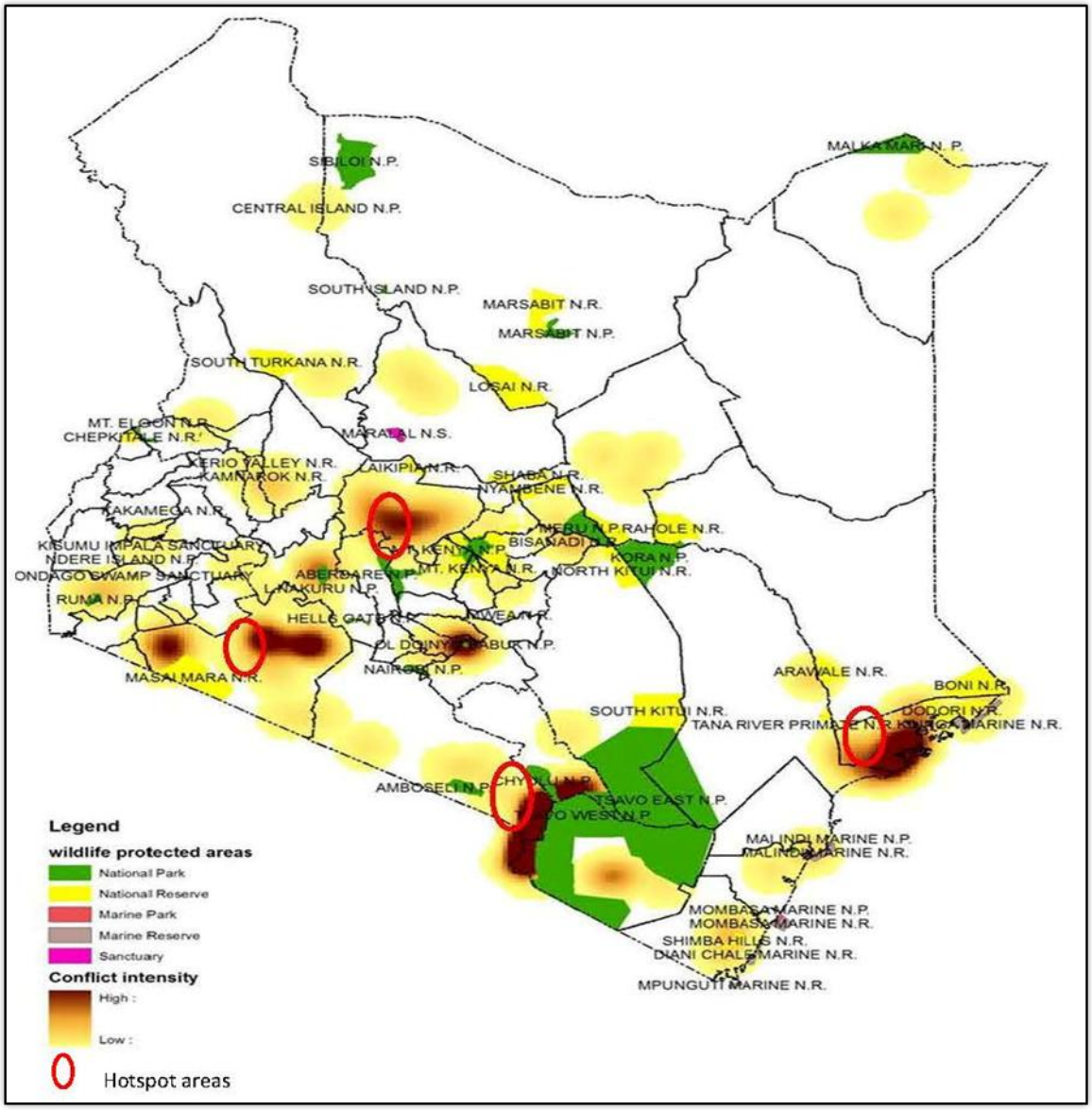

Figure 2.5: Human-wildlife conflict hotspot areas in Kenya

(Source: KWS, 1995)

Land use system in NC has changed and evolved from pastoralism to agro-pastoralism (Barrow *et al.*, 1993; Hackel, 1999). As cultivation has expanded into wildlife habitats, human-elephant conflicts have intensified. The problem has been compounded by the subdivision of communal land to individuals who lease the lands out for cultivation,

forest logging and charcoal burning to non Maasai communities (Kinnaird *et al.*, 2003). These have added to the conservation crisis being experienced in the study area. As a result of HEC, the local community injures or kills elephants in revenge (Plate 2.1). Human inflicted injuries on elephants are the most prevalent in the study area and its surroundings, and consist of deep intra-dermal gashes. Adult males are predominantly injured more compared to females, and the most affected parts are the fore legs (Omondi, *et al.*, 2008).

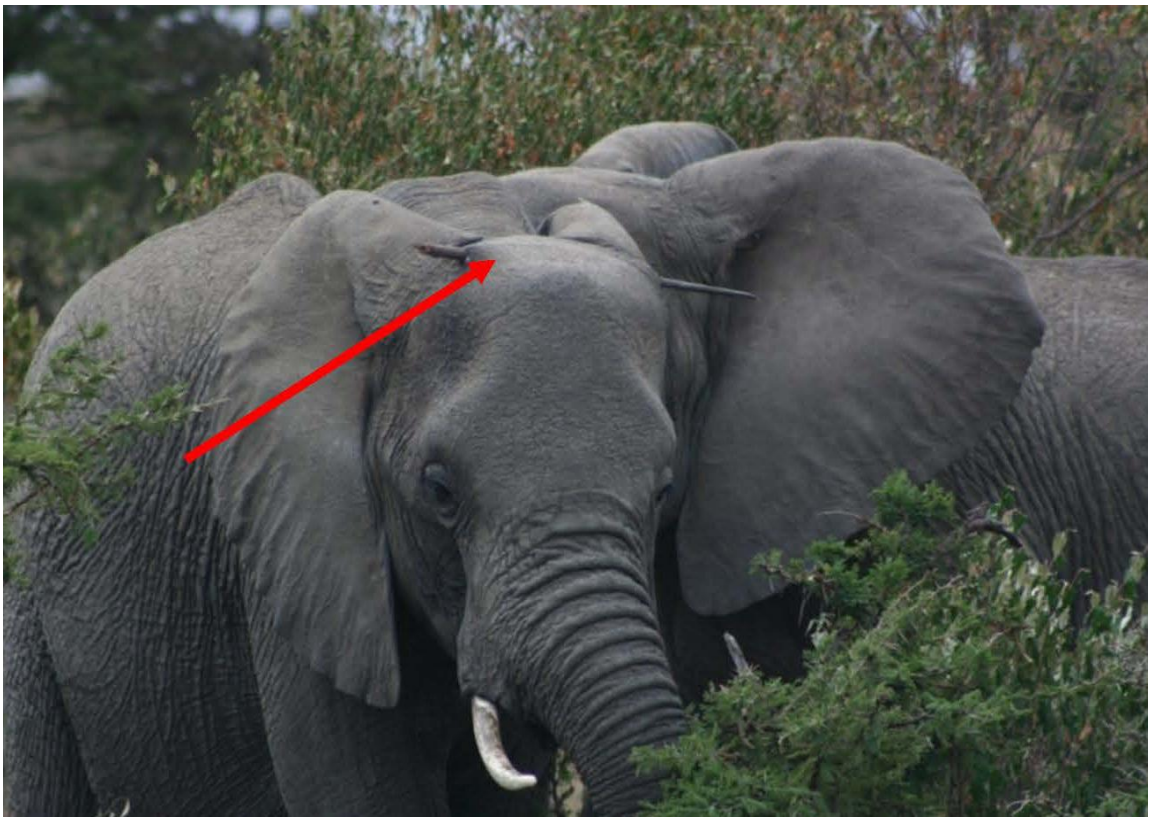

Plate 2.1: An elephant with a spear (arrow) lodged in its head

(Source: Kaelo, 2008)

Due to accelerated HEC, KWS carries out PAC on rogue elephants by scaring them away or shooting them. Shooting of problem elephants began as early as 1912. In 1936, 228 elephants were killed in Kenya (Melland, 1938). The situation worsened as wounded elephants became more troublesome and vicious and a new approach had to be sought. Elephants sensed and abandoned the danger zones and migratory routes (Sitati, 2003). However, the approach of killing problem elephants is viewed as wasteful and uneconomical since it involves loss of life and considerable costs are incurred in terms of manpower and material resources in destroying the problem elephant (Sitati, 2003).

2.7.2 Poaching

African elephants are threatened by poaching among other factors (Waithaka, 1998). Their tusks, hides and other body parts are an important component of trade; their meat is used by local people; and they are highly prized among big game hunters (Stiles, 2011). More than 1.3 million elephants roamed Africa in 1979; and in 1989, there were approximately 600,000 (Van-Aarde and Jackson, 2006). Currently the remaining population is endangered as a result of poaching activities.

2.7.2.1 Poaching for elephant meat

While elephant meat may be a by-product of the ivory trade, it could also be a primary driver of elephant deaths in some localities and is of particular concern for conservation, given that elephants with small or no tusks can be targeted (Stiles, 2011). While ivory networks target large tusk accumulations intended for export, and thus focus on the last remaining sub-population concentrations, usually in protected areas, elephant bush meat

can be attractive and even profitable when the number of elephants to be killed are far fewer, and the value of the acquired ivory is almost negligible (Vigne and Martin, 2010).

Although the primary purpose of an elephant hunt may be ivory, when bush meat traders become aware of an expedition being mounted, they may visit the hunting camp to buy meat, or encounter the party upon its return at a road or in a village to make a purchase (Plate 2.2). Elephant meat disperses quickly to several middlemen, who take it to sell in local or regional markets and restaurants using a variety of means of transport like motorbike, rented car or public transport (Stiles, 2011).

Plate 2.2: Elephant tusks and meat displayed by a hunter

(Source: Stiles, 2011)

In West Africa, for the hunter, the economic potential of elephant meat often exceeds that of ivory. If all meat could be harvested and sold from an adult male (estimated to equal approximately 1,000 kg smoked) earnings would amount to USD 1,000-5,000, or

an average of about USD 2,600. Only an elephant with very large tusks (>20 kg each) could provide that much from ivory. On average, hunters could earn much more from meat than from ivory from one elephant (Stiles, 2009).

The government of Zimbabwe has been considering feeding prisoners with elephant meat in a bid to improve their diet and keep the country's population of pachyderms in check (New Zimbabwe, 2011). Some 20 inmates died each day in 2009 as a result of a poor diet and disease, according to estimates and the government and prison officials are now considering elephant meat as an option (New Zimbabwe, 2011), although the conservationists disagreed with the proposal.

In Kenya, elephants are not poached for their meat although there are few circumstances where some local community eat the meat. In cases where the community has been found eating elephant meat, the elephant could have been killed by KWS during PAC, or it died as a result of an accident. Many communities avoid elephant meat because of widespread taboos (Bousquet, 1978; Peters, 1993; Tchamba, 1995). Some communities believe that the relationship between man and elephant is so close that man takes up residence in an elephant body after death or even while still alive. According to a Maasai myth, which resembles the Biblical story of Lot's wife, an elephant descended from a Maasai woman who looked back at the forbidden sight of her old home, and was turned into an elephant (Sitati, 2003). However, in countries where elephant poaching for meat is practised, most kills are made deep in the forest where the probability of detection is low because of the fear of being caught by the authorities. When the hunters feel safe, and depending on the

number of porters available to carry meat, tusks and other gear, meat will be smoked to reduce weight and to preserve it (Plate 2.3). This takes on average two days or even three (Stiles, 2011).

In cases where no meat is taken at all, either tusks are the target, or there are not enough porters for meat, or the kill is made in a spot where the probability of detection is high, in which case the tusks are hacked out and the poachers depart quickly. These spots are usually near roads or settlements (Vigne and Martin, 2011). Other elephant products that are targeted include non-meat products such as the trunk, tail, hide, ears, feet, spinal column marrow, fat and dung.

Plate 2.3: Elephant meat being smoked to reduce weight and preserve it before being transported to market

(Source: Stiles, 2011)

2.7.2.2 Poaching for ivory

After South Africa, Botswana, Namibia and Zimbabwe were allowed a one-off stockpile sale in 2008 to Japan and China, there was a surge in illegal ivory trade and consequently the highest elephant poaching in recent years is for ivory purpose. Tusks have been used in jewelry, piano keys, hanko (the personalized signature seals required on official documents in Japan) and other items (Vigne and Martin, 2011). The escalating large ivory quantities involved in 2011 (Table 2.1) reflect both a rising demand in Asia and the increasing sophistication of the criminal gangs behind the trafficking. Most illegal shipments of African elephant ivory end up in either China or Thailand. The smugglers also seem to have shifted away from using air to sea freight. In early 2011, three of the large scale ivory seizures were at airports, but later in the year most were found in sea freight (Plate 2.4).

The only common denominator in the trafficking is that the ivory departs Africa and arrives in Asia, but the routes are constantly changing, presumably reflecting where the smugglers gamble on being their best chance of eluding detection. Carved ivory is painted to resemble wood, making detection of the illicit product more difficult for Customs officials (Courouble *et al.*, 2003). Between 2009 and 2011, a total of more than 109,898 kg of ivory was smuggled (Table 2.2). Because bigger tusks mean bigger profits, bull elephants with tusks weighing six or seven times those of females are the usual targets for poaching. This has led to skewed sex ratios in some herds thus calling into question their long-term survival (Walker and Stiles, 2010).

Table 2.1: Ivory seizures in 2011

Where Seized	Month in 2011	Number of ivory pieces	Estimated weight (kg)
Kenya	December	727	2575
Kenya	December	465	1647
Malaysia	November	-	1400
Viet Nam	November	-	1100
Tanzania	September	1041	1895
Hong Kong	August	794	1898
Malaysia	August	405	2974
Malaysia	August	664	1587
Malaysia	July	695	2000
China	April	707	2234
Thailand	April	247	2033
Kenya	March	115	1304
Thailand	February	118	1026

(Source: Traffic, 2011)

Plate 2.4: A Kenyan customs officer and KWS official inspect elephant tusks, seized inside a warehouse at the port of Mombasa.

(Source: Daily nation, 2011)

Table 2.2: Ivory seizures between 2009 and 2011 all over the world

Year	No. of Large-scale Seizures	Weight of Large-scale Ivory Seizures (kg)
2001	5	7,062
2002	6	19,539
2003	3	4,421
2004	2	2,750
2005	2	4,742
2006	6	16,442
2007	2	2,152
2008	0	-
2009	8	19,314
2010	6	9,798
2011	13	23,676*
TOTAL		**109,898**

(*Estimated, provisional figure)

(Source: Traffic, 2011)

2.7.2.3 Impact of elephant poaching

Poaching has caused the collapse of elephants' social structure and also decimated their numbers. Poachers target the biggest elephants because their tusks are larger (Moss, 2001). They often kill all the adults in the group, leaving young elephants without any adults to teach them migration routes, dry-season water sources, and other learned behavior. Many of Africa's remaining elephant groups are leaderless sub-adults and juveniles (Moss, 2001). This makes them more susceptible to predation; injury and death due to natural or unnatural factors. As indicated earlier, elephants have one of the most closely knit societies of any living species and are highly matriarchal that their families can only be separated by death or capture (Dublin *et al.,* 1997). A family can be devastated by the death of another (especially a matriarch), and some groups never recover their organization (Plate 2.5), (Moss, 2001; IBN, 2012). Moss (2001) reports

observing an elephant cow walking sluggishly at the back of a family for many days after the death of her calf.

Elephant poaching and ivory trade are illegal in Kenya and pose a serious threat to elephant populations. In the 1970s, 1900 elephants were killed in Kenya for their ivory tusks, increasing to 8300 elephants in the 1980s (KWS, 1996). In 1989, as a dramatic gesture to persuade the world to halt the ivory trade, Kenya's President Daniel Arap Moi ignited twelve tons of elephant tusks (Perlez, 1989). Illegal elephant deaths decreased between 1990, when CITES ban was enforced, and in 1997, only 34 elephants were illegally killed. Seizures however, rose dramatically since 2006 with many illegal exports going to Asia (CNN, 2011). Poaching spiked between 2007 and 2010, and arrests continued at Nairobi's international airport, where 92 kilos of raw ivory were seized in 2010, and 96 kilos in 2011 (Voice of America, 2011).

Plate 2.5: An adult female and a juvenile elephant examine broken tusks of a dead elephant

(Source: Wasser et al., 2010)

Despite the strict anti-poaching measures and restrictions on ivory trade, hunting of elephants still continues. Hunting was reported as the leading cause of the decline in elephant populations (Waithaka, 1998; Thoules *et al.*, 2008). Although elephants became prized trophies for big-game hunters after Europeans arrived in Africa, more recently, and more devastatingly, hunters have slaughtered more elephants for their ivory tusks (Straziuso *et al.*, 2010).

A sudden oil shortage in 1970s caused the world economy to collapse, and ivory became more valuable than gold. In fact, ivory has been called "white gold" because it is beautiful, easily carved, durable, pleasing to touch, valuable and highly priced (Martin, 2009). Most of the world's ivory is carved in Japan, Hong Kong, and other Asian countries, where skilled carvers depend on a supply of ivory for their livelihoods (Vigne and Martin, 2011). These countries also provide a market for ivory and other elephant products. This coupled with increased demand has contributed to an increase in poaching.

Hunting elephants is no longer legal in many African countries, but poaching remained widespread until very recently (Waithaka, 1998). For many, the high price of ivory, about USD 100 a pound in the 1980s, was too tempting to resist (Martin, 2009). Local people often had few other ways to make a living, and subsistence farmers or herders could make more by selling the tusks of one elephant than they could get in dozen years of farming or herding (Waithaka, 1998). As the price of ivory soared poachers became more organized, using automatic weapons, motorized vehicles, and helicopters to chase and kill thousands of elephants (Njumbi, 1995).

For many years, intense poaching of elephants for their ivory was a serious conservation problem, and many countries faced serious declines in elephant populations (Cumming *et al.*, 1990). Between 1979 and 1989, the species population was estimated to have dropped from 1.2 million to 600,000 (Blanc *et al.*, 2007). An ivory ban was implemented in 1989, and with management and anti-poaching measures, populations in some countries like South Africa rose. While commissioning an electric fence protecting Aberdare National Park, the third president of Kenya, President Kibaki noted "*tourism accounts for 21 per cent of the total foreign exchange earnings and 12 percent of Gross Domestic Product (GDP) in Kenya. Tourism resources must, therefore, be guarded fiercely, hence Kenya's relentless conservation efforts; I appeal to all friends of Kenya to support this call to save the African elephant and rhino from extinction*" (Daily Nation, 2010). As a result of poaching, the elephant population in Kenya declined by 67% from 130,570 animals to 19,749 in 1987 (Swara, 1988). Poaching remains a significant threat to the survival of the African elephant in its range and is poached due to availability of black markets for ivory, better price of the product and extreme poverty among communities surrounding elephant ranges (Martin, 2009).

By 1989, the elephant population in Kenya had dropped to 16,000 from over 100,000 two decades earlier due to poaching activities (Douglas-Hamilton *et al.*, 1994). As a result, Kenya has been campaigning for a total ban on ivory trade as its herd of elephants continues to be exposed to poachers, and their populations drop (Daily Nation, 2011). In the past few years, the country has witnessed an increase in poaching activities with up to 230 elephants being felled in 2009, 145 in 2008 and 47 in 2007, and KWS had managed

to seize 1,087 kilograms of ivory (KWS, 2010). This vice saw the elephant population drop from 167,000 in 1973 to only 30,000 in 2005. In 2010 the number stood at 35,000 (KWS, 2010), although this is under constant attack from poachers and the annual drought.

In 1992, KWS established an Elephant Mortality Database to monitor elephant deaths. Elephant poaching declined in the 1990s and by 1996, there were more elephants outside protected areas than inside due to re-establishment (Waithaka, 1998). Kenya's elephant population benefited from protection by what was then, one of the best financed and run wildlife department on the continent (Dublin *et al.,* 1995). In the 1900s, the elephant range in Kenya stood at 135,005 km^2 which is 22.70% of the total land surface and elephant numbers grew from 19,000 to 27,000 in 1989 and 1997 respectively (Waithaka, 1998). A large proportion of Kenya's elephant range lies outside PAs and elephants often migrate between both protected and unprotected areas (Chepkwony, 2001). Expanding human population and increased cultivation in marginal, unprotected areas of elephant range have escalated conflicts between humans and elephants competing for land and access to water (Ngure, 1992; Thouless, 1994; Kiiru, 1995).

Kenya has most advanced wildlife monitoring units and KWS provides up to real-time data on endangered species. Despite this, it has been noted that the real battle to protect endangered species in the 21st Century will not be in the conference rooms but on the ground in the game parks and wildlife reserves in Africa, India and South East Asia, where an increasingly bloody battle is being waged between wildlife protectors and

poachers (CITES, 2009). KWS runs the Wildlife Anti-Poaching Unit which was established by the government with support from the World Bank, the United States and the European Union. The unit boasts of 19 aircrafts, a modern communication system and 24-hour monitoring teams (KWS, 1995). Unfortunately, it is the increasingly sophisticated poachers who are winning this battle, which is causing a devastating impact on the rapidly dwindling populations of elephants. Poachers will often have access to the most sophisticated automatic weapons, night sights, heat sensors and GPS tracking and phone systems. On the other hand, the park rangers are poorly paid and equipped; many have been killed in recent years fighting on the front line of wildlife protection (African Conservation Foundation, 2010).

In recent years, Tanzania and Zambia have become less transparent about population sizes and poaching-related mortalities (African Conservation Foundation, 2010). Three weeks before the CITES decision in March 2010, information on Tanzanian elephant population trends and mortalities was still unavailable, thus impeding scientific assessment (Anon, 2010). Carcass counts, often an important metric of population trends (Douglas and Burrill, 1991), were either not collected or inaccurate in many recent aerial surveys. In 2010, Serengeti Game Reserve (SGR) carcass count was reportedly less than 2%, low even for populations with minimal mortality (Douglas and Burrill, 1991). Since 1989, elephant populations in Kenya, Tanzania and Uganda have shown some recovery (Blanc *et al.*,2007; Thouless *et al.,* 2008) but the debate has been raging over whether ivory stocks from countries with large elephant populations should be allowed for sale (Wasser *et al*., 2010).

2.7.3 Sport hunting

Sport hunting of elephants is permitted under the legislation of a number of elephant range states, and the following countries in 2007 CITES had export quotas for elephant trophies: Botswana, Cameroon, Gabon, Mozambique, Namibia, South Africa, Tanzania, Zambia and Zimbabwe. Hunters use the size of the track as a good indicator of animal size and sometimes trophy size. Elephant dung is also used to indicate the age, and condition of the animal's teeth. The coarser the particles in the dung, the older the elephant's teeth and the belief that the animal may carry more ivory. If hunting is not well managed in countries that practice it, it can lead to a skewed sex ratio as hunters may target large bulls with bigger tusks (Lamprey, 1995).

In countries like South Africa that practice hunting, some community-based conservation programmes in which revenue from sport hunting of elephants reverts directly to local communities have proved effective in increasing tolerance to elephants, and thus indirectly helped in reducing levels of human-elephant conflict.

2.7.4 Natural death

The average life span of an elephant is estimated at 70 years, and this is determined using the teeth, consequently, once their last tooth wears out they will essentially starve to death. In a normal population, there must be natural mortality, and this could be as a result of old age, sickness and natural calamity. Elephant predators include lions, hyenas and crocodiles which prey on young, sick, orphaned or injured elephant. However, humans are the greatest threat to all elephant populations (Sitati, 2003).

2.7.5 Other causes of elephant mortality

Electrocution is another cause of elephant mortality although not well documented, India has lost a number of elephants due to electrocution, and this happens when elephants uproot electric poles and installed high voltage and loose electric wires (India Times, 2011).

2.8 Measures to curb elephant mortality

Measures that have been used to reduce elephant mortality include review in land use policy, benefit sharing, awareness raising through education and extension, fencing of protected areas, compensation, arresting and jailing or killing of poachers, increasing patrols and improved management of elephant areas among others (Omondi, 1994).

2.8.1 Mitigating human-elephant conflict

The future of elephants in NC and other areas in Kenya depends largely on how local communities utilize their land, and mitigate on the immigration of non-Maasais into the ecosystem (Sitati, 2003). To realize this, change in land use policy is paramount to reduce the introduction of incompatible land use activities in elephant ranges and dispersal areas as well as human encroachment on wildlife areas. The second measure is providing tangible benefits from elephant conservation to local communities. Currently, there is very little or no benefits accruing from wildlife resources that are given to local communities and this has contributed to the local Maasai having negative attitudes and perceptions towards wildlife and especially elephants. The negative attitude by the local community towards elephants has been engendered by lack of wildlife-related monetary

benefits (Sitati, 2003). Thirdly, education and awareness, and compensation for HEC cases are being encouraged to enhance appreciation, co-existence and tolerance (Omondi *et al.*, 2004).

2.8.2 Mitigation measures for poaching

2.8.2.1 Poaching for Ivory

It is impossible to distinguish poached ivory and ivory purchased from legal sources, and therefore, the government of Kenya made a decision not to sell ivory confiscated from poachers. Continuing to sell this ivory would undermine the effect of an anticipated CITES ban. The decision was announced to the world on 18 July 1989, when Kenya burned 2,000 confiscated elephant tusks, an event where an estimated 850 million people worldwide learned about it from the television and newspapers (Leakey and Morell, 2001). This action was to show that African elephant was threatened with extinction because of the ivory trade, and it was time to do something about it.

On 27th June 2012, Gabon president Ali Bongo publicly set the entire stockpile of elephant tusks and ivory carvings on fire. 4,825kg of elephant tusks and ivory carvings went up in flames sending a powerful message to international community that poaching and wildlife crime will no longer be tolerated in Gabon (Scientific American, 2012). On 20th July 2011, President Mwai Kibaki set on fire five tonnes worth of confiscated tusks and processed ivory which were seized in Singapore in 2002 (Plate 2.6). This ivory burning was significant because it drew international attention to the alarming increase in elephant poaching. To underscore Kenya's action, the third president of Kenya, President

Kibaki remarked that "Through the disposal of contraband ivory, Kenya seeks to demonstrate to the world its determination to eliminate all forms of illegal trade in ivory," *"We must all appreciate the negative effects of illegal trade to national economies"* (Daily Nation, 2011). The destruction followed an agreement reached by Malawi, Tanzania and Kenya in May 2011 in Nairobi under the Lusaka Agreement Task Force. The task force is charged with implementing the 1992 Lusaka Agreement designed to help African law enforcement agencies tackle wildlife smuggling.

Plate 2.6: A contraband of tusks and ivory set on fire by President Kibaki at Manyani Field Training School in Tsavo West National Park

(Source: Daily Nation, 2011)

Although different countries had varying views on ivory trade, for example, Zambia and Tanzania were of the opinion that controlled ivory trade could be beneficial for conservation with profits being invested in wildlife projects. Kenya has been opposed to this idea as it believes that a move like this would encourage poaching. Some conservationists agree with the views expressed by Tanzania and Zambia and expressed

the opinion that burning the ivory is a waste. Although, the burning was the first involving regional countries, it was the third in Africa (Daily Nation, 2011; Moses *et al*., 2012). Kenya in 1989 torched 12 tonnes of ivory, three years later Zambia also burnt a stockpile of smuggled tusks.

Anti-poaching investigators can with the help of Deoxyribonucleic acid (DNA) forensics know the source of illegal elephant tusks (Wasser *et al*., 2008). For example, 605 elephant tusks valued at USD 8 million that were seized at the port of Hong Kong were traced back via DNA to forest elephants that lived in southern Gabon near the border with DRC. In big seizures, there is a tendency to ship ivory out of a different country than where it was poached. This method is essential in that it focuses on where poaching is taking place and harsh sentences can be imposed for ivory smuggling, and management improved (Wasser *et al*., 2008).

2.8.2.2 Poaching for meat

Stiles (2011) in his study on bush meat in Central Africa suggests that to control illegal elephant meat there is need for public awareness. Further education should be carried out by the government in collaboration with NGOs to sensitize communities on the long-term negative consequences of unsustainable bush meat off take and loss of biodiversity in general. Rangers should monitor bush meat markets more effectively and enforce existing laws to control the sale of protected species, especially in urban centers like Nairobi and Naivasha where several arrests have been made (KWS, 2012)

2.8.3 Mitigation measures for sport hunting

In countries like South Africa, Botswana, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe and Cameroon where sport hunting is practiced, there is need to have strong management to reduce chances of young, breastfeeding and pregnant elephants being hunted. Bulls with large tusks should not be the only ones targeted by hunters but old cows too so as to avoid skewed sex ratio (Stiles, 2009).

2.8.4 Mitigation measures for natural death

Although natural death cannot be controlled, if it is due to sickness measures can be put in place through habitat protection, and an increase in veterinary officers to respond to sick animals in time. Habitat protection is important as it enables elephant access trees that have medicinal value and this can help sick elephants in a variety of ways. Digestive diseases may be treated through fasting or natural treatment involving consumption of bitter herbs, bark, or alkaline (basic) earth. Wounds may be protected from insects or worm infestation by coating them with mud (Sitati 2003).

2.9 Impacts of elephant mortality

2.9.1 Ecological impacts of elephant mortality

Loss of keystone species like elephants impacts on the integrity of ecosystems and their services (Simpson, 1978). Local extinction of elephants as primary seed disperser of large trees in Central African forests can substantially affect long-term viability of the second most important carbon capture forest in the world (Edkins *et al*., 2007).

Elephants can have profound impacts on the ecosystems they occupy, as well as other species. Elephants' foraging activities often greatly affect the ecosystems in which they live (Kerley and Landman, 2006). Elephants reduce woody cover by pulling down trees to eat leaves, breaking branches, and pulling out roots, creating clearings in forests, converting forests to savannas, and converting savannas to grasslands. These changes tend to benefit grazers at the expense of browsers (Repton, 2007). In Amboseli National Park past studies showed that elephants prevented the regeneration of woodland areas and were the cause of keeping sedges short during both the wet and dry season (Western and Maitumo, 2004; Western, 2010).

During the dry season, elephants use their tusks to dig into river beds to reach underground sources of water (Balfour, 2005). These holes may then become essential sources of water for other species. Elephants make paths that are used by other animals (Leuthold, 1996) in their environments. Some of these pathways have apparently been used by several generations of elephants, used by humans and eventually even been converted to roads. Elephant droppings are also important to the environment. Baboons and birds pick through elephant dung for undigested seeds and nuts, and dung beetles reproduce in these deposits (Chafota, 2007). Both dung beetles and termites eat elephant dung. The nutrient-rich manure replenishes depleted soil. Finally, elephants are a vehicle for seed dispersal. Some seeds will not germinate unless they have passed through an elephant's digestive system (Leuthold, 1996).

2.9.2 Economic impacts of elephant mortality

The Asian elephant has been captured, tamed and used by people to plough and pull logs for more than 4,000 years, and it stirs the human imagination like no other animal. These elephants can easily move through swamps or climb mountainous terrain that is too difficult for a horse. In Africa, meat from culled elephants in Zimbabwe is sold to local communities, city markets or crocodile farms (Martin *et al.*, 1992), or to restaurants in South Africa (Hall-Martin, 1990). Elephant skins are used to make boots, briefcases, handbags, drums, luggage and golf bags (Child and White, 1988). Other values of the elephant include sport hunting (Craig and Gibson 1993), and promotion of Protected Areas and Wildlife Management Programme and tourism (Garai, 1994; Mendelson, 1995).

Despite all its values, the elephant is experiencing a number of conservation and management problems arising mainly from habitat loss, poaching and HEC. Therefore, if these mortality causes are not put into consideration, economic values of elephants will diminish in the near future.

2.9.3 Cultural impacts of elephant mortality

Different communities across the world have different beliefs as pertains to the elephant and its products. For instance, in Thailand, the ivory powder is believed to alleviate baldness, and the powder is burnt, mixed with oil and applied to the scalp. In Gujarat, it is believed that a woman's infertility can be cured if she mixes ivory powder with honey and takes this "medicine" twice a day for a week. Some people take regular doses of

ivory powder in the hope of improving their memory, and while others think hemorrhoids can be cured if a concoction of this powder mixed with an equal amount of rusted iron is applied. Ivory powder sells for about USD 1 per kg in Bombay (Martin and Vigne, 1989). In NC, the local community believes that elephants discover and expose salt licks and water for livestock use. They destroy thick forest increasing visibility; elephant fat treats skin disease and other ailments and is mixed with herbs and given to babies for quick growth. Pregnant mothers also take a mixture of elephant dung with milk for healthy babies. The elephant's after-birth is used to speed up delivery in pregnant mothers, and is also considered as a source of wealth. Elephant dung is burned to smoke bees during honey harvesting and to treat measles among other uses (Sitati, 2003). All these traditional beliefs and practices can be easily shut down if elephant mortality is not controlled.

2.10 Attitudes and perceptions of local communities towards elephant conservation

Attitude is a predisposition about or towards something, and it may be positive, negative or neutral (Allport, 1935), while perception is a process of critically analyzing and comprehending things (Lindsay and Norman, 1977), and it involves being aware and understanding an object or what is around you. Attitude change is an imperative aspect of wildlife conservation and a positive attitude will augment conservation of elephants (Kasiki, 1998).

The assessment of peoples' attitudes and perceptions towards conservation has become an important aspect in many studies on wildlife conservation (Newmark *et al.,* 1993;

Kasiki, 1998; Ashenafi, 2001; Sitati, 2003). In the case of elephant conservation, success depends on the attitudes of people towards the species (Omondi, 1994). Equally, understanding factors influencing attitudes is important to enable wildlife managers to implement approaches that attract support of stakeholders and the general public. The Maasai community of NC has undergone considerable transition in recent years that needs to be understood in relation to elephant conservation. A Previous study by Omondi (1994) has shown that the local community may develop a negative attitude towards wildlife if their crops and livestock are depredated and if no benefit is derived from wildlife resources.

NC has undergone rapid changes in social and economic terms (District Development Plan (DDP), 1997), and this has had significant influence on the relationship between people and wildlife conservation. The benefits accrued from conservation are not well channeled to the grass root level yet the local community bears the costs of living with wildlife (Kiss, 1990). As a result, majority of these communities have developed negative attitudes towards conservation (Omondi, 1994; Hill, 1998) and a decline in wildlife population in these areas has been noted (Norton-Griffiths, 1998). The decline is as a result of people practicing other land uses that are not conservation friendly and leads to HWC. However, despite the accelerated costs of living with wildlife, some communities have retained positive attitudes towards conservation (Newmark *et al.,* 1993; De-Boer and Banguete, 1998). NC is a typical example of such an area as over the years, it has experienced intense conflicts pitying humans against wildlife (Sitati, 1997; 2003). Notable among these have been HWCs, HEC and resource conflict.

When local people do not benefit from conservation, they lack the commitment to conservation objectives (Mwamfupe, 1998). As a result, local communities develop negative attitudes towards elephants and other wildlife (Ndung'u, 1998; Kasiki, 1998; O'Connell-Rodwell *et al.,* 2000). However, where some communities are aware of the benefits of elephants PAC is preferred as the best conflict resolution strategy (Ndung'u, 1998). As a consequence of lack of benefits to communities, Kenya lost over 44% of its wildlife in the 1990s (GOK, 1995a, 1995b). Norton-Griffiths (1998) blames this loss on a major policy failure. This trend is serious because about 70% of wildlife lives permanently or seasonally outside PAs (GOK, 1995b). Hence, PAs have been only partially effective in wildlife conservation, losing less wildlife than areas outside PAs (GOK, 1995a; GOK, 1995b).

2.11 Theoretical framework of the study

This study utilized the elephant mortality and mortality resolution theories advanced by McCullagh (1972), Hanks (1979), Conybeare and Haynes (1984), and Haynes (1988). Proponents of the elephant mortality theories contend that causes of elephant mortality are diverse and include natural death, poaching for ivory and meat, accidents when they cross roads, electrocution, fighting among the bulls, sport hunting and human-elephant conflict which may be due to poisoning, snaring and spearing when elephants invade people's farms and PAC by KWS. All these causes of death may lead to a decline in elephant population if correct mitigation measures are not employed.

On the other hand, mortality resolution theories argue that to mitigate elephant mortality, national governments, conservation bodies, local communities and other stake holders have come up with diverse mitigation strategies to reduce incidences of elephant mortality experienced in elephant ranges. Literature reviews revealed that elephants face various forms of mortality of which some like poaching and HEC can be controlled to improve elephant population. It is therefore important to develop mitigation measures that can help improve elephant population and at the same time create a safe environment to live. This is through education extension to local community members within elephant ranges through video shows, football tournament, songs and poems. Quick responses to HEC cases by KWS, harsh penalties to poachers, good compensation schemes in cases of human death and injury, property destruction and crop raiding by elephants and translocation among other mitigation measures, are needed.

If the foregoing mitigation measures are carried out, they can change the attitudes and perceptions of the local community towards elephant conservation in NC. This study focused on the causes and patterns of elephant mortality in NC, the trend of mortality from the year 2000 to 2011, the possible mitigation measures to curb mortality and the attitudes and perceptions of the local community towards elephants.

CHAPTER THREE
MATERIALS AND METHODS

3.1 Study area

Narok County (Figure 3.1) which encompasses the old Narok and Transmara Districts is an important wildlife dispersal area for resident wildlife population in the Maasai Mara National Reserve (MMNR), and also enjoys unique and diverse biophysical features. Increased cultivation threatens the future of wildlife through increased conflict since it is a zone of high agricultural potential.

3.1.1 Size and location

Narok County lies in south-west of Kenya in the southern part of the Rift Valley Province. The County covers an area of 17,987.8 km^2. The County borders the Republic of Tanzania to the South, Kuria and Migori County to the West, Gucha, Kisii, Nyamira, Bomet, Bureti and Nakuru County to the North; and Kajiado County to the East. Maasai Mara National Reserve is located within Narok County.

3.1.2 Climate

Long rains occur between February and June while short rains occur between October and December. The mean annual rainfall is about 1500 mm. Total annual rainfall ranges from 1,200 to 1,800 mm. Temperatures within the study area range from 5°C to 28°C, with lower temperatures reaching 5°C in the June to September period while maximum temperatures reach 28°C between November and February (KWS, 2010).

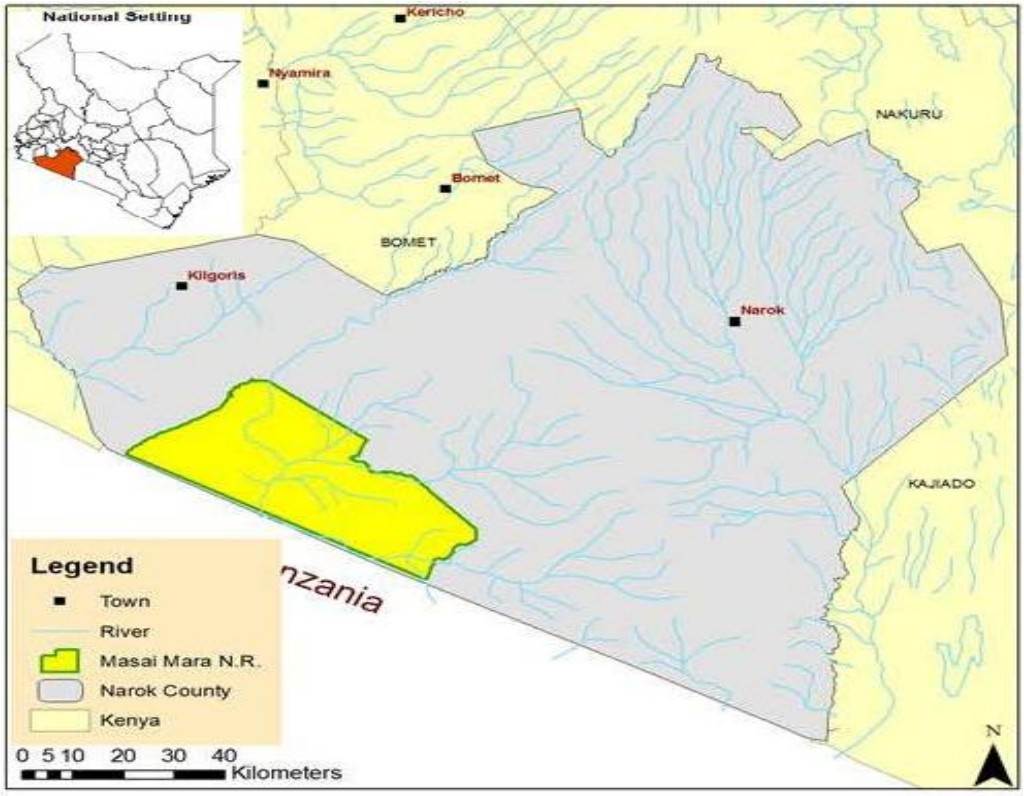

Figure 3.1: Narok County and MMNR

(Source: Author, 2010)

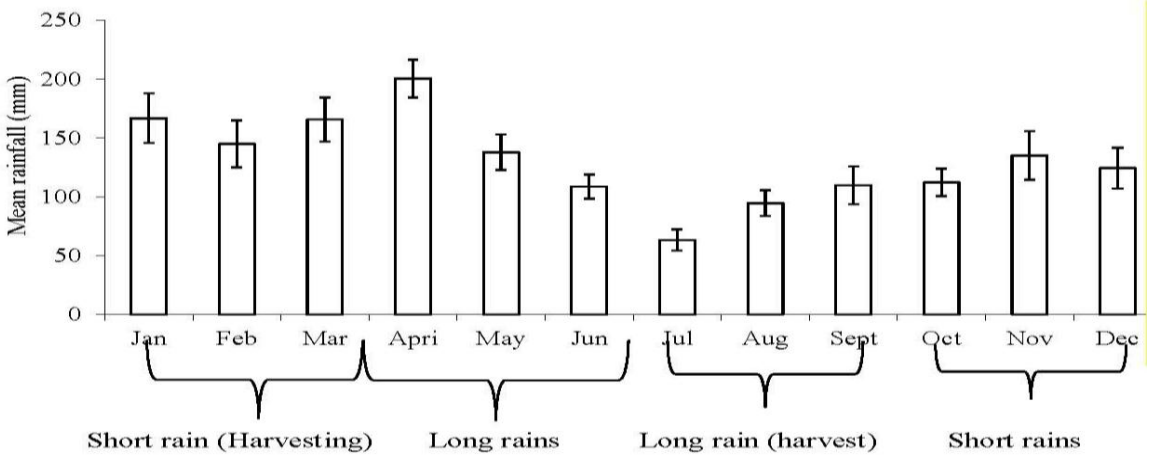

Figure 3.2: Mean rainfall by month and rainfall pattern in Narok County

(Source: KWS, 2010)

3.1.3 Wildlife and tourism resources

MMNR is the northern extension of Serengeti-Mara Ecosystem (Sitati, 2003). MMNR was originally a wildlife sanctuary but was declared a National Reserve in 1961 covering an area of 647 km^2. In 1974, the reserve was enlarged and over 1,700 km^2 was gazetted as a National Reserve. However, the recent boundary modifications reduced it to 1,510 km^2. MMNR generates a lot of revenue from wildlife-based tourism to Transmara County Council (TCC), Narok County Council (NCC) and the local communities, due to abundant wildlife in the area and the tourist hotels that have been built. For example, the world's well-known hotels including Keekorok lodge, Kichwa Tembo Camp, Governors' Camp, Mara Serena Lodge and Mara Paradise are located here (Plate 3.1). Tourists who come to these hotels also buy locally produced cultural materials and souvenirs, and also visit Maasai *manyattas* to experience the social and cultural life of the Maasai people (Ogutu, 2000)

Plate 3.1: Mara Serena Lodge in MMNR

(Source: Author: 2011)

Narok County has a great diversity of wildlife and bird species. There are several corridors that are critical to wildlife movement through which wildlife spread out onto communal lands. Most corridors have been blocked, while the remaining central corridor that links group ranches and MMNR is also threatened by human settlement and farming (Duraiappah *et al.,* 2000).

Wildlife in NC has been declining in recent years as a result of increasing pressure from livestock, agriculture and poaching activities (Ottichilo, 2000; Ogutu, 2000). The reduction of rangelands has resulted in increased competition between livestock, wildlife and humans over the remaining resources such as water, grazing land, and mineral salts among others. Little or no wildlife is found in the north or north–east of NC due to the great extent of cultivation and human settlement (Sitati, 2003).

3.1.4 Socio-economic profile

3.1.4.1 Agriculture

Pastoral Maasai communities predominantly inhabit the study area. However, with change in land tenure systems in the ecosystem in the past 20 years, there has been increased influx of people from other communities to this area. The emigrants normally come from agricultural communities and have been instrumental in the introduction of agriculture in the ecosystem. They buy or lease land from Maasai land owners for this purpose. NC heavily relies on tourism, agriculture and livestock keeping as its main economic activities. Agriculture and livestock keeping have been enhanced due to the moderate climatic conditions and moderately fertile soils. These conditions support the production of cash and food crops, as well as fodder for livestock. Both the highlands and

the plateau permit crop farming and livestock activity, and the ecosystem has considerable potential for agricultural activity (Sitati, 1997; Serneels and Lambin, 2001).

A variety of both cash and food crops are grown in NC for subsistence and commercial purpose mainly in the highland areas. The main crops grown include wheat, maize, sugarcane, beans, and irish potatoes. Destruction by wildlife, the high costs of inputs, and patterns of communal land ownership are the main constraints to farming in the area. Despite this, high rainfall patterns and fairly fertile soils have attracted many farmers from outside the County, as the Maasais also try to engage in farming. TM District has the highest maize farms while Narok district has a lot of wheat farms. The land use change from pastoralism to farming has a great impact on elephant conservation. Elephant habitats are reduced, and there is an increase in competition over limited resources. There is also an increase in HEC as elephants invade farms, and in the long run, they are killed by the local community. Agriculture as a land use contributes to elephant mortality through HEC (Ottichilo, 2000).

3.1.4.2 Land use and tenure

Originally the Maasai in the study area were primarily a pastoral community with little or no sedentary farming. However, during the last three decades the study area has experienced rapid land use changes. These changes which include the expansion of agriculture have been more pronounced to the north of Lemek where large wheat fields have been cultivated from the mid-1970s (Sitati, 1997; Ogutu, 2000; Serneels and Lambin, 2001).

Narok County is well endowed with resources such as fertile soils, livestock, forestry, rich culture, wildlife; and tourism if well exploited could reduce poverty. Land ownership in NC falls under three categories; communal land, group ranches and individual holdings. This is due to change in land tenure as a result of the increasing human population, and consequently the need to raise capital, and the fear of marginalization by stronger group (Kituyi, 1990). Land use changes in NC group ranches, where large community lands are being subdivided into smaller units, and agriculture is expanding, have led to compression of the elephant range and led to intense conflict as people and elephants compete for space (Kiiru, 1995; Sitati, 2003).

The main land uses in NC include semi-nomadic pastoralism, arable farming, wildlife conservation, tourism and forestry. Pastoralism is the main source of livelihood for the Maasai community, while for the migrant communities and foreign firms' large-scale crop production of wheat, barley, maize and beans is practiced**.**

The nature of land tenure system influences the nature of land use in the County. Individuals with freehold titles make their own decisions on how to utilize their parcels and most of them are mixed farmers. They practice large-scale wheat and barley production for commercial purposes, whereas communal tenure restricts an individual mainly to livestock production.

3.1.4.3. Livestock keeping

Livestock keeping is prevalent in the plateau areas of NC. The local Maasai communities are pastoralists and attach a high value to livestock keeping. Goats, sheep and local Zebu cattle are the dominant livestock. TM District has been famous as a dry season grazing ground for both livestock and wildlife from other districts, especially Narok (Sitati, 2003). Therefore, increased farming activities in the area threaten the future viability of both livestock and wildlife in the area. The limiting factors to livestock keeping include the presence of trypanosomiasis, group ranch tenure and resource use, which conflict with human activities and wildlife.

The Maasai community keeps large herds of livestock. The high livestock density contributes to overgrazing and encroachment. Nomadism, which has been the backbone of the Maasai range management practice, has been disrupted, pasture has been depleted, and livestock has been displaced (Serneels and Lambin, 2001). During the long drought periods, there are limited grazing grounds and water points for livestock and wildlife. Elephants aggregate near water points during the drought to get water, and this leads to competition between livestock and wildlife over limited resources. The elephants are in turn speared by pastoralist to pave the way for livestock to take water or graze thus contributing to their mortality.

3.2 Research design

The study utilized the descriptive research design whereby a description of opinion on the investigated phenomenon was explored and examined so as to use information generated

to make inferences about the entire population from which the sample was drawn. Descriptive research design was found appropriate for the study since some of the objectives focused on gathering opinions on the causes and patterns of elephant mortality from the field and local and key respondents.

3.3 Sampling procedures, sample selection and sample size

Two study populations for this study included elephant and local people. The target population for spatial and temporal distribution pattern of elephant mortality was total counts of all recorded deaths that occurred between 2000 and 2011.

The target population used for determining the attitudes and perceptions towards elephant mortality and causes was the local people living in NC especially in areas adjacent to elephant corridors or habitats. Households in the study area were first grouped into clusters according to economic activity and occupation in relation to benefits accrued from wildlife conservation in Community conservancies and MMNR. Local community members who are farmers but do not benefit from conservation activities (FNB) although they incurred the costs of living with elephants and other wildlife on their farm included respondents from areas like Ang'ata Barrakoi, Masurura and Olalui on the TM side and Ntulele and Siyaipei on Narok side. The second cluster entailed respondents from those areas that practice mainly pastoralism and never benefited from conservation of wildlife (PNB). They were drawn from Olmotonyi, Sitoka and Olesentu in TM and Majimoto, Olontoto, Ntuka areas in Narok. The third cluster had respondents that were pastoralists and benefited from conservation (PB). They were drawn from Kawai and Emarti in TM

District and Nkoilale, Lemek, Naikara in Narok District. The total household population in the study area was 9404 (Figure 3.3).

Respondents were selected as follows: the total number of households from each cluster was determined from existing records in chiefs' offices and village elders, that is, FNB 3120 households, PNB 3104, and PB 3180. The sample size was calculated according to the method of proportional allocation whereby the size of the sample from different clusters was kept proportional to the size of the cluster (Kothari, 2008). Proportional allocation was formed based on common characteristics of the items to be put in each cluster (Kothari, 2008) in this case FNB, PNB and PB. The desired sample size (n) was 600 proportionately calculated from the three strata to get n1, n2 and n3 which formed the final sample size of 600. The calculation was as follows:

Population (N) =9,404

n1 = n *P*1 = 600		n 1 = 600 (3120/9404) = 201
n2 = n *P* 2 =600	Therefore;	n 2 = 600 (3104/9404) = 200
n3= n *P* 3 =600		n3 = 600 (3180/9404) = 204

Sketch maps showing location of homesteads were produced to form a base for simple random sampling choices of the respondents.

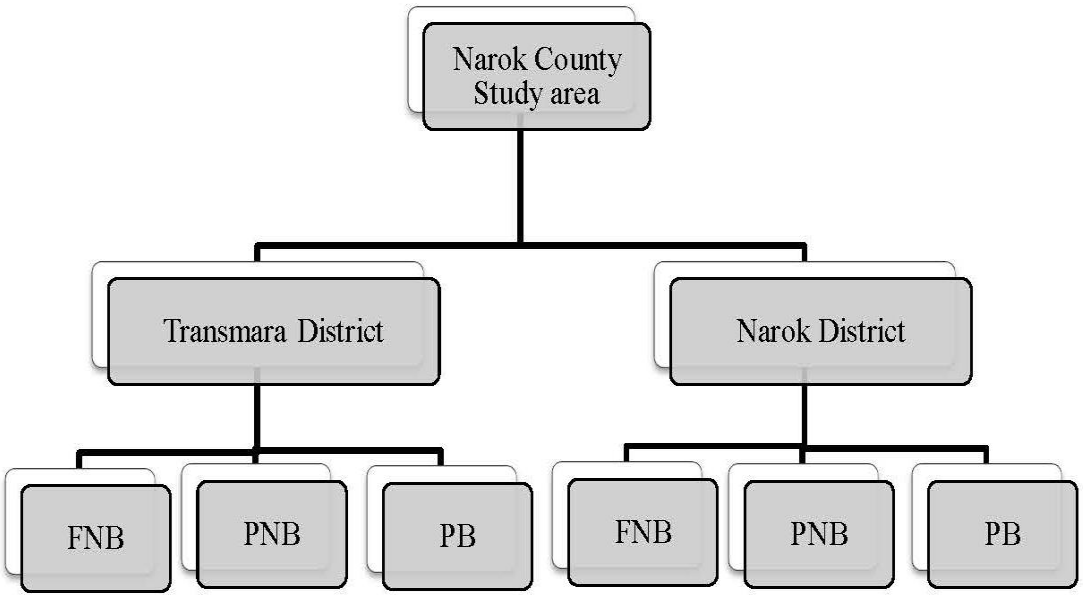

Figure 3.3: Clusters of respondents' in Narok County

3.4 Data collection method

Guided by the study objectives and the need to combine indigenous knowledge and empirical evidence to understand elephant mortality, a blend of data collection methods was employed in collecting both primary and secondary data.

Primary data were generated using focus group discussions (Appendix I), questionnaire survey (Appendix II), interview schedules with key informants (Appendix II), and monitoring (Appendix 4) of elephant mortality. Trained community scouts were engaged to assist in data collection.

Secondary information was generated from both published and unpublished materials like books, journals, elephant aerial census and ground survey by KWS and WWF respectively, distribution maps from KWS, maps of Elephant ranges, Rainfall

information from KWS and human population information from Kenya bureau of statistics.

3.4.1 Data collection on the elephant mortality in NC over the last 12 years

Elephant mortality was determined through use of primary data through field monitoring of elephant deaths incidences between October 2010 and September 2011. Data collected included date of death, geographic location using Geographical Positioning System (GPS) points in Universal Transverse Mercator (UTM), cause of death (poaching, control, conflict, accident, natural, euthanasia, and unknown), and sex of the carcass (male, female or unknown), state of the carcass which was recorded as fresh (immediately-seven days old carcass), recent (two-three weeks old), old (four weeks old) and very old (five weeks and beyond) (Appendix 4 and Plate 3.2). Unfortunately, some of the earlier records were missing spatial reference and were entirely omitted from the analysis. In order to compare trends in elephant mortality under different circumstances, data on past elephant deaths and their locations was obtained from KWS Occurrence Book (OBs) records and WWF-HEC project records.

3.4.2 Data collection on attitudes and perceptions of the local community

To assess the attitudes and perceptions of local community members towards elephant mortality and conservation, focus group discussions, questionnaire surveys and interviews were conducted.

(a) Fresh carcass with tusks pulled out

(b) Fresh carcass with tusks intact

(c) Old carcass

(d) Very old carcass bones

Plate 3.2: Elephant carcasses
(Source: Author, 2011)

3.4.2.1 Focus group discussion

Focus group discussion (FGD) is a form of qualitative research in which a group of people are asked about their opinions, beliefs, attitude and perception towards an idea. FGD was used as the first step because it was a good way of gathering respondents from similar backgrounds to discuss their indigenous relations with elephants in NC. One FGD was carried out in each cluster (Plate 3.3). The number of local community members present in each cluster ranged between 10 and 30. A list of all household heads in a given cluster was entered into Ms-Excel spread sheet and a random list of 20 household heads who were invited for FGD was generated automatically. This represented 10% of the total number of house hold heads in a cluster which was considered as adequate sample

size since the population was homogeneous and gave similar responses (Moser and Kalton, 1972; DeVaus, 1996).

(a) (b)

Plate 3.3: Focus Group Discussion sessions at Naikara (Plate a) and at Majimoto Narok County (Plate b).

(Source: Author, 2011)

In some areas like Majimoto, Naikara and Olesentu, it was not possible to limit the number of members participating in FGD to 30 and therefore, members were split into smaller groups of 4-10 people for easier discussions. Questions were asked in an interactive group setting where participants were free to talk with other group members. Participants were also assured of confidentiality to make them feel comfortable enough to converse with others. Responses in FGD were used in designing questionnaire surveys.

3.4.2.2 Questionnaire surveys

Questionnaires were distributed to local community members to gauge their opinion on causes of elephant death as well as and the attitudes and perceptions of the local community towards elephant mortality in the study area.

Heads of households were targeted for questionnaire survey. However, in their absence any member of the household aged above 18 years was interviewed to give a balanced representation of views from all age groups and gender. Each household was visited and interviews conducted on site. Both open and close-ended questions were asked (Appendix 2). Respondents were encouraged to elaborate on points of interest and relevance. Pilot testing of the questionnaire was done on a sample of 15 respondents to gauge their understanding and some questions were rewritten before final administration of the questionnaires (DeVaus, 1996).

3.4.2.3 Interview schedules

Informal, in-depth interviews were also held with selected KWS staff from different stations and outposts, the two County Councils (Narok and Transmara County), local NGOs and local leaders (Appendix 3). An interview schedule was guided by questions to produce quick and easy quantitative data. All key respondents were purposively selected.

3.5 Data analysis and presentation

3.5.1 Spatial and temporal patterns of elephant mortality

Elephant mortality data were first entered in an Ms-Excel spreadsheet with the following fields: date of mortality, UTM x-coordinate, UTM y-coordinate, cause of mortality and name of the place where mortality occurred. The data were then converted into DBF 4 (dBASE IV) format and imported to ArcGIS 9.3 to create a point shape file of elephant

mortality and associated attribute data. A map was drawn linking mortality with other aspects like elephant population, human population and rainfall.

In order to determine the spatial proximity of elephant mortality to roads, rivers and settlements, distances to these sites were created in ArcGIS 9.3 using spatial analysis tools. The distances were extracted using the mortality point data and further analyzed for correlation using SPSS. Elephant mortality was compared between wet and dry seasons, distance to water points, roads, settlements and vegetation cover type in the study area. Point pattern analysis was used to describe patterns of point events that occurred in specified geographic areas (Gatrell *et al.*, 1996). In point pattern analysis, it is possible to ascertain whether mapped point events show random, clustered or regular distribution (Figure 3.4).

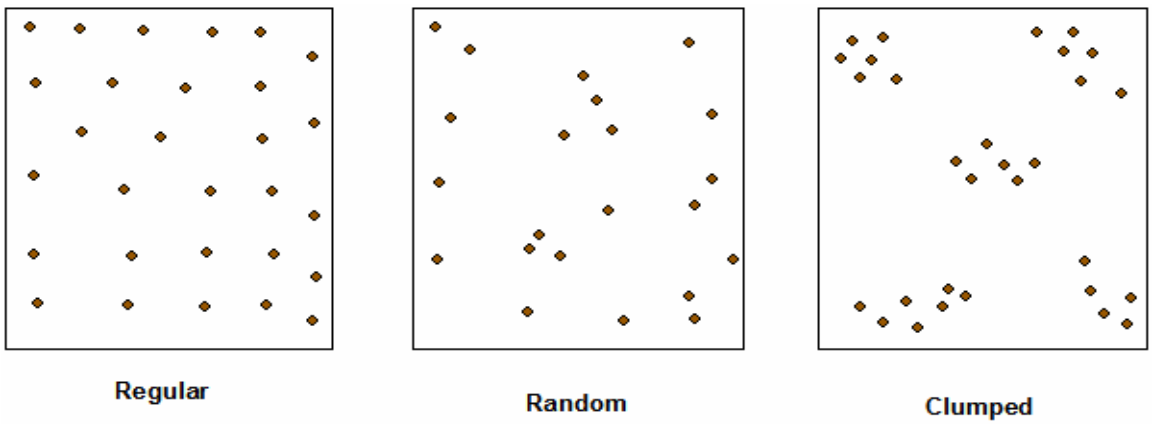

Figure 3.4: Classification of spatial distribution patterns of elephant mortality

For each elephant mortality category analyzed, the mortality data set was selected by attribute then exported to create point shape files in ArcGIS' ArcMap. Elephant mortality

point shape files were generated for mortality pattern analyses. The elephant mortality data sets were then subjected to exploratory first order descriptive statistical analysis by kernel density estimation (O'Sullivan and Unwin, 2003). It was felt that exploring elephant mortality using these point pattern techniques would show both graphically and statistically spatial patterns the elephant mortality in each category assumed. The use of multiple point pattern analysis techniques would further show among others, the stronger indicator of elephant mortality patterns.

Kernel density analyses were performed to identify areas within the study area that were hotspots for elephant poaching. The kernel density transformation is one of the most useful techniques in applied GIS which provide a good way of visualizing point pattern to detect hotspots (O'Sullivan and Unwin, 2003). Kernel density estimation provides a map of estimates of the local intensity of any spatial process from a set of observed occurrences (Bailey and Gatrell, 1995). Its estimation results in a continuous surface and provides a means to link point features to other geographic data (O'Sullivan and Unwin, 2003). The degree of smoothness of the output surface is determined by the bandwidth (the length of the search radius within which the kernel exerts its influence) used in the analysis. A large bandwidth results in a large amount of smoothing and produces a fluid map with low intensity levels. A small bandwidth results in less smoothing and a spiky map, with local variations in intensity levels (Anselin *et al*., 2000). The ability of Kernel estimation to transform spatial point patterns into a smooth image makes it ideal for visualizing hotspots and potential hotspots as areas of high density.

Kernel density analyses for different elephant mortalities due to poaching were performed using ArcGIS. A band width of 23.9 km was selected in the analysis because it corresponds to mean home range size for NC elephants. Female elephants have an average home range of 2400 km^2 while that for males averages at 1200 km^2 (Leuthold and Sale, 1973). During the dry season, however, mean elephant home range expands (Leuthold and Sale, 1973), and as such, a wider band width (31.5 km) was used for analysis of the dry season mortality.

3.5.2 Trend in elephant mortality over the from the year 2000 to 2011

The trend of elephant mortality between 2000 and 2011 was obtained from KWS elephant mortality database and field monitoring. The Proportion of Illegally Killed Elephants (PIKE) was calculated for the 12 years.

$$\text{PIKE} = \left(\frac{\text{Trophy Poaching + Conflict}}{\text{Total of all causes}} \right) \text{X } 100$$

3.5.3 Analysis of social-economic data

Data obtained from respondents was analysed using the Statistical Package for Social Sciences (SPSS Version 18). Frequencies of the responses obtained were calculated, and where appropriate, a chi-square test was used. The respondents' opinions were subjected to the chi-square test which is a measure of the disagreement between observed and expected frequencies. A larger disagreement between observed and expected frequencies results in a larger χ^2 value. Also, a larger χ^2 value is obtained if the fit is very bad (Lomax, 2007). In this study, a 0.05 level of significance is used to determine the

relationship existing between data categories and drawing conclusions about the study. Statistical testing for this study was performed only on those variables that answered the stipulated research questions. Results are presented using maps, figures and tables.

CHAPTER FOUR
RESULTS

4.1 Introduction

This chapter presents results obtained from the questionnaire survey, focus group discussions, key informant interviews, elephant mortality mapping and data from secondary sources regarding the spatial and temporal distribution of elephant mortality.

4.2 General information about respondents

4.2.1 Gender of respondents

Most of the respondents (66%) interviewed were males while 34% were females. Results further showed that majority of the respondents (64.5%) from the FNB cluster were males while 35.5% were females. From the PNB cluster, 135 (67.5%) respondents were males while 65 (32.5%) were females. Most (66%, n=200) respondents from PB cluster were males while 68 (34%) were females (Table 4.1). Chi-square results however, indicated that there were significant differences between respondents' gender in the three clusters sampled.

Table 4.1: Gender of respondents

Cluster	**Male**		**Female**		**Chi-square**
	Frequency	**%**	**Frequency**	**%**	
FNB	129	64.5	71	35.5	χ^2 =16.820, df =1, p=0.000
PNB	135	67.5	65	32.5	χ^2 =20.480, df =1, p=0.000
PB	132	66	68	34	χ^2 =24.500, df =1, p=0.000
Total	**396**		**204**		**χ^2=61.440, df=1, p=0.000**

4.2.2 Age of respondents

Results on the age of respondents are shown in table 4.2. From the results majority of the respondents (92%) were aged between 21 and 40 years. Only 1.8% of the respondents were aged above 50 years. Age of respondents according to clusters is shown in Table 4.2. Pearson chi-square results showed that there was a strong association between age of respondents and their clusters (χ^2 = 50.821, df= 8, p=0.000).

Table 4.2: Age of respondents according to clusters

Age	Cluster						Pearson chi-square	Total Freq	Total %
	FNB		PB		PNB				
	Freq	%	Freq	%	Freq	%			
Below 20	17	8.5	20	10	7	3.5	χ^2 =50.821, df = 8, p=0.000	44	7.3
21-30	81	40.5	65	32.5	111	55.5		257	42.8
31-40	81	40.5	69	34.5	73	36.5		223	37.2
41-50	19	9.5	37	18.5	9	4.5		65	10.8
51 and above	2	1	9	4.5	0	0		11	1.8

4.2.3 Respondents education level

Results showed that 202 respondents (33.7%, n=600) interviewed had informal level of education, 27.5% had university level of education. There was a significant difference in the education level of the respondents (χ^2=200.117, df= 4, p=0.000) (Table 4.3). In the PB cluster, 52.5% (n=200) of the respondents had informal level of education while only 5.5% had university education. In the FNB cluster, 38% of the respondents had secondary education, 26% and had attained informal education. From the PNB cluster, results showed that 40.5% of the respondents (n=200) had primary education, 22.5% and

informal education (22.5%, n=45). Respondents education level was however, was associated with clusters (χ^2=80.371, df= 8, p=0.000) (Figure 4.1). There was a significant difference in the level of education between gender of respondents and their clusters (χ^2=12.510, df=4, p=0.014).

Results also showed that 3.7% (n=600) of the respondents aged 20 years and below had primary education level; respondents in age group 21-30 years, 94 (15.7%) had primary education level. Overall, the informal education level had the highest number of respondents (16%, n=600) in age bracket 31-40 years followed by secondary (11.5 %,), primary (6.8%), tertiary (2%), and finally university education level (0.8%). In age group 41-50 years, 37 (6.2%) respondents had informal education, 2.8% secondary, 1.3 % primary, 0.3% tertiary education, 0.2% university education. Lastly, 1.2% of the respondents aged 50 years and above had informal education and 0.7% secondary. Pearson chi-square results showed that there was a significant difference in the level of education among the various age classes of the respondents (χ^2=93.339, df=16, p=0.000).

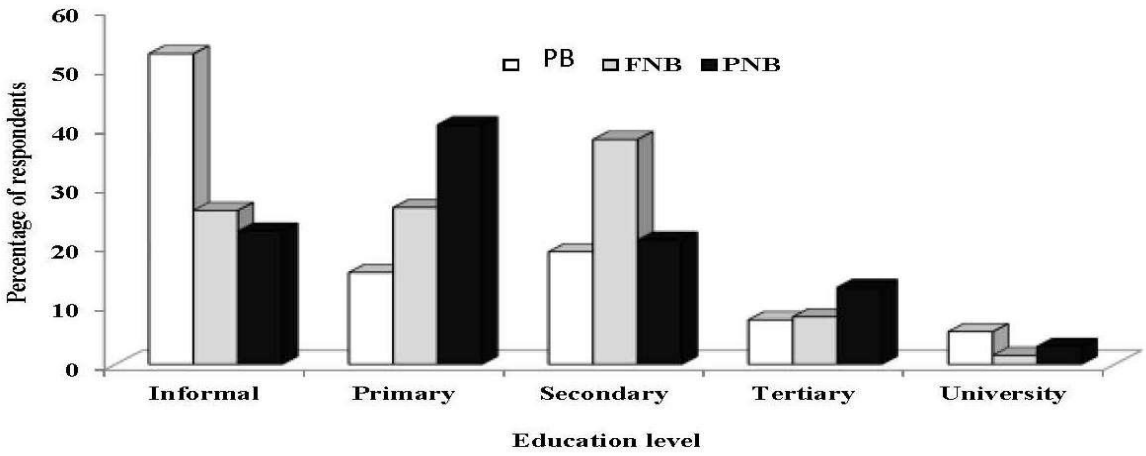

Figure 4.1: Education level of respondents in relation to categories of respondents

Table 4.3: Education level in relation to gender and age of respondents

	Education Level										Pearson Chi-square
	Informal		Primary		Secondary		Tertiary		University		
Gender	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
Male	119	19.8	118	19.7	100	16.7	46	7.7	13	2.2	$\chi 2$ = 12.510, df= 4, p=0.014
Female	83	13.8	47	7.8	56	9.3	11	1.8	7	1.2	
Total	**202**	**33.6**	**165**	**27.5**	**156**	**26**	**57**	**9.5**	**20**	**3.4**	
Age (Years)											
Below 20	8	1.3	22	3.7	10	1.7	4	0.7	0	0	$\chi 2$ = 93.339, df =16, p=0.000
21-30	54	9	94	15.7	56	9.3	39	6.5	14	2.3	
31-40	96	16	41	6.8	69	11.5	12	2	5	0.8	
41-50	37	6.2	8	1.3	17	2.8	2	0.3	1	0.2	
50 and above	7	1.2	0	0	4	0.7	0	0	0	0	
Total	**202**	**34**	**165**	**27.5**	**156**	**26**	**57**	**9.5**	**20**	**3.3**	

4.2.4 Occupation of the respondents

Respondents were drawn from diverse occupations which included unemployed (45%, n-600), self-employed (38.8%) and employed (15.5%) and others (Figure 4.2). Chi-square results showed that there was a significant difference in the occupation of respondents (χ^2=301.160, df=3, p=0.000). According to cluster results, self-employed respondents who constituted 43.5% (n=200) of the respondents was leading in FNB, From PNB cluster, most (50.5%, n=200) respondents were self-employed and in PB cluster, most respondents were unemployed (59%, n=200). There was a significant difference in occupation of respondents on the cluster of respondents (χ^2=57.369, df=6, p=0.000).

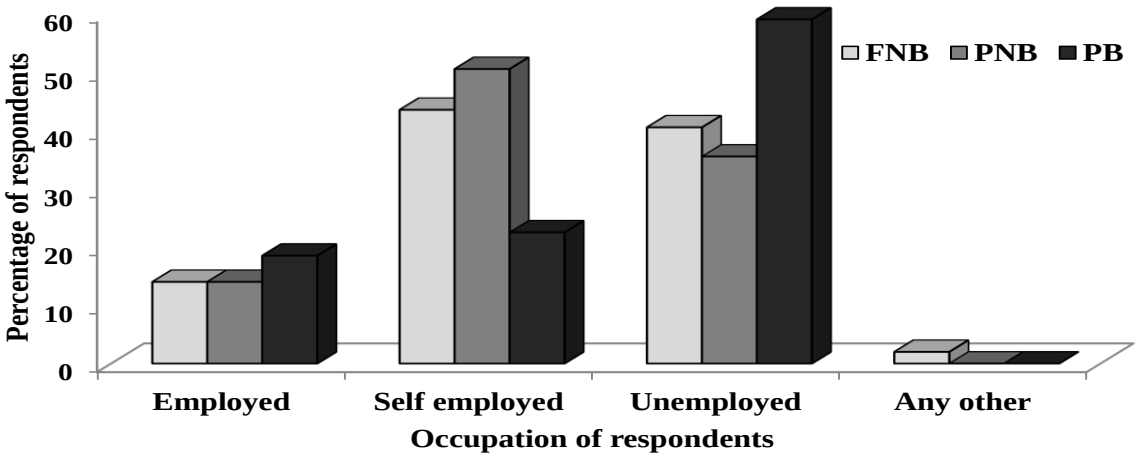

Figure 4.2: Occupation of respondents according to categories of respondents

The occupation of respondents was also ranked in relation to gender, age and education level. Table 4.4 highlights the foregoing results as well those from the chi-square analysis.

Table 4.4: Occupation of respondents in relation to gender, age and education level

	Employed		**Self employed**		**Unemployed**		**Other**		**Pearson's chi-square**
Gender	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	
Male	70	17.7	175	44.2	149	37.6	2	0.5	χ^2=11.494, df=3, p=0.009
Female	23	11.3	75	36.8	104	51	2	1	
Age									
Below 20	1	2.3	8	18.2	33	75	2	4.5	χ^2=55.4610, df=12, p=0.000
21-30	40	15.6	133	51.8	83	32.3	1	0.4	
31-40	41	18.4	76	34.1	105	47.1	1	0.4	
41-50	7	10.8	29	44.6	29	44.5	0	0	
51 and above	4	36.4	4	36.4	3	27.3	0	0	
Education level									
Informal	6	3	62	30.7	134	66.3	0	0	χ^2=181.412, df=12, p=0.000
Primary	7	4.2	103	62.4	53	32.1	2	1.2	
Secondary	44	28.2	68	43.6	43	27.6	1	0.6	
Tertiary	25	39.1	6	9.4	8	12.5	25	39.1	
University	14	82.4	1	5.9	2	11.8	0	0	

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4.2.5 Residency of respondents

Results indicated that most (93.6%, n=600) of the respondents interviewed through questionnaires were residents while only 38 (6.3%) were migrants from other parts of the country like Central, Nyanza and Western provinces. Results showed that there was a significant difference in the residence of respondents (χ^2=11.856, df=2, p=0.003). In relation to clusters, most (91%, n=200) respondents from FNB were residents by birth while 18 (9%) were immigrants. In the PB cluster, 197 (98.5%) respondents were residents by birth while 3 (1.5%) were immigrants, while the PNB cluster had 183 (91.5%) respondents by birth while 17 (8.5%) respondents were immigrants (Table 4.5).

Table 4.5: Residence of respondents according to clusters

	Cluster						**Pearson's Chi-square**
Resident	**FNB**		**PB**		**PNB**		
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	
Birth	182	91	197	98.5	183	91.5	χ^2=11.856, df=2, p=0.003
Immigrant	18	9	3	1.5	17	8.5	

4.2.6 Land use activity

Results showed that various types of land use activities are practiced in the study area among them livestock keeping (44.3%, n=600), crop farming (25.4%), wildlife conservation (23.2%), mining (4.2%) and other activities (3%). According to clusters, 44.3% (n=200) of respondents from FNB cluster practiced crop farming, 36.5% livestock keeping, 15% wildlife conservation, 2.2% mining and 5.3% other land use activities. In

the PNB cluster, 43.8% (n=200) of respondents practiced livestock keeping, 24.7% wildlife conservation, 22.4% farming, 7.6% mining and 1.5% other land use activities . In PB cluster, most respondents (55.4%, n=200) practiced livestock keeping, 32.3% wildlife conservation, 7.8% crop farming, 3% mining and 1.5% other land use activities (Figure 4.3). The proportion of respondents land use was significantly different among the various clusters. (χ^2=153.386, df=8, p=0.000).

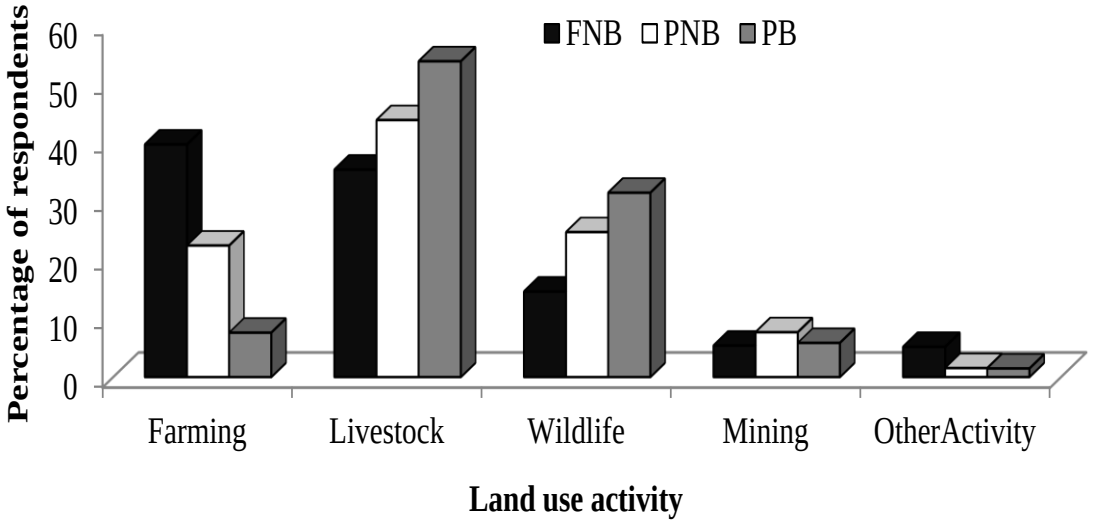

Figure 4.3: Land use activity in relation to categories of respondents

Respondents' land use activity was ranked in relation to education level, age, gender and occupation to determine whether these social attribute influenced land use activity. There was dependence between land use activities practiced and selected socio-demographic variables (Table 4.6).

Table 4.6: Land use activity in relation to education level, age, gender and occupation

	Farming		Livestock		Wildlife		Mining		Other activity		Pearson chi-square
Age	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
Below 20	24	8	38	7.2	25	9.1	2	4	6	17.1	$\chi2$ = 49.655, df = 16, p=0.000
21-30	146	48.8	223	42.7	131	48	43	88	18	51.4	
31-40	103	34.4	189	36.2	92	33.7	4	8	9	25.7	
41 and above	26	9	72	13.8.7	23	9.2	0	0	2	5.7	
Gender											
Male	193	64.5	353	67.6	179	65.6	40	81.6	26	74.3	$\chi2$ = 6.747, df= 4, p=0.150
Female	106	35.5	169	32.4	94	34.4	9	18.4	9	25.7	
Education											
Informal	76	25.4	192	36.8	113	41.4	7	14.3	12	34.3	$\chi2$ = 667.577, df = 16, p=0.000
Primary	98	32.8	142	27.2	76	27.8	36	73.5	8	22.9	
Secondary	78	26.1	119	22.8	47	17.2	4	8.2	8	22.9	
Tertiary	40	13.4	55	10.5	29	10.6	1	2	5	14.3	
University	7	2.3	14	2.7	8	2.9	1	2	2	5.7	
Occupation											
Employed	42	14	78	14.9	40	14.7	2	4.1	4	11.4	$\chi2$ = 41.240, df = 12, p=0.000
Self-employed	156	52.2	217	41.6	92	33.7	33	67.3	16	45.7	
Unemployed	97	32.4	223	42.7	141	51.6	14	28.6	15	42.9	
Others	4	1.3	4	0.8	0	0	0	0	0	0	

4.3 Trend in elephant mortality between 2000 and 2011

4.3.1 Number and reasons of elephant deaths

The number of elephants that died between 2000 and 2011 was 265, while the highest number (11.7%, n=265) of elephant deaths was recorded in 2008, followed by 2009 (11.3%) and 2011 and 2006 with 10.9% each. The lowest deaths occurred in 2001 (3.4%). The total number of elephants that died between 2000 and 2011 due to trophy poaching (TP), conflicts (CF), unknown reasons (UN), euthanasia (EU), natural cause (NA), control (CT), and accidents (AC) were significantly different ($\chi^2 = 118$, df = 6, $p < 0.05$). More elephant deaths were due to conflict (30.6%, n=200), trophy poaching (22.3%), unknown reasons (14.7%), natural death and control with 14.3% each, and euthanasia and accidents each with 1.9% cases respectively. The proportion of illegally killed elephants (PIKE) for the 12 years was 52.8%. There was a significant difference in the PIKE value over the 12 years ($\chi^2 = 65$, df = 11, $p < 0.05$), with the PIKE value increasing from 23% in 2000 to 79% in 2011 (Table 4.7; Figure 4.4 and 4.5).

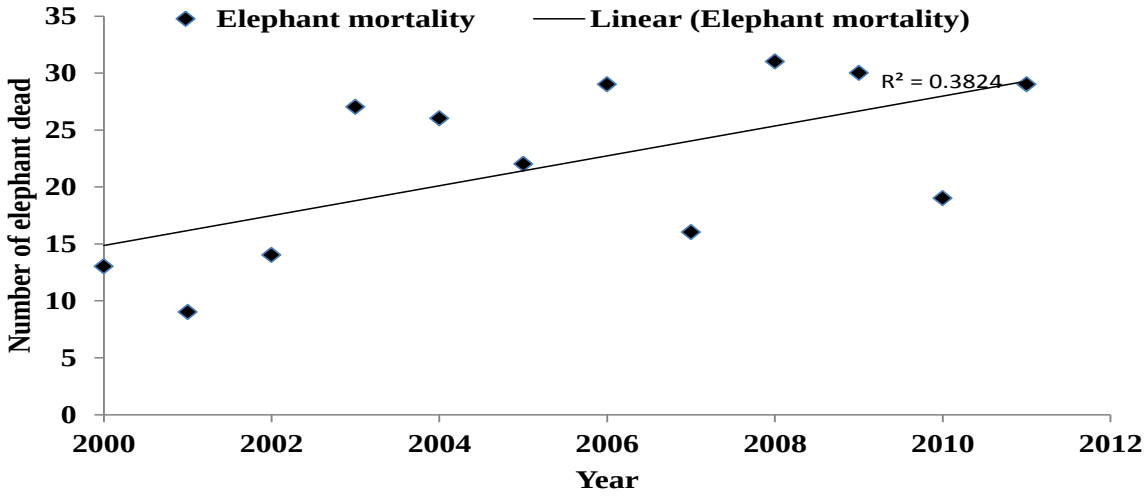

Figure 4.4: Dead elephants reported in Narok County between 2000 and 2011

(Source: KWS Elephant Mortality Database, 2012)

Table 4.7: Number of elephants that died due to different reasons between 2000 and 2011

Year	Cause							
	TP	**CF**	**UN**	**EU**	**NA**	**CT**	**AC**	**PIKE (%)**
2000	0	3	5	0	0	4	1	23.1
2001	1	2	1	1	1	2	1	33.3
2002	5	2	3	0	3	1	0	50
2003	4	10	5	0	4	4	0	51.9
2004	4	6	2	1	7	6	0	38.5
2005	2	6	5	1	4	4	0	36.4
2006	3	9	7	0	5	5	0	41.4
2007	4	8	1	0	1	2	0	75
2008	3	14	6	1	3	3	1	54.8
2009	13	5	1	1	6	4	0	60
2010	5	8	1	0	2	3	0	68.4
2011	15	8	2	0	2	0	2	79.3
Total	**59**	**81**	**39**	**5**	**38**	**38**	**5**	

Legend

TP=Trophy poaching EU=Euthanasia AC=Accidents
CF= Conflicts NA=Natural causes
UN=Unknown CT=Control

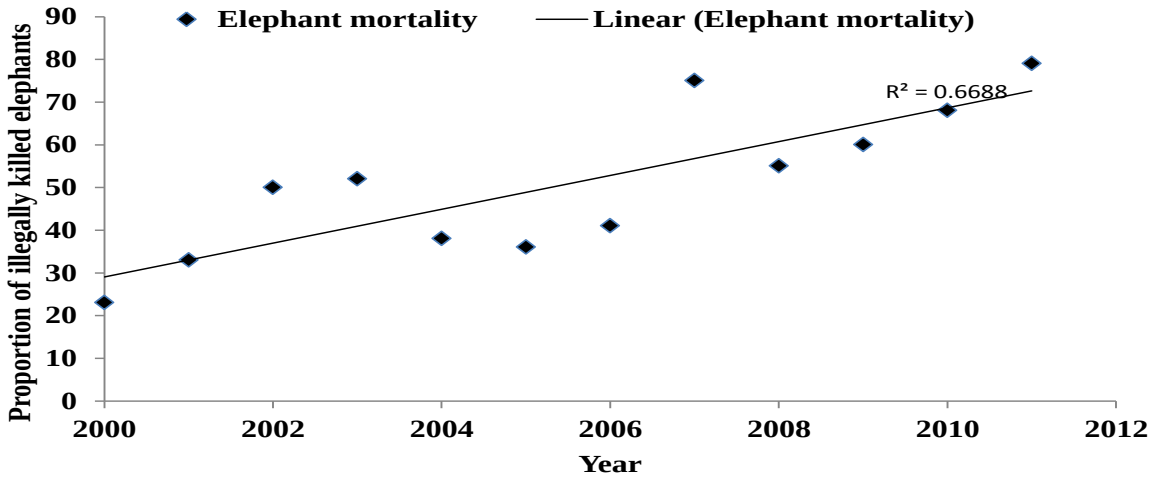

Figure 4.5: Proportion of elephants killed illegally (PIKE) in Narok County between 2000 and 2011

(Source: KWS Elephant Mortality Database, 2012)

4.3.2 Trend in elephant mortality in relation to other factors

Elephant mortality was assessed in relation to other factors such as human and elephant population, and rainfall (Table 4.8). There was a positive correlation between human population and elephant population increase and number of elephants killed during the period 2000-2011 (Figure 4.6) and (Figure 4.7) respectively. Despite the increase in mortality due to illegal killing, elephant population is still on the increase (Figure 4.6). This may however, be challenged by the increase in human population leading to changes in land use and encroachment on elephant habitats. In relation to rainfall, there was no significant relationship between number of elephant killed and annual rainfall (Figure 4.8).

Table 4.8: Elephant mortality in relation to humans and elephant population and rainfall in Narok County between 2000 and 2011

Year	Human Population	Elephant population	Rainfall (cm)	Elephant mortality
2000	554041*[1]	2094	50.0	13
2001	572324	2204	97.6	9
2002	591210	2320	104.9	14
2003	610720	2442	89.8	27
2004	630875	2564	74.5	26
2005	651693	2692	93.5	22
2006	673199	2827	105.5	29
2007	695415	2968*[2]	68.8	16
2008	718364	3110	80.5	31
2009	850920	3265*[2]	62.6	30
2010	879000	3428	63.1	19
2011	908007	3600	67.3	29

*[1] Human population in thousands (000) derived from the 1999 (536,341) census using a 3.3% annual growth rate.

*[2] Elephant Population in hundreds Projected from 2007 and 2010 Aerial and Dung count census using 5% growth rate

(Source: KWS and WWF 2000-2011, GoK, 1999 and 2009)

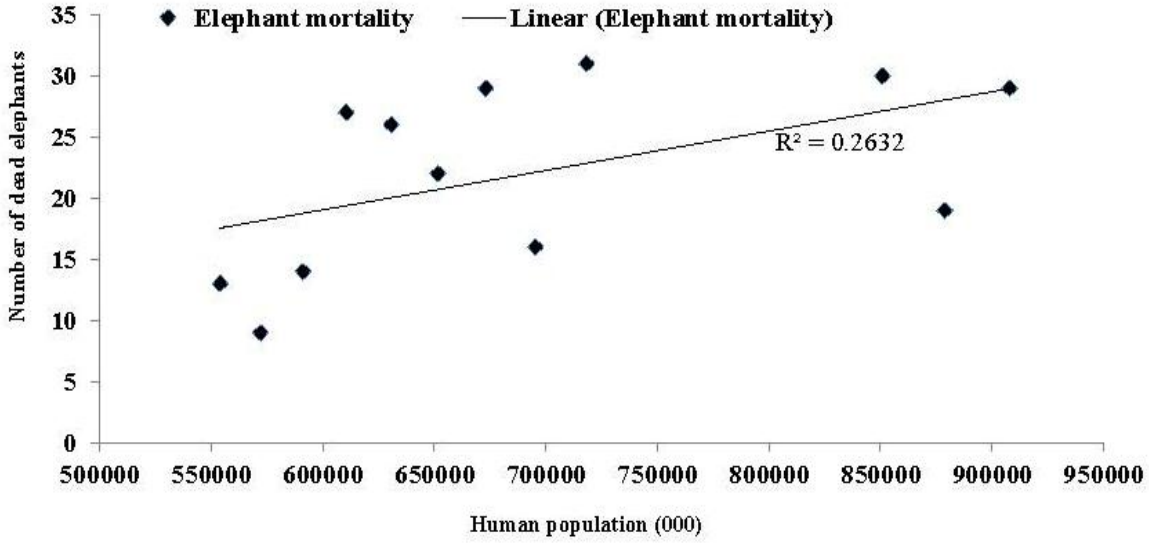

Figure 4.6: Elephant mortality in relation to human population

(Source: KWS and WWF 2000-2011, GoK, 1999 and 2009)

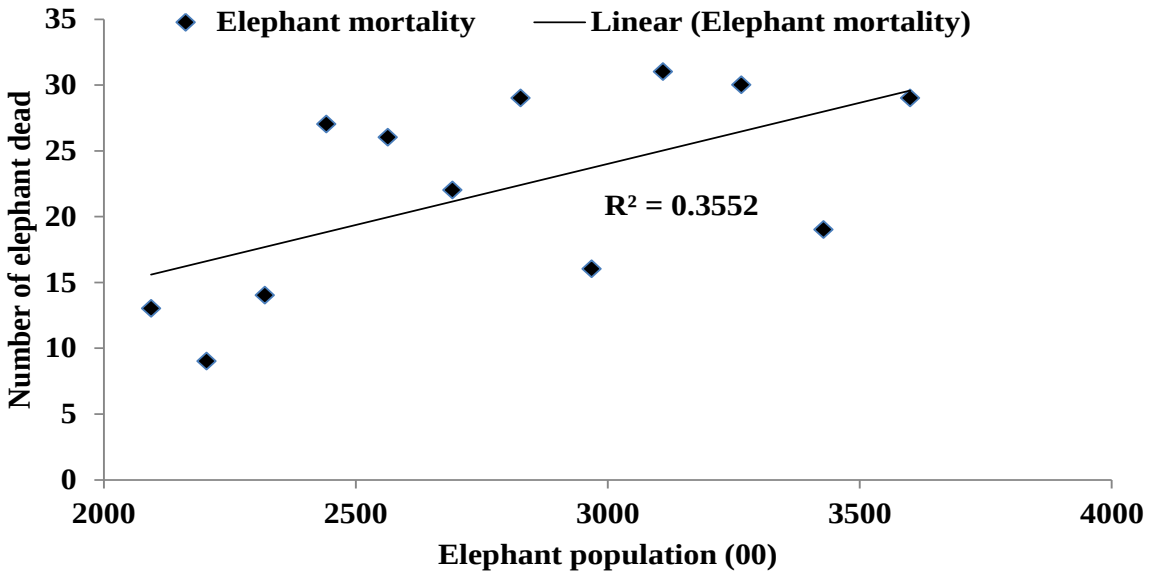

Figure 4.7: Elephant mortality in relation to elephant population growth

(Source: KWS and WWF 2000-2011)

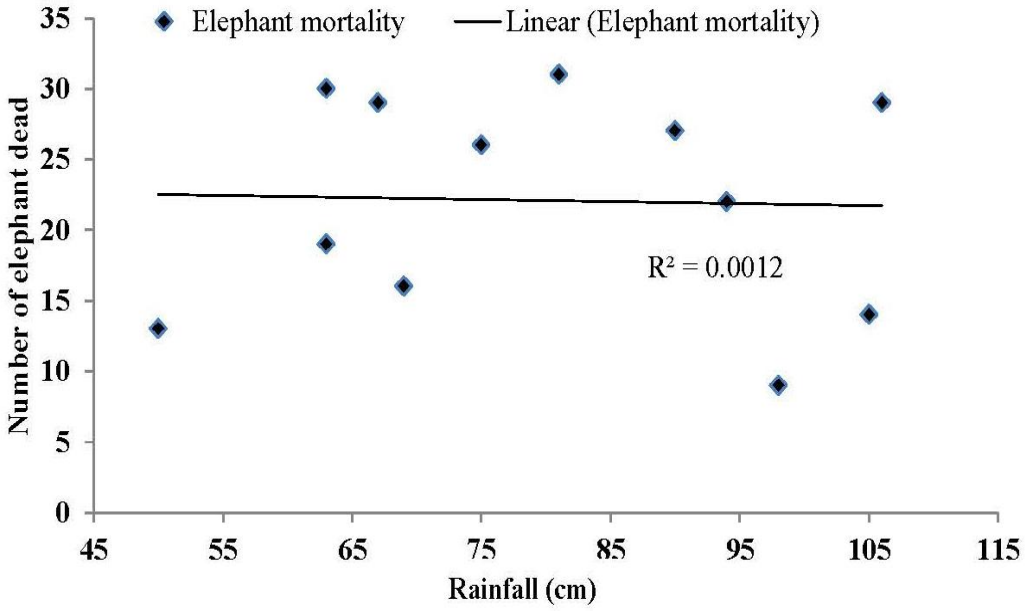

Figure 4.8: Elephant mortality in relation to rainfall

(Source: KWS and WWF 2000-2011)

4.4 Spatial and temporal patterns of elephant mortality

4.4.1 Distribution of dead elephants from 2000 to 2011

Most elephant deaths occurred outside the protected area (MMNR) (Figure 4.9). Only four deaths were recorded inside the Reserve between 2010 and 2011. These deaths were due to natural (n = 2) and unknown reasons (n = 2; Figure 4.9). Most deaths due to conflict and trophy and poaching were concentrated around Lemek-Ng'osuani area in Narok and within Nyakweri and Laila forests in TM.

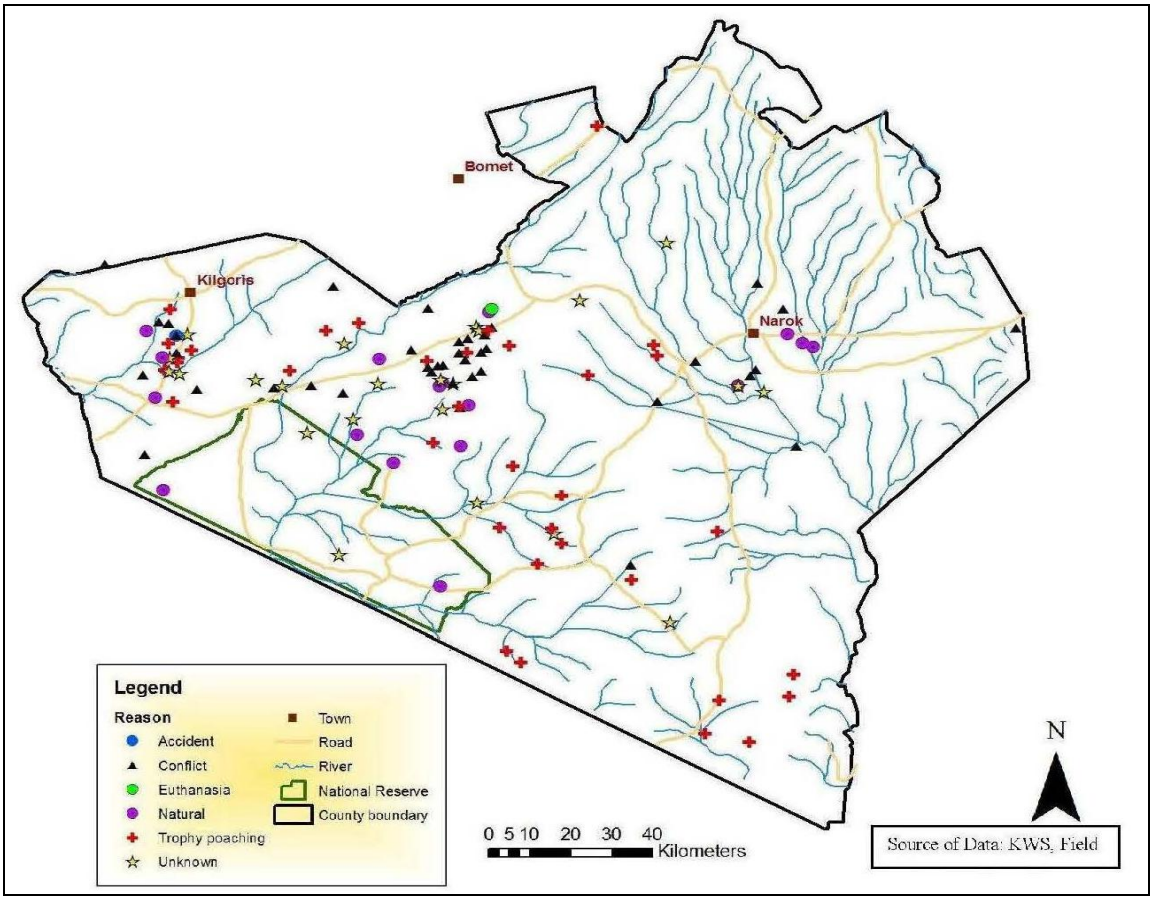

Figure 4.9: Distribution of elephant death in Narok County between 2000 and 2011 (Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

4.4.2 Elephant mortality in 2011

From primary data collected in 2011, most of the deaths were concentrated around Lemek area in Narok District (Figure 4.10)

4.4.3 Distribution of elephant mortality in relation to other factors

Elephant mortality distribution was also recorded in relation to other factors like rain season, vegetation cover, farming season, human settlement, distance to rivers, and distance from roads among other factors.

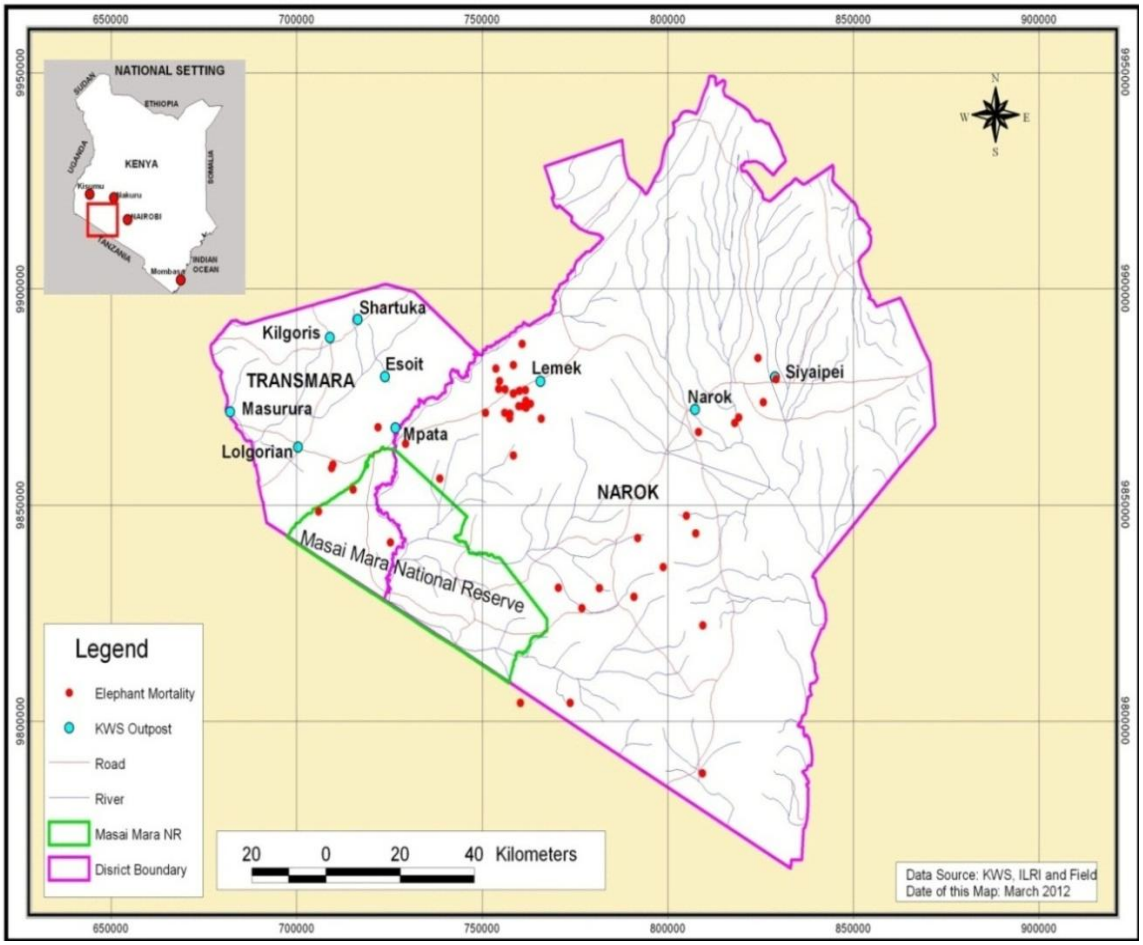

Figure 4.10: Distribution of elephant mortality in the year 2011

(Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

4.4.3.1 Elephant mortality in relation to rain season

Most elephant mortality attributed to trophy poaching (TP) (61.5%, n=13) occurred during long rainy seasons followed by dry season (38.5%) cases (Table 4.9). Elephant mortality as a result of conflicts (CF) mostly occurred during the short rainy season (October to December) with 43.8% (n=16) cases followed dry season with 37.5% and the long rains season with 18.8% cases (Figure 4.11).

Table 4.9: Elephant deaths in relation to rain seasons in 2011

	Causes											
	TP		**CF**		**UN**		**EU**		**AC**		**CT**	
Season	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Dry	5	38.5	6	37.5	3	37.5	1	100	0	0	1	25
Long rains	8	61.5	3	18.8	5	62.5	0	0	1	100	2	50
Short rains	0	0	7	43.8	0	0	0	0	0	0	1	25

4.4.3.2 Elephant mortality in relation to vegetation cover

Results from field monitoring showed that 11 (84.6%) elephant poaching activities were carried out in dense bush lands while only 1 (7.7%) case was recorded in woodland and sparse bush land (Table 4.10 and Figure 4.12). Elephant mortality due to conflicts occurred mostly on agricultural land with 10 (50%) cases followed by dense and sparse bush land with 5 (25%) cases each.

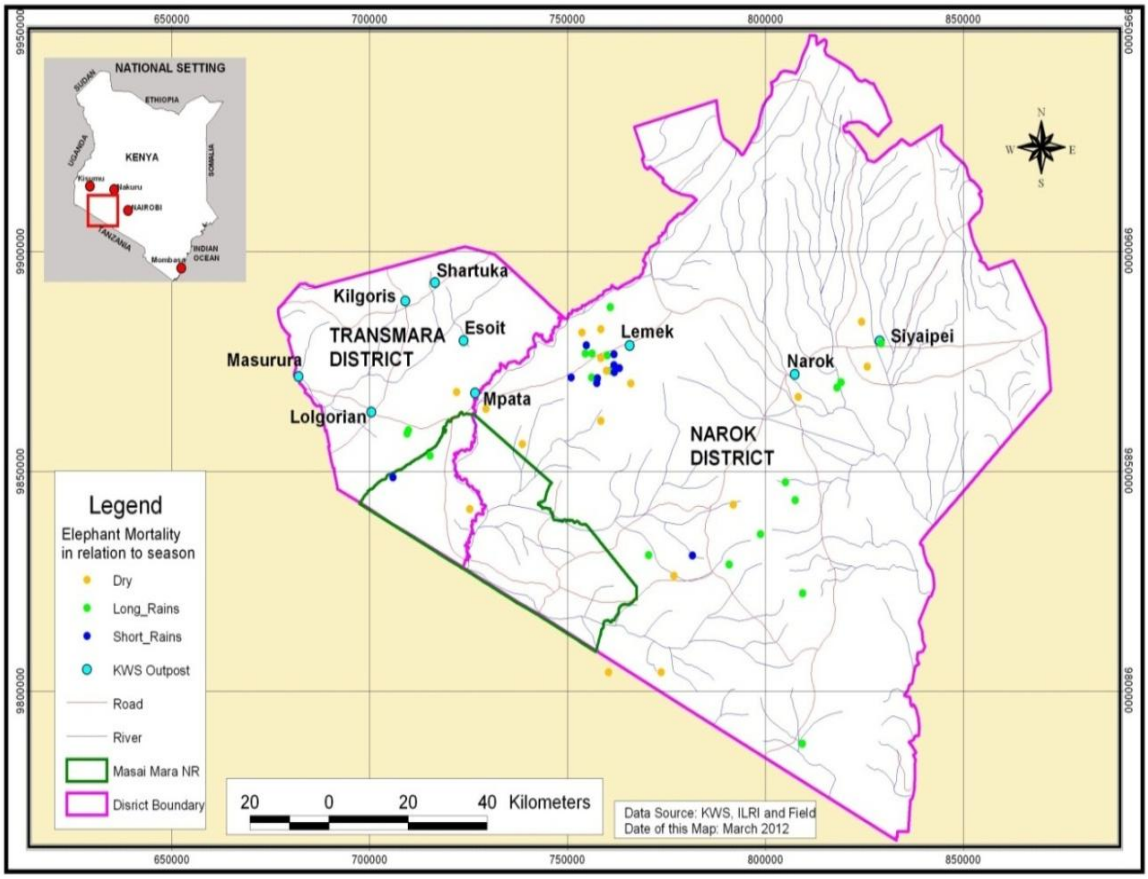

Figure 4.11: Distribution of elephant mortality in relation to rain season

(Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

Table 4.10: Elephant mortality in relation to vegetation cover in 2011

		Causes									
	Area	**CF**		**EU**		**NA**		**TP**		**UN**	
Land use	**sq km**	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Bush land (dense)	6341	5	25	0	0	2	40	11	84.6	2	28.6
Agriculture (sparse)	143.3	10	50	0	0	1	20	0	0	4	57.1
Bush land (sparse)	1809.9	5	25	1	100	2	40	1	7.7	1	14.3
Woodland	33.7	0		0	0	0	0	1	7.7	0	0

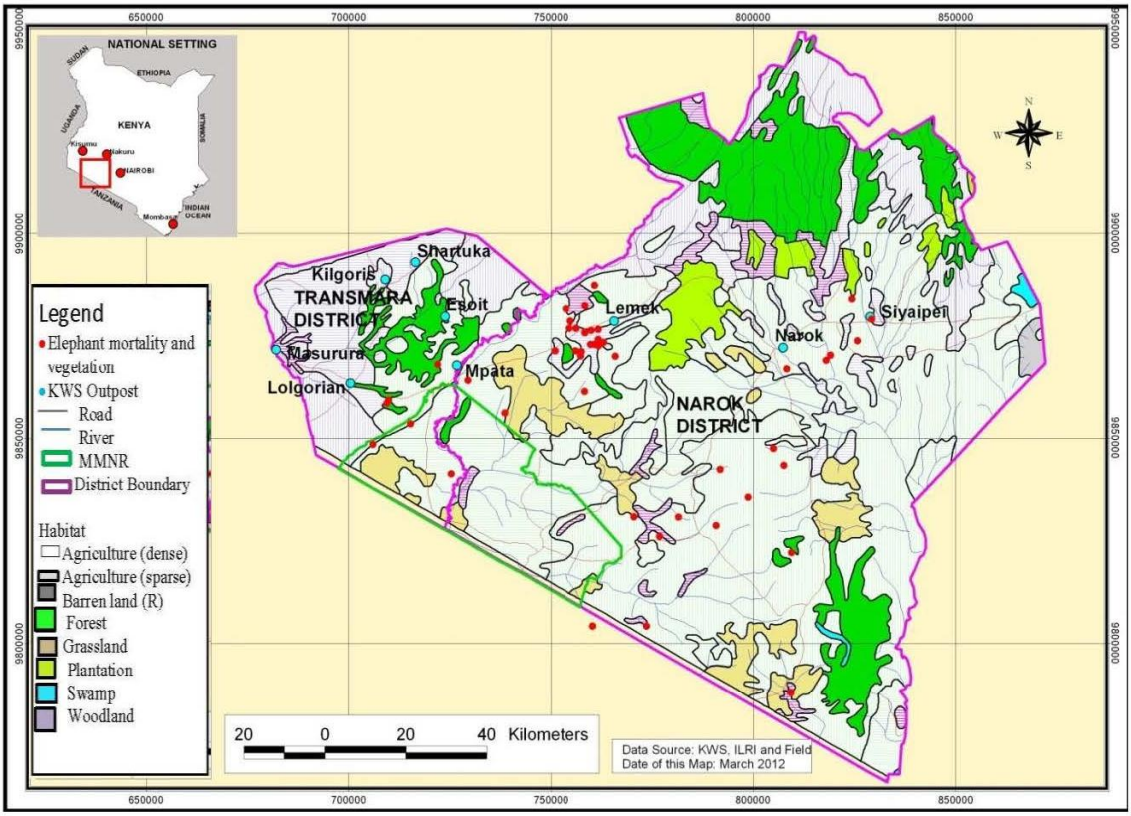

Figure 4.12: Distribution of elephant mortality in relation to vegetation cover in 2011 (Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

4.4.3.3 Elephant mortality in relation to farming season

Results on elephant mortality cases in relation to the farming season showed that most cases (62.5%, n=48) occurred when crops were on the farm while only 18 (37.5%) cases occurred during harvesting period (Table 4.11). Elephant poaching (61.5%, n=13) was highly recorded when crops were still on the farm and during harvesting period (38.5%) (Figure 4.13).

Table 4.11: Elephant deaths in relation to farming season

	TP		CF		NA		UN		AC		EU		CT	
Crop season	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Harvesting	5	38.5	6	37.5	2	40	3	37.5	0	0	1	100	1	25
Not harvesting	8	61.5	10	62.5	3	60	5	62.5	1	100	0	0	3	75

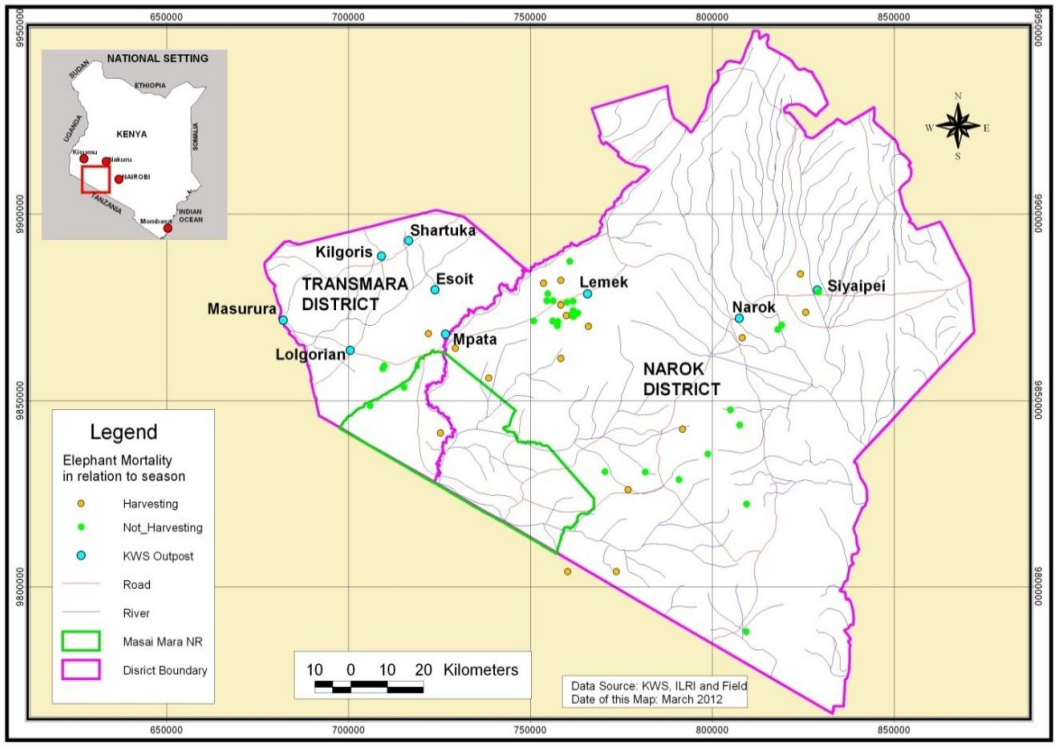

Figure 4.13: Distribution of elephant mortality in relation to farming seasons

(Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

4.4.3.4 Elephant mortality in relation to distance from rivers

Results on causes of elephant mortality in relation to distance from rivers showed that mortality cases reduced with increase in distance from rivers (Figure 4.14 and 4.15). The

trend which is explained by 48% elephant mortality in relation to distance from rivers is therefore not strong and there could be other variables causing elephant mortality. According to different causes of mortality poaching (46.2%, n=13) occurred between 0 and 3010m from rivers followed by 3011-6021m (38.6%) and finally 6022-9031m (15.4%). Elephant mortality due to conflicts (35%, n=20) was highly recorded at 9032-12042m from the rivers followed by 0-3010m with (30%), 6022-9031m (25%) and (10%) cases were between 3011 and 6021m (10%) from the river (Table 4.12 and Figure 4.14). Poaching, natural death, accidents and euthanasia cases decreased with increase in distance from rivers while elephant mortality as a result of human-elephant conflict increased with increase in distance from rivers.

Table 4.12: Elephant mortality in relation from distance from rivers

	Causes											
Distance (m)	**TP**		**CF**		**UN**		**AC**		**NA**		**EU**	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
0-3010	6	46.2	6	30	3	37.5	1	100	1	20	1	100
3011-6021	5	38.5	2	10	0	0	0	0	2	40	0	0
6022-9031	2	15.4	5	25	3	37.5	0	0	1	20	0	0
9032-12042	0	0	7	35	2	25	0	0	1	20	0	0

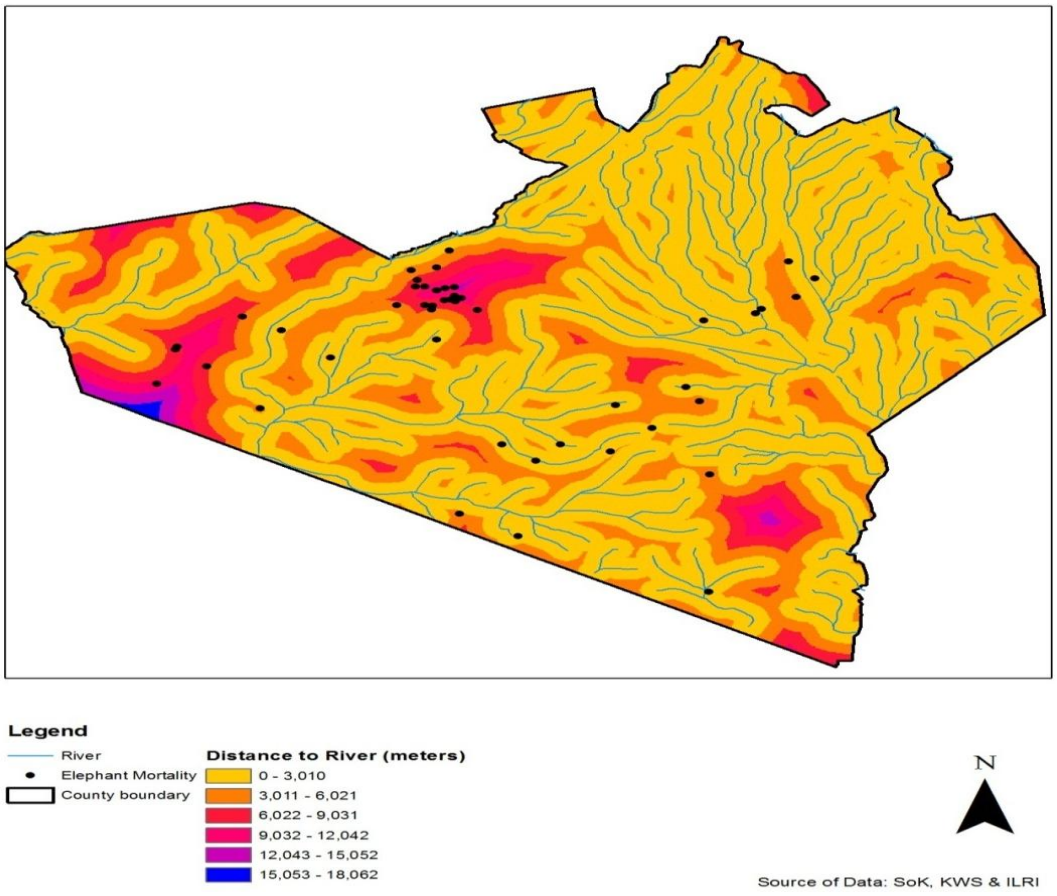

Figure 4.14: Distribution of elephant deaths in relation to distance from rivers

(Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

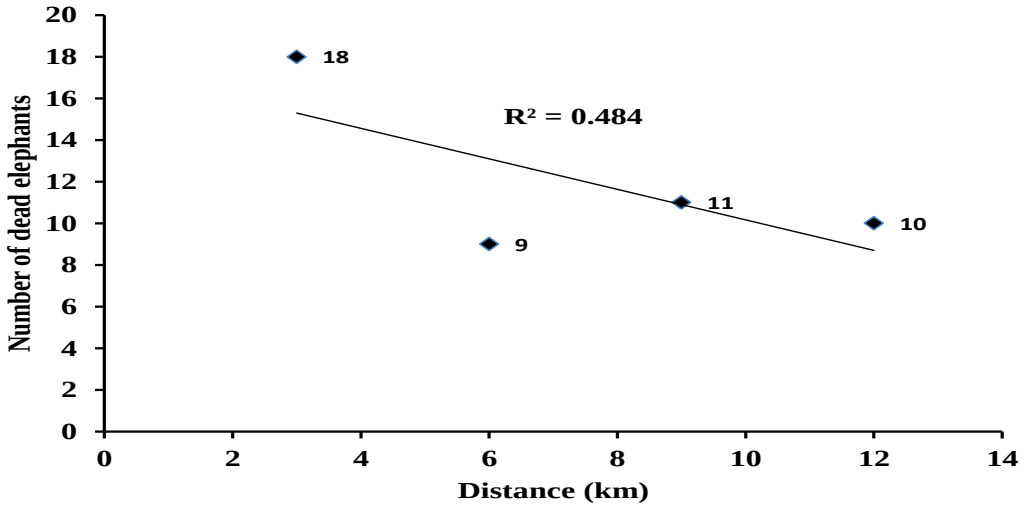

Figure 4.15: Relationship between elephant mortality according to all causes in relation to distance from rivers

4.4.3.5 Elephant mortality in relation to distance from roads

Results on elephant mortality in relation to distance from roads are shown in Table 4.13. From the results it is evident that elephant mortality cases occurred frequently near roads, and decreased with increase in distance from roads (Figure 4.16 and 4.17). The correlation in elephant mortality is explains 79% of the relation between distance and roads, thus significantly contribute to elephant mortality. Elephant poaching incidences were higher (30.8%, n=13) between a distance of 0-3km and 6-9km from the road respectively, those from conflict were highly recorded at 3-6km from road (55%, n=20), and mortality due to unknown reasons was high at both 0-3km and 3-6km (37.5%, n=8) from roads (Table 4.13). Elephant mortality caused by trophy poaching, conflict, natural, accident, unknown, and euthanasia decreased with increase in distance from roads.

Table 4.13: Elephant mortality in relation to distance from the road

	Causes												Total
Distance	**TP**		**CF**		**UN**		**AC**		**NA**		**EU**		
(km)	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	
0-3	4	30.8	7	35	3	37.5	1	100	0	0	1	100	**16**
3-6	2	15.4	11	55	3	37.5	0	0	2	40	0	0	**18**
6-9	4	30.8	1	5	1	12.5	0	0	2	40	0	0	**8**
9-12	1	7.7	0	0	0	0	0	0	0	0	0	0	**1**
12 and above	2	15.4	1	5	1	12.5	0	0	1	20	0	0	**5**

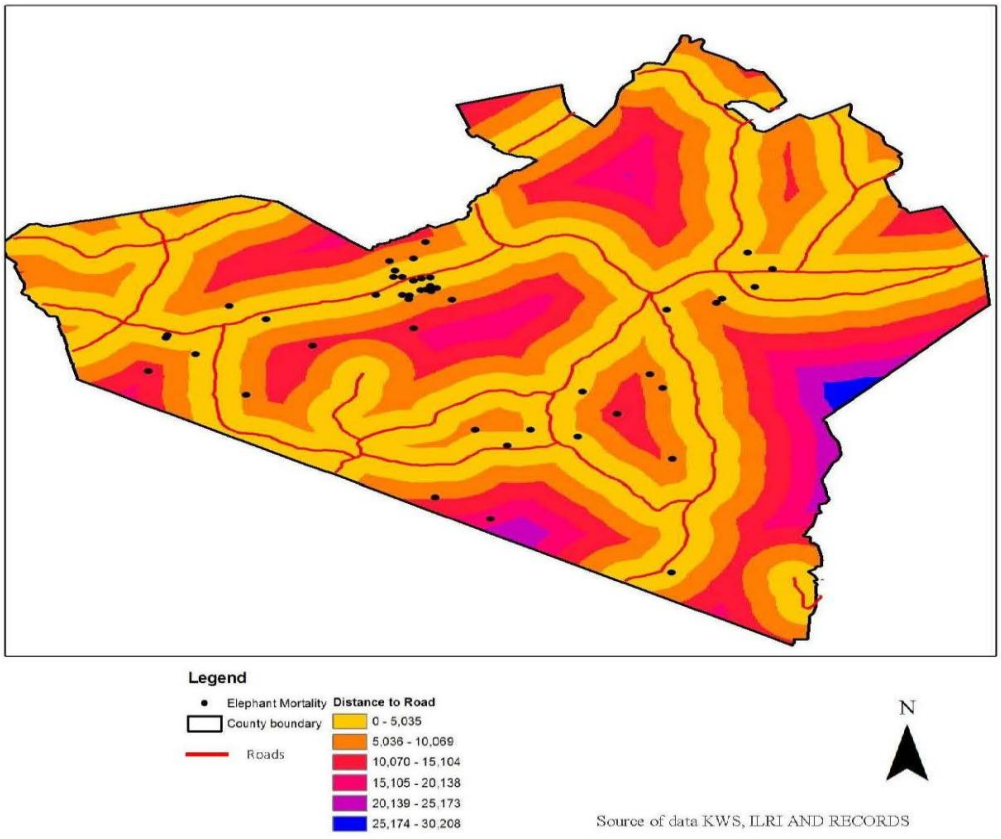

Figure 4.16: Distribution of elephant deaths in relation to distance from nearest roads

(Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

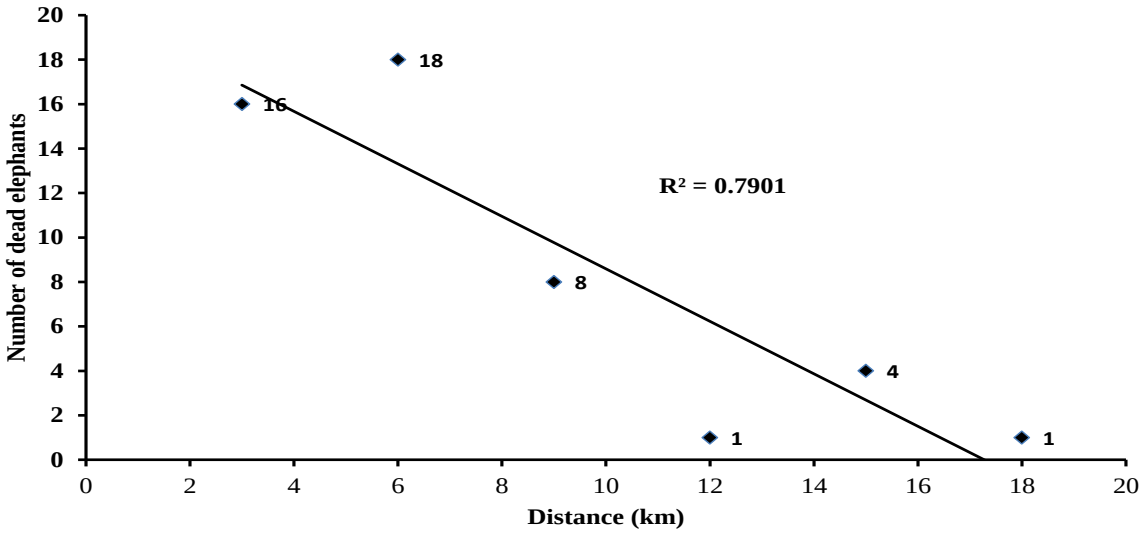

Figure 4.17: Elephant mortality in relation to distance from roads

4.4.3.6 Elephant mortality in relation to distance from human settlements

Illegal killing of elephants through poaching and conflicts was highest at 2-4km to human settlements (Figure 4.18). The correlation in elephant mortality explains a 42% distance in relation to human settlement and is therefore not strong to solely explain the high mortality thus implying that there could be other variables causing elephant mortality. Trophy poaching was highly recorded at a distance of 0-2km (61.5%), while elephant deaths due to conflicts was highly recorded at 2.1-4km (70.5%) from human settlements (Table 4.14). Elephant mortality caused by trophy poaching, conflict, natural, accident, unknown, and euthanasia decreased with increase in distance from human settlements.

Table 4.14: Elephant deaths in relation to distance from human settlement

Distance (km)	Causes														Total
	TP		CF		NA		UN		AC		EU		CT		
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
0-2.1	8	61.5	2	11.8	3	60	3	37.5	1	100	1	100	1	33.3	19
2.1-4	2	15.4	12	70.6	2	40	4	50	0	0	0	0	2	66.7	22
4.1 and above	3	23.1	3	17.6	0	0	1	12.5	0	0	0	0	0	0	7
Total	13		17		5		8		1		1		3		48

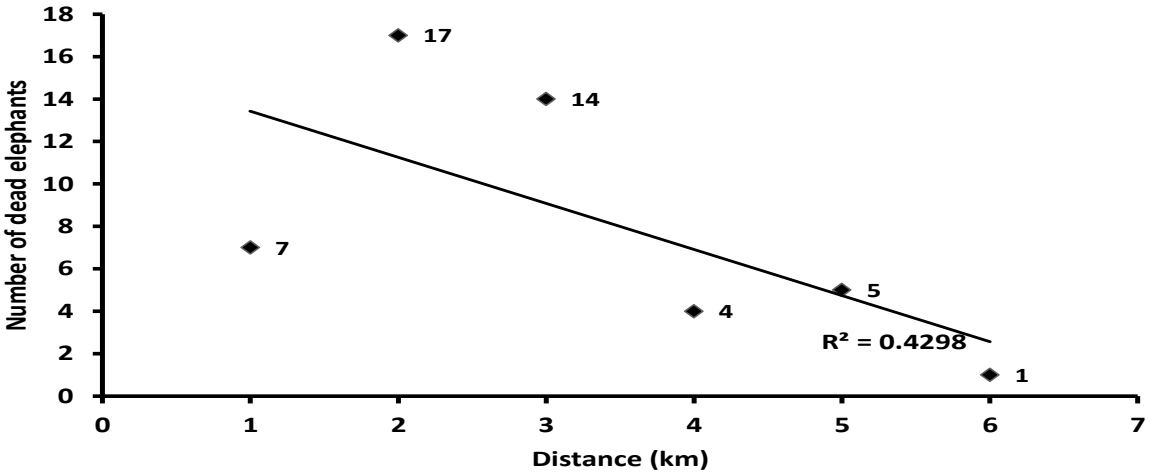

Figure 4.18: Relationship between elephant mortality and human settlements

4.4.4 The kernel density of dead elephants

Standard deviation ellipses showed that the mean center of elephants that died due to trophy poaching was about 20 kilometers to the north east of MMNR boundary. Poached elephants were recorded outside the reserve, parallel to the reserve boundary (Figure 4.19). A high density of poached elephants occurred in Transamara.

On the other hand, the mean center of elephants that died due to conflicts with humans was at Lemek area. A high density of dead elephants due to conflicts occurred around

Lemek in Narok and in sitoka and Olesentu in Transmara District (Figure 4.20). The standard deviation ellipses and kernel density of dead elephants due to other reasons (euthanasia, natural, unknown, and accidents) is shown in figure 4.21.

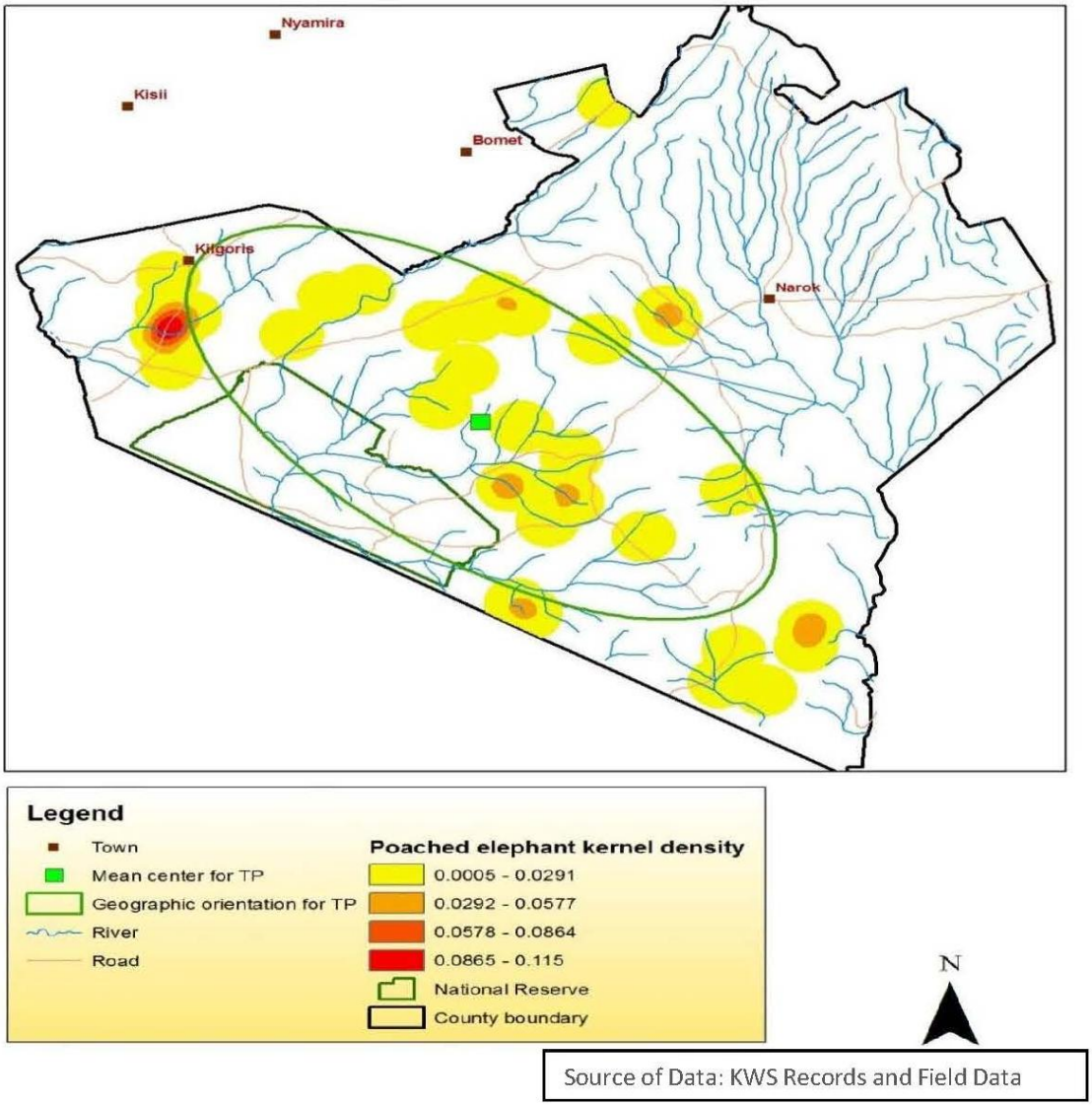

Figure 4.19: Kernel density and standard deviation ellipses of elephants that died due to trophy poaching in Narok County

(Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

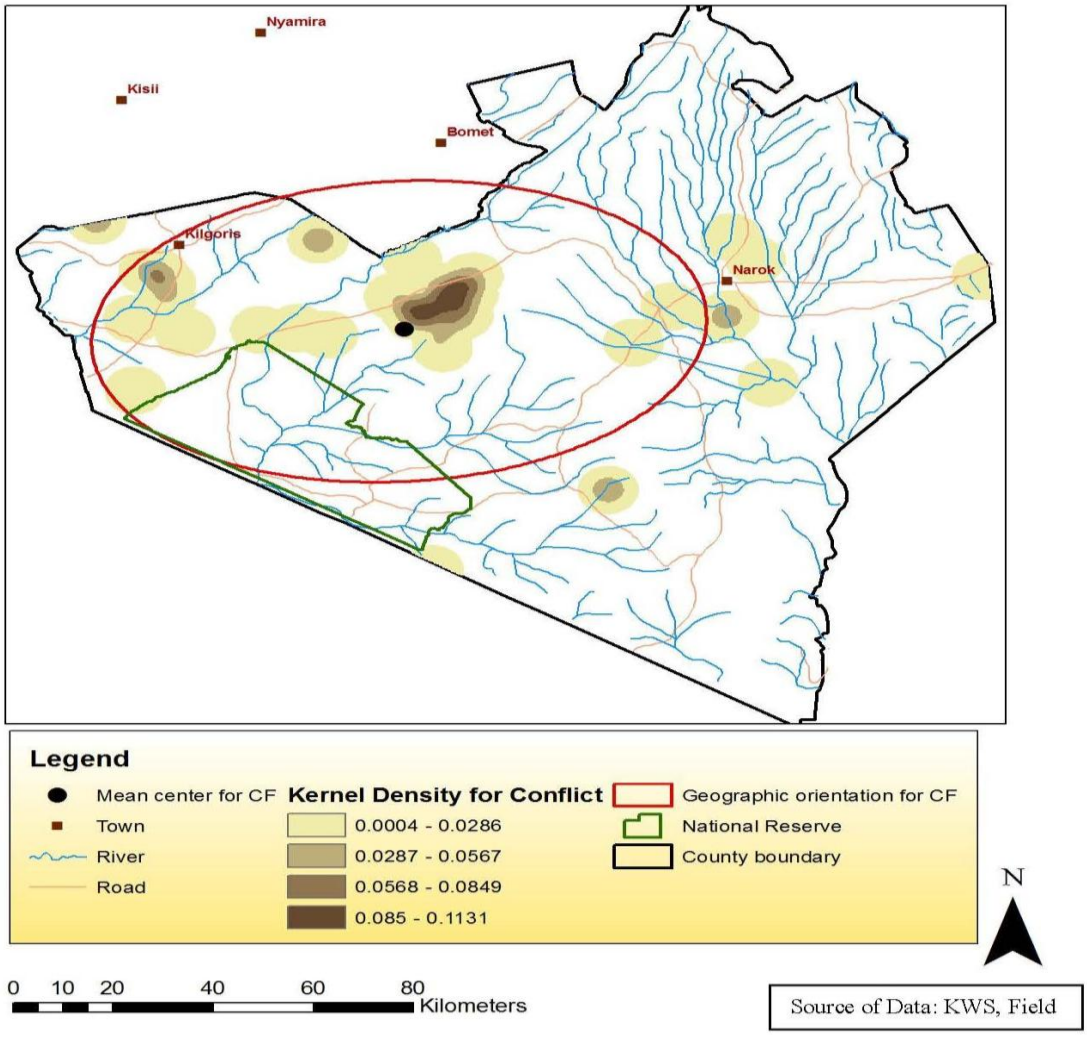

Figure 4.20: Kernel density and standard deviation ellipses of elephants that died as a result of Conflict with humans

(Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

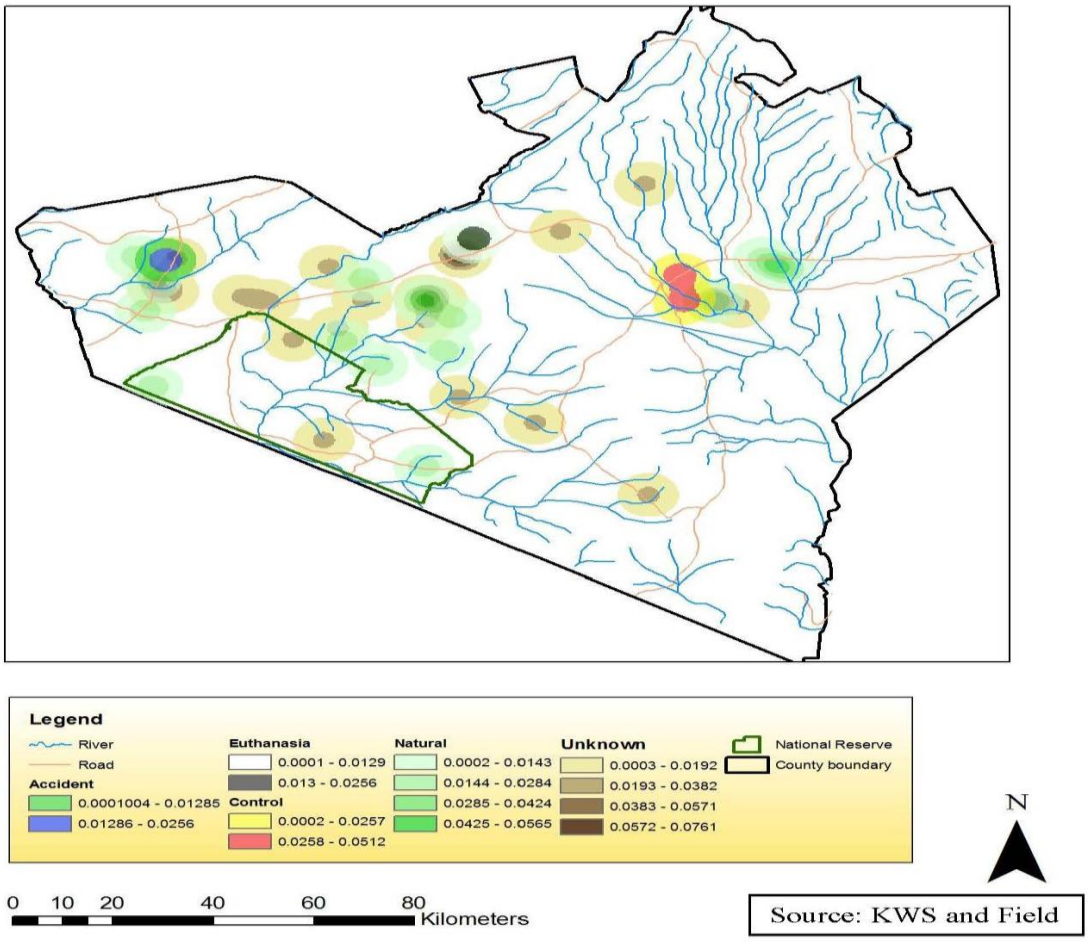

Figure 4.21: Kernel density and standard deviation ellipses of elephants that died as a result of other causes

(Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

4.5 Causes of elephant mortality

4.5.1 Respondents' view of the state of elephant population

Most (83%, n=600) of the respondents interviewed reported that the population of elephants in the study area is increasing while 102 (17%) stated that the population of elephants is decreasing. Chi-square results showed that there was a significant difference in the state of perception of the respondents on elephant population (χ^2 =261.360, df =1,

p=0.000). However, according to cluster results, most FNB respondents (86%, n=200) stated that the population is increasing while 14% indicated that the population of elephants is decreasing. From PNB, 85% of the respondents alluded that the population is increasing while 15% indicated stated that the population is decreasing. In PB cluster, 154 (77%) respondents reported that the population is increasing while 46 (23%) contended that the population is decreasing (Table 15).

4.5.2 Elephant deaths in the year 2010 based on respondents views

Respondents were also asked if they had witnessed elephant deaths or seen carcasses in the past one year (2010) in the study area. Most respondents (62%, n=600) reported not witnessing any elephant death in 2010 while 225 (38%) respondents had witnessed it. Chi-square results showed that there were significant differences in respondents' view about witnessing elephant death (χ^2 =37.500, df =1, p=0.000). According to cluster results, 29% (n=200) of the respondents from FNB had witnessed while 141 (71%) had not. From PNB cluster, 81 (40%) respondents reported witnessing dead elephants in the year 2010 while 119 (60%) had not. From PB cluster, 85 (42%) respondents reported they had witnessed dead elephants in the year 2010 while 115 (58%) had not witnessed (Table 15). Chi-square results showed that there were significant differences in respondents views from cluster FNB (χ^2 =33.620, df =1, p=0.000), PNB (χ^2 =7.220, df =1, p=0.007), and PB (χ^2 =4.500, df =1, p=0.034).

Table 4.15: Respondents' view on the state of elephant population and deaths

	Description	FNB		PNB		PB		Chi-square
		Freq	%	Freq	%	Freq	%	
Population State	**Increasing**	173	86.5	171	85.5	154	77	χ^2 =261.36, df =1, p=0.000
	Decreasing	27	13.5	29	14.5	46	23	
Elephant death	**Yes**	59	29.5	81	40.5	85	42.5	χ^2 =37.500, df =1, p=0.000
	No	141	70.5	119	59.5	115	57.5	

4.5.3 Number of elephant deaths witnessed by respondents

Overall, 63% of respondents reported not witnessing any elephant deaths in the year 2010, 34% had witnessed between 1-3 elephant deaths while 3% had witnessed between 4-6 elephants deaths (Figure 4.22). The number of elephant deaths witnessed by the respondents was significantly different (χ^2 =9264.917, df =3, p=0.000).

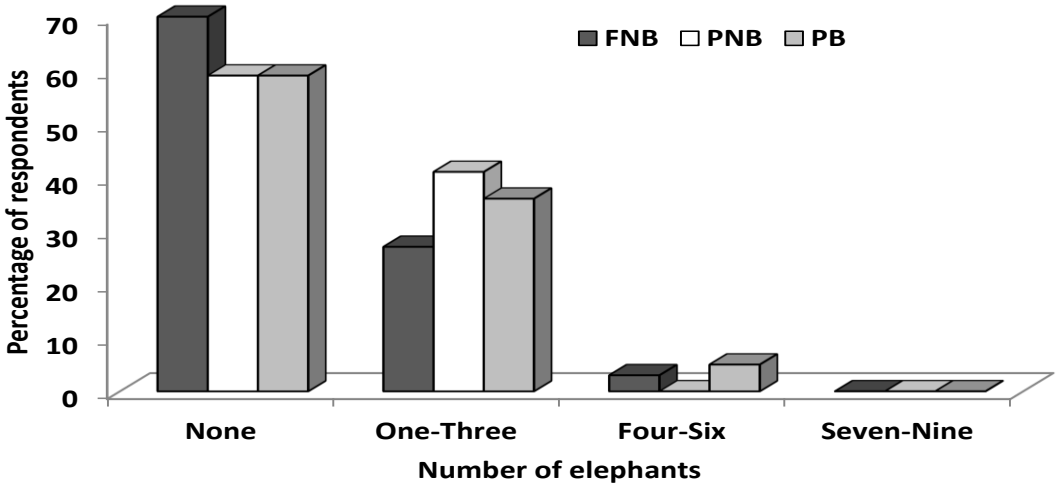

Figure 4.22: Number of dead elephants witnessed by respondents

Several cases of elephant deaths were reported in Narok District 27 (71%) and Transmara District 11 (29%) cases during the study period.

4.5.4 Causes of elephant deaths in 2011

The total number of elephants that died between September 2010 to October 2011 due to trophy poaching, conflicts, unknown reasons, euthanasia, natural cause, control, and accidents were significantly different (χ^2 = 35.161, df = 6, p < 0.000). The major causes of (45%, n=29) elephants deaths were due to trophy poaching followed by those due to conflict (29%) cases (Figure 4.23). The proportion of illegally killed elephants (PIKE) for September 2010 to October 2011 was 74%. The distribution of elephant deaths in relation to various mortality causes is shown in Figure 4.24

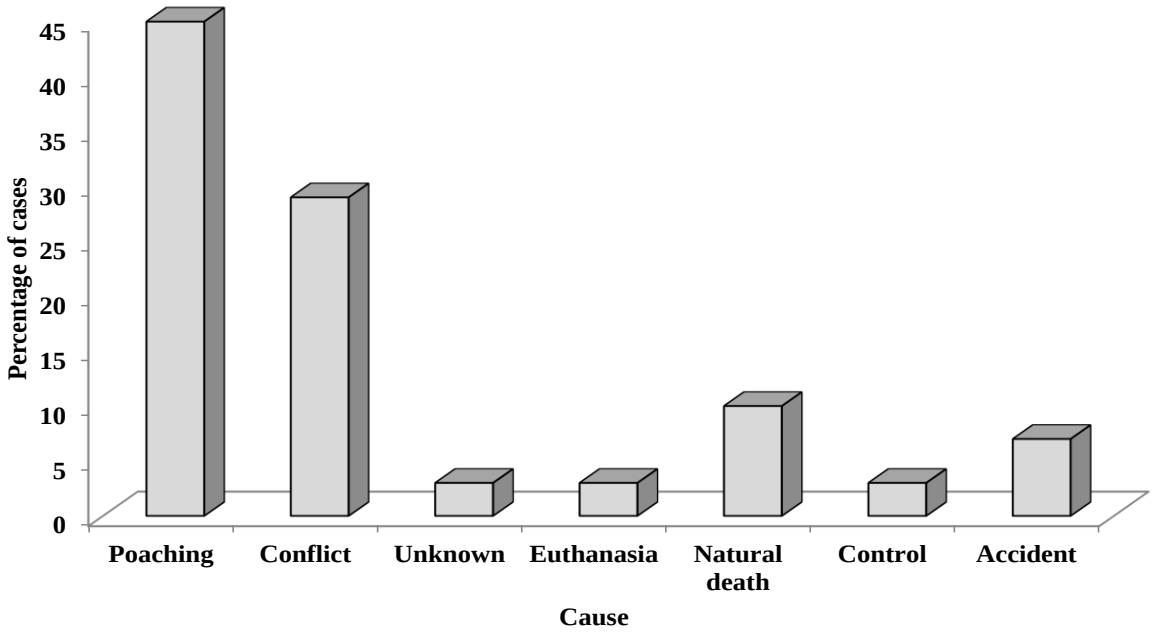

Figure 4.23: Causes of elephant deaths in 2011

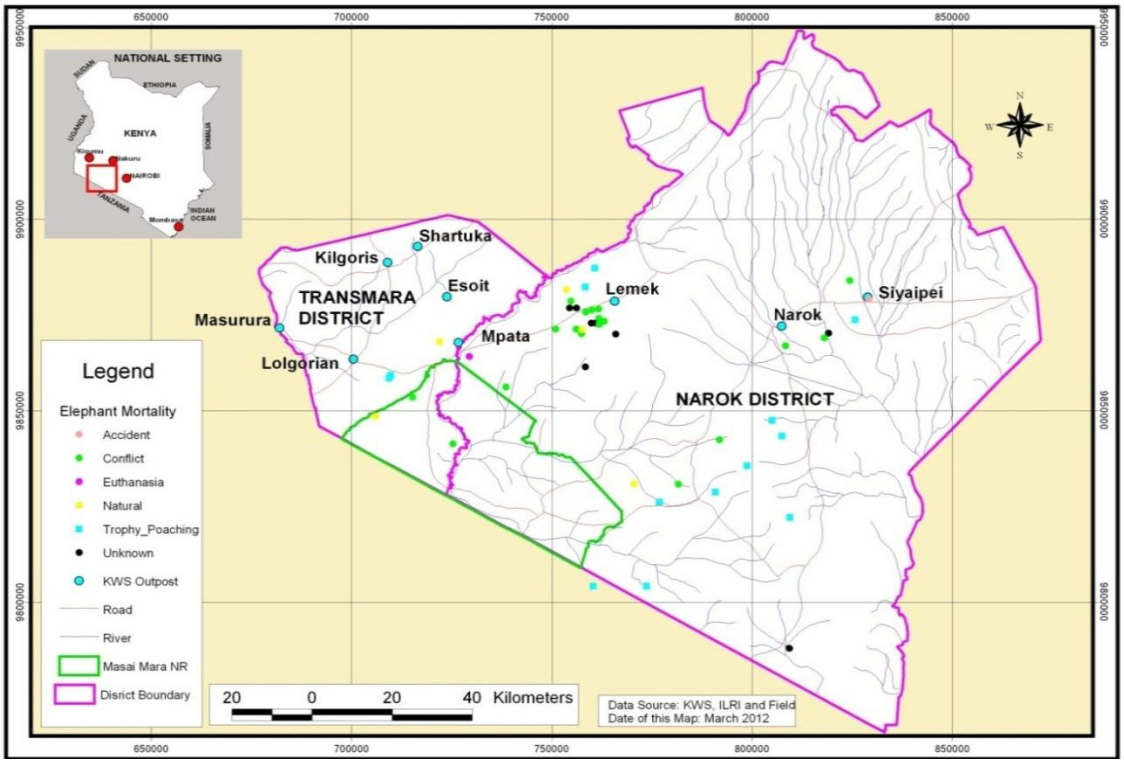

Figure 4.24: Distribution of elephant mortality in relation to various causes in 2011 (Sources: KWS Elephant Mortality Database, 2012 and Author, 2011)

4.5.5 Sex of elephant carcass encountered

Male elephant carcasses were highly recorded (68%, n=31), unknown gender carcasses recorded constituted 18% and the least were females with 13% cases (Figure 25). The number of dead elephants varied significantly by sex (χ^2 =21.211, df =2, p=0.000). According to districts, Narok had the highest percentage of male elephant carcasses (74%), followed by unknown with 19%) and lastly female elephant carcass (7%). In TM District male elephant carcasses were leading with 55% (n=11) followed by female (27%) and finally unknown (18%). There were significant difference in the sex of elephant carcasses in both Narok and Transmara District (χ^2 =42.41, df =2, p=0.000).

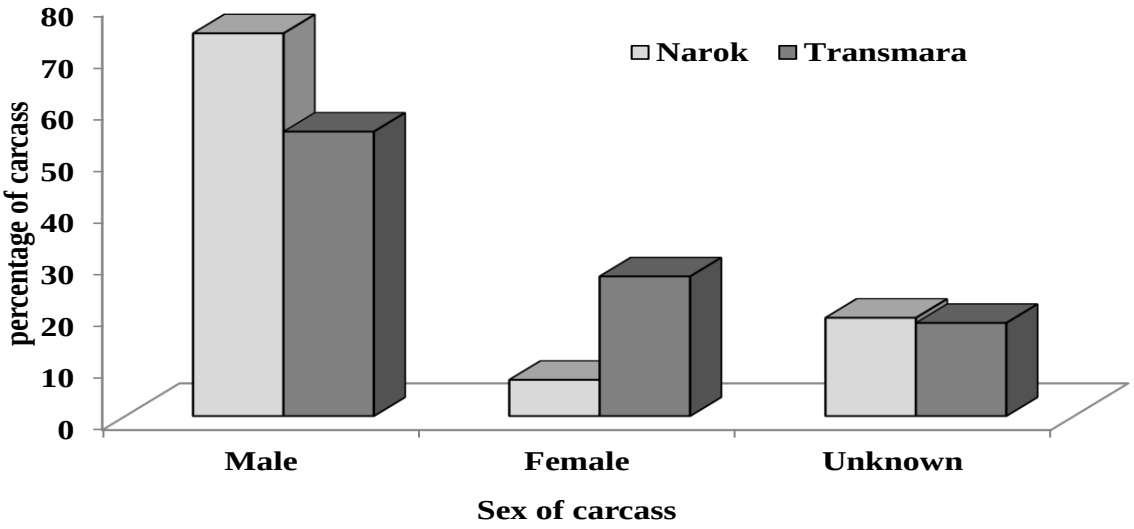

Figure 4.25: Sex of elephant carcasses encountered

4.5.6 State of elephant carcasses recorded

Most (70%, n=27) carcasses recorded in Narok District were fresh, followed by old carcass (15%, recent (11%) and very old (4%). In TM District, most (55%, n=11) carcasses recorded were old, followed by recent (27%) and fresh (18%). No carcasses that had stayed beyond five weeks were recorded. Chi-square results showed that there were significant differences in the state of carcasses (χ^2 =2.364, df =2, p=0.0307) (Figure 4.26).

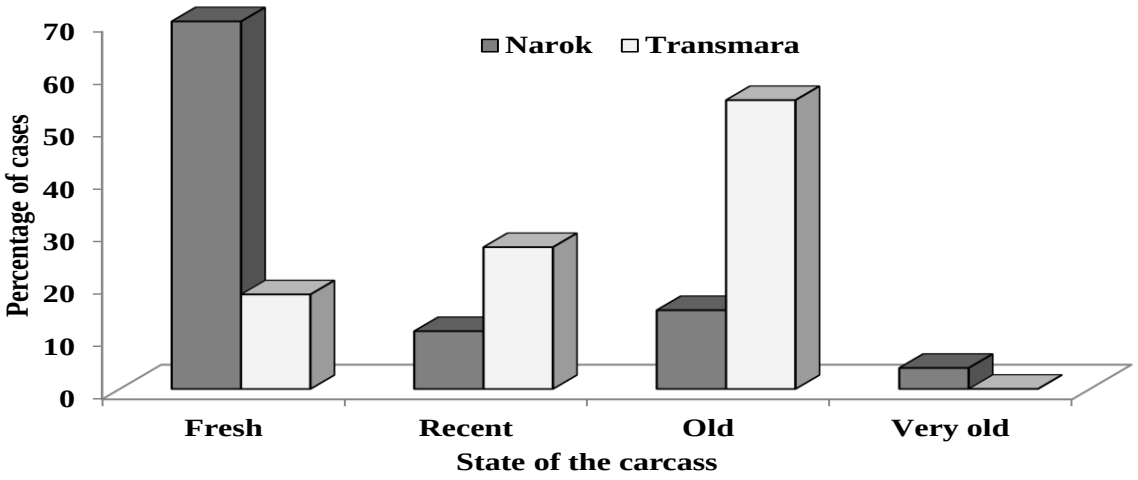

Figure 4.26: State of elephant carcasses

4.5.7 Recovery of tusks

On all the elephant carcasses recorded, details noted included whether the tusks were still intact, removed by poachers, pulled out by KWS or were naturally absent. Overall, tusks collected by KWS were highest (55.3%, n=21) followed by those removed by poachers (31%, n=12) and tusks that were found still intact (13.2%, n=5). Results showed that there was significant difference in the state of tusks found on the carcasses recorded (χ^2 =10.158, df =2, p=0.006). Results showed that 63% (n=17) of tusks recorded in Narok District had been removed by KWS from the carcasses or recovered, followed by those pulled out by poachers by the time of identification and recording, (18.5%) and tusks found intact on the carcass (18.5%) (Table 16). The number of tusks recovered using different modes of recovery of tusks did not differ significantly (χ^2 =10.667, df =2, p=0.05). On the other hand, in TM District, tusks pulled by poachers were leading with 63.3% (n=7) followed by those removed out by KWS (36.6%, n=4). The analysis showed

that there was a significant difference in the mode of tusks recovery on the carcass in Transmara District (χ^2 =0.818, df =1, p=0.036).

Table 4.16: Recovery of tusks from encountered dead elephants

District	Removed by KWS		Chopped by poachers		Intact		Total	Chi-Square
	Freq	%	Freq	%	Freq	%		
Transmara	4	36.6	7	63.3	-	-	11 (28.9%)	χ^2=0.818, df=1, p=0.366
Narok	17	63	5	18.5	5	18.5	27 (71%)	χ^2=10.667, df=2, p=0.05
Total	21	55.3	12	31.6	5	13.2	38 (100%)	χ^2=10.158, df=2, p=0.006

4.5.8 Local respondents' views on selected effects of elephant mortality

The views of the respondents on selected effects of elephant mortality in three clusters are shown in Table 4.17. From the results 58% (n=600) respondents agreed that revenue generated from conservation of elephants had decreased, 176 (29%) disagreed and 77 (13%) had no idea. Respondents' responses differed significantly (χ^2 =186.570, df =2, p=0.000). Other responses are shown in Table 4.17.

Table 4.17: Effects of elephant mortality on the local community

Effect	**Agree***		**Disagree***		**No Idea***		**Chi-square**
	Freq	%	Freq	%	Freq	%	
Little revenue	347	57.8	176	29.3	77	12.8	χ^2 =186.570, df =2, p=0.000
No employment	342	57	199	33.2	59	9.8	χ^2 =200.230, df =2, p=0.000
Enhanced poor living standards	295	49.2	250	41.7	55	9.2	χ^2 =162.750, df =2, p=0.000
No HEC	62	10.3	487	81.2	51	8.5	χ^2 =1.681, df =2, p=0.000
No effect	72	12	413	68.8	115	19.2	χ^2 =3.449, df =2, p=0.000
***Multiple response**							

4.6 Attitudes and perceptions of the local community towards elephant conservation

4.6.1 Ranking of attitudes and perceptions of the local community towards elephant conservation

237 (40%, n=600) respondents strongly agreed with the statement that elephants are important wildlife, 33% respondents agreed, 7% had no idea, 11% disagreed and 9% respondents strongly disagreed. Chi-square results showed that there is a significant difference in the attitudes and perceptions of the local community towards elephant being an important wildlife resource (χ^2 =273.017, df =4, p=0.000). According to cluster results, 72% (n=200) of respondents in FNB had a positive attitude towards elephants (agreed), 11.5% were non-committal about their attitude and 16.5% disagreed (Table 4.18). From PNB cluster, 157 (78.5%, n=200) respondents were positive about elephants, 6% were non-committal while 15.5% disagreed (had negative attitude). From PB cluster, 134 (67%, n=200) respondents had a positive attitude and perception towards elephants (agreed), 4% were non-committal and 29% respondents disagreed. Chi-square results

revealed that respondents' attitudes and perceptions towards elephants were dependent on clusters (χ^2 =74.157, df =8, p=0.000).

Table 4.18: Attitudes and perceptions of respondents towards elephants according to clusters

	Agree		**Not sure**		**Disagree**		**Chi-Square**
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	
FNB	144	72	23	11.5	33	16.5	χ^2=135.310, df=2, p=0.000
PNB	157	78.5	12	6	31	15.5	χ^2=181.990, df=2, p=0.000
PB	134	67	8	4	58	29	χ^2=120.760, df=2, p=0.000
							Pearson's chi-square
Total	**435**		**43**		**122**		**(χ^2 =74.157, df =8, p=0.000).**

Attitudes and perceptions towards elephants were also ranked in relation to respondents' education level, occupation, age, and gender (Table 4.19). In relation to education level, most respondents strongly agreed that elephants are important wildlife. Results of respondents' views drawn from different education categories are shown in table 4.19. Chi-square results revealed that respondents' attitudes and perceptions towards elephants was dependent on education level attained (χ^2 =17.775, df =16, p=0.000). In terms of occupation, results showed that most respondents had a positive attitude and perception towards elephants whereby, unemployed respondents were leading with 43.5% (n=600), followed by self-employed (38.8%) and employed respondents (17.7%). Chi-square results revealed that respondents' attitudes and perceptions towards elephants was dependent on occupation (χ^2 =36.080, df =12, p=0.000).

According to age, most respondents had a positive attitude and perception (strongly agreed) towards elephants whereby, 119 (50.2%, n=600) respondents who were aged between 21 and 30 years were leading, followed by those aged 31-40 years (31.6%), below 20 and 41-50 years with (8.4%) each, and 51 years and above (0.3%). Chi-square results revealed that respondents' attitudes and perceptions towards elephants were not dependent on age (χ^2 =26.158, df =16, p=0.052).

Table 4.19: Attitudes and perceptions of respondents towards elephants in relation to age, gender, occupation and education level

Education level	**Strongly Agree**		**Agree**		**Not Sure**		**Disagree**		**Strongly Disagree**		**Pearson chi-square**
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
Informal	70	29.5	40	20.2	24	55.8	30	44.1	38	70.4	χ^2 =79.775, df
Primary	63	26.6	65	32.8	10	23.3	18	26.5	9	16.7	=16, p=0.000
Secondary	59	24.9	70	35.4	9	20.9	13	19.1	5	9.3	
Tertiary	33	13.9	18	9.1	0	0.0	6	8.8	0	0.0	
University	12	5.1	5	2.5	0	0.0	1	1.5	2	3.7	
Occupation											
Employed	42	17.7	36	18.2	2	4.7	10	14.7	3	5.6	χ^2 =36.080, df
Self employed	92	38.8	92	46.5	19	44.2	33	48.5	14	25.9	=12, p=0.000
Unemployed	103	43.5	66	33.3	22	51.2	25	36.8	37	68.5	
Other	0	0.0	4	2.0	0	0.0	0	0.0	0	0.0	
Age											
Below 20	20	8.4	14	7.1	2	4.7	4	5.9	4	7.4	χ^2 =26.158, df
21-30	119	50.2	79	39.9	17	39.5	23	33.8	19	35.2	=16, p=0.052
31-40	75	31.6	69	34.8	20	46.5	33	48.5	26	48.1	
41-50	20	8.4	28	14.1	4	9.3	8	11.8	5	9.3	
50 and above	3	1.3	8	4.0	0	0.0	0	0.0	0	0.0	
Gender											
Male	166	70.0	133	67.2	31	72.1	38	55.9	28	51.9	χ^2 =10.477, df
Female	71	30.0	65	32.8	12	27.9	30	44.1	26	48.1	=4, p=0.033

4.6.2 Importance of elephants to the community

Results in Table 4.20 showed that 332 (55%) respondents agreed with the statement that elephants were important to the local community while 268 (45%) stated they were not, and this differed significantly (χ^2 =6.827, df=1, p=0.009). When rated in terms of according to age, gender, education level, clusters and occupation of the respondents, respondents gave different views as shown in table 4.19. More males (39%, n=600) agreed that elephants are important to the community while 163 (27.2%) disagreed. 105 (17.5%) females disagreed while 99 (17%) agreed with the statement, and these results differed significantly (χ^2 =57.89, df=1, p=0.016). According to age, the importance of elephants to the community decreased with increase in age (Table 4.20). Overall, young respondents agreed while the old disagreed. Highly educated respondents felt elephants were important to the community than those with lower education level. According to clusters, respondents in PNB and PB agreed while those in FNB disagreed.

4.6.3 Respondents' willingness to support conservation

Results for respondents willing to support conservation showed that most respondents (54%, n=325) were willing to support elephant conservation in the study area while 275 (46%) were not (Figure 4.27). Results showed that there was a significant difference in response to willingness to support elephant conservation (χ^2 =4.167, df =1, p=0.041). According to cluster results, respondents in FNB area did not support elephant conservation as much as respondents in PNB and PB did since only 78 (39%) respondents in FNB cluster agreed while 122 (61%) disagreed. In the PNB 125 (62%)

agreed and 75 (38%) disagreed, while in PB 122 (61%) agreed and 78 (39%) stated no. The results revealed that there was a strong association between importance of elephants and respondents' clusters (χ^2 =27.887, df =2, p=0.000) (Figure 4.27).

Table 4.20: Importance of elephants to the community in relation to age, gender, education level and occupation of respondents

		Yes		**No**		**Pearson chi-square**
		Freq	**%**	**Freq**	**%**	
Gender	Male	233	39	163	27.2	χ^2 =5.789, df=1, p=0.016
	Female	99	17	105	17.5	
Total		**432**	**56**	**268**	**44.7**	
Age	Below 20	26	4	18	3.0	χ^2 =11.540, df=4, p=0.021
	21-30	161	27	96	16.0	
	31-40	109	18	114	19.0	
	41-50	31	5	34	5.7	
	50 and above	5	1	6	1.0	
Total		**332**	**55**	**268**	**44.7**	
Education level	Informal	105	18	97	16.2	χ^2 =13.132, df=4, p=0.011
	Primary	97	16	68	11.3	
	Secondary	75	13	81	13.5	
	Tertiary	41	7	16	2.7	
	University	14	2	6	1.0	
Total		**332**	**56**	**268**	**44.7**	
Occupation	Employed	57	10	36	6.0	χ^2 =7.064, df=3, p=0.70
	Self employed	123	21	127	21.2	
	Unemployed	149	25	104	17.3	
	Others	3	1	1	0.2	
Total		**332**	**57**	**268**	**44.7**	
Cluster	FNB	71	12	129	21.3	χ^2 =47.757, df=2, p=0.000
	PNB	130	22	70	11.7	
	PB	130	22	70	11.7	
Total		**331**	**56**	**269**	**44.7**	

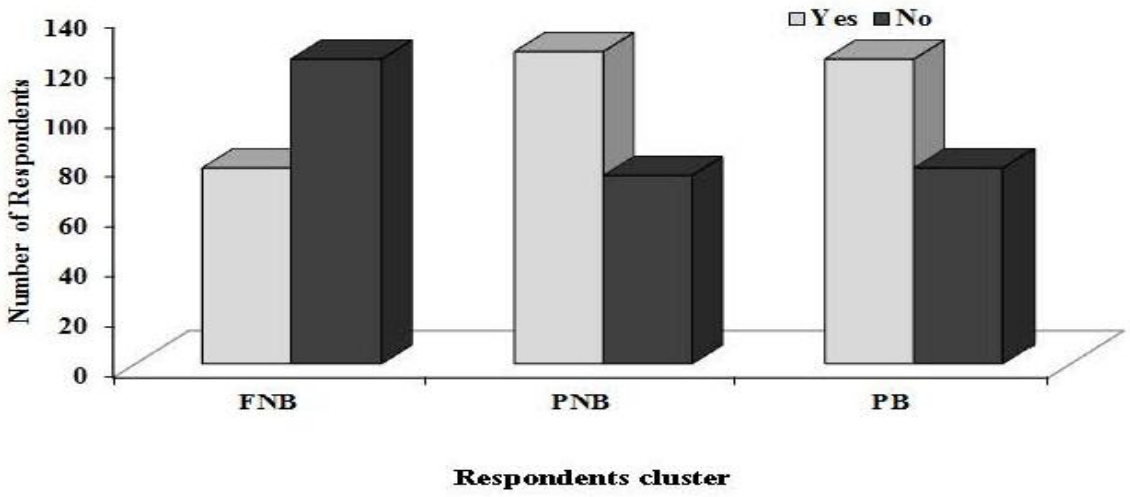

Figure 4.2727: Respondents' wish to support elephant conservation

Respondents' willingness to support elephant conservation in the study area was also compared across gender, age, occupation and education level of respondents and results are presented in Table 4.21. According to gender, more male respondents (34.8%, n=600) were willing to support elephant conservation than the females (19.3%). Results showed that the willingness of respondents to conserve elephants was dependent on clusters (χ^2 =0.905, df =1, p=0.0341).

4.6.4 Importance of elephants to Narok County in general

In relation to the importance of elephant conservation and the local community's willingness to support conservation, respondents were presented with several statements to determine if they agreed or disagreed with the statements, and results are shown in Table 4.22. Most 269 (44.8%) respondents agreed that money from elephants through tourism has helped many schools, has supported many children to get

education/scholarships (49%), has helped to develop infrastructure and social amenities in Narok County (42.8%) and elephant conservation has created employment for the local people (53%). The rest of the responses are shown in Table 4.22. Further, 354 (59%) agreed that income was generated through tourism activities as a result of elephant conservation, income from elephant conservation and tourism has improved local community welfare (43.7%), the future of elephants in Narok County is good/promising (53.5%), and the respondents/local community wish to live with elephants as before (47.3%). With respect to the unemployment, the proportion of those willing to support elephant conservation (21.5%) was nearly similar to those who did not (20.7%). Other responses pertaining to respondents' views are presented in Table 4.21.

Table 4.21: Respondents' willingness to support elephant conservation according to gender, age, occupation and education level

		Yes		No		Pearson chi-square
		Freq	**%**	**Freq**	**%**	
Gender	Male	209	34.8	187	31.2	χ^2 =0.905, df=1, p=0.341
	Female	116	19.3	88	14.7	
Age	Below 20	19	3.2	25	4.2	χ^2 =23.502, df=4, p=0.000
	21-30	116	19.3	141	23.5	
	31-40	136	22.7	87	14.5	
	41-50	46	7.7	19	3.2	
	50 and above	8	1.3	3	0.5	
Education level	Informal	95	15.8	107	17.8	χ^2 =26.573, df=4, p=0.000
	Primary	94	15.7	71	11.8	
	Secondary	106	17.7	50	8.3	
	Tertiary	19	3.2	38	6.3	
	University	11	1.8	9	1.5	
Occupation	Employed	64	10.7	29	4.8	χ^2 =10.755, df=3, p=0.013
	Self employed	131	21.8	119	19.8	
	Unemployed	129	21.5	124	20.7	
	Others	1	0.2	3	0.5	

Table 4.22: Perceived benefits derived from elephant conservation by respondents

	Agree*		Disagree*		No Idea*		Chi-square
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	
Help Schools	269	44.8	251	41.8	80	13.3	χ^2 =108.810, df =2, p=0.000
Scholarships	294	49	230	38.3	76	12.7	χ^2 =125.560, df =2, p=0.000
Infrastructure development	257	42.8	281	46.8	62	10.3	χ^2 =144.270, df =2, p=0.000
Employment	318	53	220	36.7	62	10.3	χ^2 =166.840, df =2, p=0.000
Income generated	354	59	177	29.5	69	11.5	χ^2 =2.070, df =2, p=0.000
Improved welfare	262	43.7	297	49.5	41	6.8	χ^2 =1.927, df =2, p=0.000
Good future for elephants	321	53.5	206	34.3	73	12.2	χ^2 =154.030, df =2, p=0.000
Enhanced co-existence with elephants	284	47.3	279	46.5	37	6.2	χ^2 =1.99, df =2, p=0.000

*Multiple answers given

4.7 Mitigation measures adopted to reduce elephant mortality

Various mitigation measures adopted to reduce elephant mortality in the study area are shown in Table 4.23. The proportion of respondents who at least agreed that there were various mitigation measures that had been adopted to reduce elephant mortality were significantly higher ($p<0.05$) relative to those who disagreed Notable among these are education and awareness to educate community members on the importance of elephant conservation (54.7%, n=600), compensation for all conflict cases caused by elephants (70.7%), equal benefit sharing benefit sharing (69%), translocation (38.7%), harsh penalties to poachers (50.3%) and quick response by KWS to HEC cases (69.8%).

Table 4.23: Mitigation measures adopted to reduce elephant mortality

	Strongly Agree		Agree		Not sure		Disagree		Strongly Disagree		Chi-square
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	
Education and Awareness	328	54.7	136	22.7	56	9.3	44	7.3	39	6	$\chi 2$ =743.083, df =4, p=0.000
Compensation	424	70.7	90	15	25	4.2	49	8.2	12	2	$\chi 2$ =992.050, df =4, p=0.000
Equal Benefit	414	69	135	22.5	19	3.2	18	3	14	2.3	$\chi 2$ =110.2, df =4, p=0.000
Translocation	232	38.7	130	21.7	104	17.3	114	19	20	3.3	$\chi 2$ =191.133, df =4, p=0.000
Harsh Penalty	302	50.3	139	23.2	82	13.7	63	10.5	14	2.3	$\chi 2$ =365.450, df =4, p=0.000
Quick response	419	69.8	95	15.8	28	4.7	25	4.2	33	5.5	$\chi 2$ =959.033, df =4, p=0.000

CHAPTER FIVE
DISCUSSION

5.1 Introduction

Elephant mortalities in NC are due to several factors, among them trophy poaching, conflict (HEC), natural death, accident and euthanasia among others**.** Leading cases such as poaching and HEC have been on the increase and can affect the tourism sector if not taken into consideration (Sitati, 2003). Resident and migratory elephants roam across many parts of NC in search of food, water, shelter and salt licks, and human-elephant conflict do arise during the times of such dispersal (KWS, 2010).

5.2 Respondents' socio-demographic characteristics and their implications on elephant conservation

Although respondents' gender was not dependent on the type of cluster that they came from, male respondents were more willing to support elephant conservation and also viewed elephants as very important wildlife to the community than female respondents; this could be due to the fact that more males are employed in MMNR as rangers and casual workers than females. Most of the respondents were aged between 21-30 years (Table 4.1). Respondents aged 21-40 years were highly willing to support elephant conservation and viewed elephants as important wildlife compared to other age brackets. This could be due to the fact they are able to understand the importance of elephant conservation in the county and nationwide. Informal education level was predominant in the pastoralism benefiting cluster compared to other clusters, the education level reduced as one climbed the academic ladder. The importance of elephants to the local community in NC decreased with an increase in education level and this could have been attributed to

the fact that the educated feel they can still get their livelihood from other sources rather than conservation (Figure 4.1).

The form of occupation had an implication on the attitude and perception of the local community towards elephants and willingness to support conservation. The self-employed and unemployed respondents had a positive attitude towards elephant conservation and were willing to support its conservation. Social economic/land use activity mainly practiced was livestock keeping which was highly evident in all clusters. There was also wildlife on respondent's land and constituted second activity, followed by crop farming. Respondents who practiced crop farming (FNB) were not willing to support elephant conservation as they viewed elephants as crop raiders while PNB and PB respondents were willing.

5.3 Trend in elephant mortality

The proportion of illegally killed elephants (PIKE) increased from 2009 to 2011 than in previous years (Figure 4.5). The increase in PIKE could be attributed to five factors. First, competition for resources like pasture and water between the local community and elephants which resulted in the spearing of elephants (Kasiki, 1998). Elephants congregated mostly on pasture land and water points forcing communities to drive them away. In the process, some elephants are speared or shot with poisonous arrows as a way of discouraging the elephant herd from visiting the site again. Second, lack of alternative community economic livelihoods especially during drought periods can stimulate the communities to kill an elephant for ivory, which is then sold for income. Third, the price

of ivory in the international black market has increased over the years. In 2011 the price of ivory in the black market was about USD 1,800 (Kshs. 151,000) per kilogram (Swara, 2011). This high price is a motivating factor for poachers to kill elephants.

Fourth, the increase in commercial crop farming activity in the study area could have also led to an increase in elephant deaths as a result of conflicts (Sitati, 2003). The County has a lot of immigrants who practice crop farming. They have influenced the local Maasais who are now shifting from practicing pastoralism to crop farming mainly maize, wheat and barley. The Maasai community has leased out big tracts of their land for crop farming and charcoal production. As encroachment on elephant habitats due to an increase in land under crop farming continues, elephants raid crops and in revenge they are killed. Lastly, the issue of benefit sharing could have also contributed to the illegal killing of elephants in Lemek-Ng'osuani area. Some of the local community members in this area have leased their land to Mara West Conservancy for conservation of wildlife. Those who have not leased their land are not part of this conservancy and they feel they are not benefiting from wildlife conservation. In addition, they have cleared their land for crop farming and charcoal production. These results are in agreement with what has been documented in literature reviewed indicating that reduction in elephant habitat has led to increased human-elephant conflicts (Omondi, 1994; Sitati *et al.*, 2003). Therefore, communities kill elephants as they do not realize any benefits from them.

In Sitoka and Olesentu area which comprise Nyakweri forest, the vegetation is thick, and poachers take advantage of the availability of the thick forest cover as they can poach and

retreat without being caught. Poaching in this area takes place mostly at night, and mainly during the rainy seasons (Tobiko *pers. Communication, 2010*) as this makes it difficult for security personnel to access the forest while on patrol. The area also has poor communication network making immediate reports of poaching incidences by phone difficult. More often, incidences of gun shots are reported after over 24 hours due to the poor communication networks. Despite this, there were no elephant deaths due to trophy poaching or conflict recorded in the reserve during the study. This could be attributed to effective policy and law enforcement inside the reserve with regard to elephant management as well as effective security patrols (KWS 1995).

5.4 Spatial-temporal patterns of elephant mortality

Most mortality occurred during the dry season running from January to March. This is the time when there is competition for pastures and water between wildlife and livestock. During the dry season, there are a lot of HEC cases due to competition for pasture and water between wild animals and livestock thus leading to high elephant mortality. Poachers also take advantage of this season as elephants and other wild animals congregate near water points, and this makes it easy for them to kill. During long rain seasons, the distribution of mortality is uniform across NC compared to the dry season.

The vegetation cover and land use activity also plays a significant role in either minimizing or promoting cases of elephant mortality. Results showed that most elephant mortality occurred near or in agricultural areas. These deaths were as a result of HEC following elephants invading farms and raiding crops. They also occurred when crops

were still on the farm and almost ready for harvesting. Conflict was the second most cause of mortality after poaching. A few cases of elephant mortalities occurred in or near forested areas which were poachers' hideouts.

Distances to features such as rivers, roads and human settlements are important in spatial temporal distribution of elephant mortality. Cases of elephant mortality due to poaching and conflict are high near rivers, but decrease with increasing distance from rivers (Figure 4:14, 4.15, and Table 4.12). Poachers take advantage of aggregation of elephants at water points especially during long dry seasons while the local Maasai kill elephants while trying to access water for domestic use and watering livestock. Causes of elephant mortality are frequently recorded near roads, but reduce with increasing in distance from roads (Figure 4.17, and Table 4.13). According to Stile, (2011), the reason for poaching activities being near roads is because poachers want to get tusks and escape before they are caught. Cases of elephant mortality due to conflicts are high near human settlements but reduce with increase in distance from settlement. This could be due to encroachment into wildlife habitats and competition over resources such as water and pasture.

The kernel density analysis depicted Olesentu and Sitoka in TM as hotspot areas for elephant mortality due to trophy poaching. In Narok, moderate poaching sites were Narosura, Lemek, Ntuka and Olontoto. The hotspot site for mortality as a result of conflicts was in Lemek and Sitoka. Sites with moderate mortality due to conflicts were Siyaipei, Olesentu and Ewaso-nyiro (Figure 4.20). The difference in mortality rates could have been due to the nature of land use activity practiced here and benefit sharing

especially in Lemek area as indicated in literature review where conflict cases are high in areas with little benefits (Kaelo, 2008).

5.5 Causes of elephant mortality in Narok County

Elephant population in NC has increased as evidenced from the local community responses (Table 4.15).The population of elephants in Majimoto within the PNB area is high, although, the local community could not establish the exact number. As a result of the increase in elephant population in this area, there have been increases in human-elephant conflicts. These include blocking children from going to school in the morning and returning home in the evening. Most children go to school from 9am and leave school as early as 3pm to avoid elephants. During the study period, schools were almost closed in Majimoto due to elephants hindering movements of pupils to and from school. Consequently, as documented by Sitati, (2003), education standards in the area have declined because of increased absentism for fear of attacks from elephants.

In Lolgorian area in TM District, community members reported that the population of elephants keeps fluctuating depending on the season of the year. During the harvesting period, cases of crop raiding by elephants are very high, and this is the period when the population of elephants is high and chances of elephants being killed by the local community are also high. Elephants are not seen during the day as they hide in thick forests and only come out at night or during daytime when there are rains to raid crops (Sitati, 2003). However, with an increase in human population, the number of elephants could decrease in Lolgorian area due to the demand for land for cultivation and

settlement. Besides, forests are being cleared through timber logging and charcoal burning activities to create space for agriculture and settlement. This has either degraded or destroyed elephant habitats thus making them susceptible to human attacks and poaching as they move in search of water, food and safer place (Mpanduji *et al.*, 2002; Musiega and Kazadi, 2004).

The population of elephants in Siyaipei an FNB area is high, but the local community could not establish the exact number. The number of elephants in the area also depends on the time (month) and season of the year although most of them are resident and have been in the area since 1982. Although, there was a time when they were driven away by KWS using a helicopter, they came back after a short period. During harvesting periods, the population is estimated to be 200 elephants and above and they move in large herds causing crop destruction. Before harvesting, the population is scattered all over the area but as harvesting season nears, they converge on the farms. As a result of the increase in elephant population in Siyaipei area, there have been also increases in human-elephant conflicts, to the extent that there was a time when an elephant used its trunks to snatch ugali from a Manyatta (Kool *per comm.* 2011). According to local communities' views, the increase in HEC is positively correlated with the apparent increase in their population.

Ottichilo (2000) reported that elephant population in NC has remained stable since 1984. However, Dublin *et al.*, (1997) predicted that elephant population is expected to increase by 5% a year in good environmental conditions, implying that elephant numbers were likely to go up. However, since fewer large males remained after poaching (Lewis, 1984;

Poole, 1989), this could have affected the breeding status of the Mara elephants. Equally, land use change and poaching regulates changes in population rather than natural control (Dublin *et al.*, 1990). According to results of aerial and dung count elephant census carried out by KWS and WWF respectively; the population of elephants in NC has increased from about 1000 in 1980 to above 2,000 elephants in 2010 (KWS, 2010). The population has also increased nationally despite the many challenges that face its conservation.

A comparison between the old TM and Narok Districts showed that, Narok district had more cases of elephant mortalities than TM, and this could be due to the fact that the old Narok was larger in size and experienced more dry periods than TM, more benefit sharing schemes, and more changes in land use activities among other factors.

The highest percentage of carcasses recorded in Narok District were either elephants that caused HEC or those poached males and big bulls, and this could be due to poachers targeting elephants with large tusks. There were cases whereby the sex of the carcass could not be identified due to decomposition. This happened especially in cases where elephants had been killed by poisonous arrows or spears and the carcass decomposed so fast due to the poison. The blood oozing out of the decaying wound was black in colour. It was established from interviews with the local community that a plant that is used to prepare the poison was known as the arrow poison tree (*Acokanthera schimperi)* (Plate 5.1) of the family of Aponcynaceae and genus Acokanthera, and referred to as "loliondo or olmorijoi" by the Maasai. It is used to prepare poison for the arrows that are used to

kill wild animals. Easy access to this plant has made poison extracted from it easily available thereby accelerating its use in killing the elephants, thus enhancing elephant mortalities in recent years.

Plate 5.1: *Acokanthera schimperi* tree used to make poison to kill elephants

(Source: Author, 2011)

Various causes of elephant mortality were recorded in NC during the study, with the highest percentage being due to illegal killings resulting from trophy poaching and conflicts. These causes could be due to various factors such as NC boardering the Republic of Tanzania which has been proposing the hunting of elephants and change of land use from pastoralism to farming thus increasing HEC. As pastoralism is being gradually replaced with an agro-pastoralist lifestyle in many areas within the county, elephant ranges are reduced due to farming resulting in resource competition and

conflicts (KWS, 1995). These conflicts threaten the survival of wildlife, especially elephants, outside protected areas (PAs) (Sitati, 1997; 2003). Crop damage, livestock predation, loss of land to conservation, and lack of control over wildlife resources cause negative attitudes towards wildlife (Asibey and Child, 1990).

During FGDs, the main causes of elephant mortality identified were poaching and conflicts. Poaching occurs in forested areas or areas bordering the forests and near water points. The local community remarked that *"If not controlled, poaching in NC can kill the goose that lays the golden eggs. We ask for vigilance from security personnel and communities for it to be eliminated,"* (Sammy Nkoitoi, the chairman of Siana Wildlife Conservancy). Other causes that were highlighted include: problem animal control (PAC), natural, bulls fighting, snares and poison.

5.6 Attitudes and perceptions of the local community towards elephants

The future of elephants in the study area depends on several factors among them the local communities view that they should benefit from conservation activities to enhance appreciation, the community should be compensated for the costs incurred from living with wild animals on their farms, being given food by the government so that they do not clear their forests for farming, providing good security in the area to arrest the poachers and above all providing education and extension services to the community to enhance local awareness about elephant conservation and benefits accruing from its conservation. From the findings, it was evident that the future of elephants is bleak if these critical issues are not addressed.

Depending on the social-economic activity practiced in the areas sampled, there was a difference in the local community's willingness to support elephant conservation. In the FNB cluster, most respondents did not support elephant conservation, and they viewed elephants as not important wild animals because they raided their crops while in PNB and PB clusters most respondents' supported elephant conservation (Figure 4.27), as they still have a chance of forming group ranches and conservancies.

Most respondents reported not benefiting directly from elephant conservation since they are far from MMNR. They contended that it is only people living near MMNR that benefit directly. As a result those who do not benefit directly wished that benefits accrued from conservation of wildlife and in particular elephants should be shared equally since they also incur the costs of living with wild animals on their lands. The foregoing sentiments were eloquently captured by FGD participants. Mr. Saruni Selelo in a FGD meeting asserted that *"the roads are so bad in the County, yet we have a lot of resources that generate good revenue to the country"*.

Some respondents viewed elephants as important wild animals and wished to support their conservation. They had various reasons for supporting elephant conservation which included: money from elephants through tourism has supported the construction of many schools; many children get education/scholarships and promote development of infrastructure and social amenities in NC. In addition, elephant conservation has created employment for the local people, there is income generation through tourism activities as

a result of elephant conservation, and income from elephant conservation and tourism has improved local community welfare among other reasons. This agrees with views by Sitati, (2003) and Omondi *et al.*, (2004) on mitigation of human-elephant conflict.

Local community members in Siyaipei and Ang'ata, an FNB area, have an antagonistic attitude towards elephants because they do not benefit at all from elephant conservation. They stated that many studies have been done in the area and reports written but nothing has been done. Given a chance they contended that they can clear all elephants in one month or clear all forests to drive out elephants. From the FGDs, it was reported that KWS staff threaten people when an elephant is killed not knowing that the community only kills an elephant if it has killed someone or in self-defense. In spite of the challenges that face the conservation of elephants, the local community in NC has a positive attitude towards elephant conservation and they felt that elephants are important to the community and they are ready to support their conservation.

5.7 Mitigation measures to minimize elephant mortality

Respondents mentioned various measures adopted to mitigate elephant mortality particularly those due to HEC. Among these are traditional measures aimed at controlling problem elephants such as using watch towers to see elephants from a distance, shouting, beating drums, burning tobacco at night to scare elephants away and planting crops early. Respondents ranked several mitigation measures which can help reduce the number of elephant deaths and promote their conservation, most respondents either strongly agreed

or agreed with the mitigation measures that were provided. This finding concurs with that of Sitati and Walpole (2006).

Education and awareness, which was ranked top is an important tool in the conservation and management of wildlife and is enhanced in the study area by NGOs like WWF, Friends of Conservation (FOC) and IFAW in collaboration with KWS to arouse awareness about HWC, HEC and other issues related to conservation. For instance, the WWF Elephant Project in TM has been conducting football tournaments (Plate 5.2), and drama, as well as poems and skits competitions (Plate 5.3) in primary schools within elephant ranges to disseminate conservation messages. However, there is a need to initiate more education and awareness activities to be initiated among the local community especially in FNB blocks about elephant needs and behaviour in particular feeding, home range, migration and breeding patterns. This will help curb high cases of HEC and elephant mortality resulting from HEC.

Plate 5.2: A teacher from Olopikidong'oe Primary School disseminating conservation information to participants during Ndovu cup tournament

(Source: Author, 2011)

Plate 5.3: Mutenkuar Primary pupils act a skit on elephant conservation during the Ndovu cup drama competition in 2009

(Source: Author, 2011)

Although the compensation process takes a lot of time, and the money paid for injury and death is inadequate, currently these figures stand at Kshs. 50,000 for injury and Kshs. 200,000 for death. There is also lack of payment for livestock death and injury and crop and property destruction which does not augur well with the community and this has eroded the potential for cooperation and collaboration between the government and the local people. Lack of compensation has also led to antagonistic attitudes and the view that elephants are vermin and a liability. Some form of compensation and incentives will make the community appreciate elephants and it can also make them stop clearing forests for agriculture and spearing elephants with poisonous arrow as a way of revenge especially when they destroy properties that are not compensated. Compensation to all HEC cases and incentives can make the community appreciate elephants.

There are very little or no benefits accruing from wildlife resources that are passed to the community and this has contributed to the local Maasai having negative attitudes and perceptions towards wildlife especially elephants. This has in turn led to alleviated human-elephant conflict whereby the community is no longer able to tolerate the costs of living with elephants and therefore kills them whenever they destroy their property. There has also been the development of social amenities and infrastructure, and employment of the local members as a result of conservation. Despite this, more needs to be done to change the community's attitudes and perceptions towards conservation.

As Sitati (2003) has contended, the negative attitudes developed by the local community towards elephants are as a result of lack of wildlife-related monetary benefits. This can,

however, be corrected by initiating entrepreneurial activities that can generate income for the local community to offset the costs incurred, and at the same time discourage land use activities that are incompatible with elephant conservation. If the benefits that accrue from elephants are shared with the local community equally there will be change in attitudes and perceptions even in the FNB cluster thus supporting its conservation, and this will reduce elephant mortality.

Some community members have leased out their communal land to conservancies such as Mara West Conservancy, Enoonkishu, Siana for conservation of wildlife, and in return they are paid although they feel that the amount that they are paid is too little since the country's cost of living is so high. However, the establishment of more conservancies and or sanctuaries in the area for elephants and other wild animals is viewed as a better place for conservation. The findings, established that communities living near conservation areas were more positive towards elephant conservation.

Community conservation is a participatory process between people and organisers who have rights and responsibilities affecting conservation (Sitati, 2003). It leads to better planning and more benefits for communities, which encourages more interest and participation in conservation. Traditionally, managers of PAs concentrated on law enforcement to protect natural resources. The government restricted resource use by local communities and controlled revenue from tourism. However, this approach suffered a major setback since communities that live around PAs often developed a negative attitude towards conservation due to competition for resources like water, land and pasture (Sitati

2003). The long term survival of PAs depends on the approval and goodwill of local communities. The principle behind community conservation programmes is to integrate the use of natural resources with rural development by channelling some benefits from resource use to socio-economic development of local communities. Local communities should hence participate as partners in the management of natural resources both within and outside PAs. For conservation efforts to succeed, they must embrace the socio-economic and cultural values of local community, and KWS established Community Wildlife Service (CWS) with a view to involve local communities in the management of wildlife.

Other mitigation measures that were suggested during FGDs include: translocation of elephants to safer/protected areas like MMNR (Plate 5.4), which may be not only expensive, but a lot of considerations like habitat, genetic, mortality risk, security and veterinary services have to be put in place first.

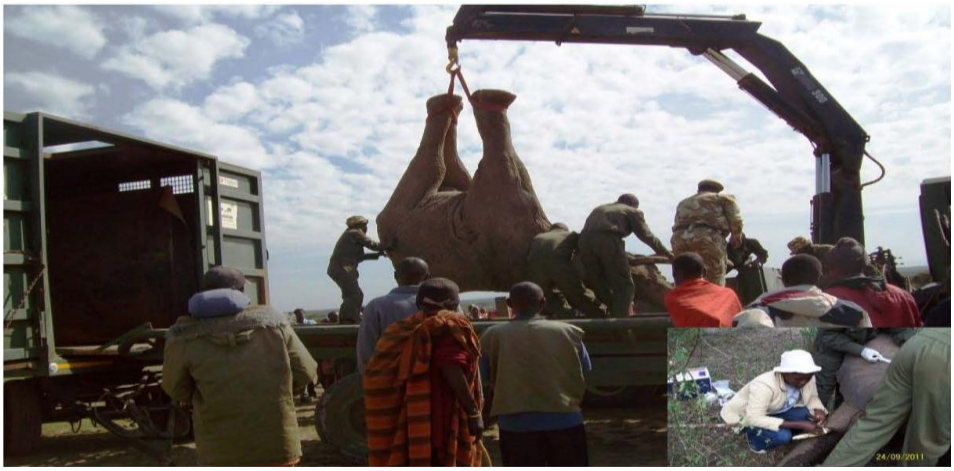

Plate 5.4: Translocation of elephants from Siyaipei area to MMNR
(Source: Author, 2011)

To reduce cases of elephant mortality as a result of conflicts and poaching, the local community feels that KWS should provide rangers to guard crops and the community throughout the year and offer tight security in the area to arrest poachers who are believed to come from the neigbouring country (Tanzania) and introduction of harsh penalties to these poachers.

Local community members also suggested that KWS, NCC and TCC should transport pupils to school in the morning before a long term solution like the establishment of more boarding schools in the study area is found to reduce cases of pupils being attacked by elephants while on their way to and from school in the morning and evening. Establishment of a KWS outpost in areas like Siana to improve elephant security and provide a quick response to HEC cases can also reduce cases of mortality especially when an elephant has injured or killed someone, provision of water points in areas with deficiency to reduce pressure on the existing ones, as well as minimizing competition with humans and livestock during long drought.

Lastly, FGD members suggested that KWS should employ more rangers and also recruit more community scouts in hotspot areas like Sitoka and Olesentu in Transmara District and Lemek and Aitong in Narok District to assist KWS in carrying out patrols. Scouts to be trained by KWS in handling ammunitions and general wildlife management principles so that they can help in offering security, carry out patrol and general wildlife management activities in NC.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

During the dry season, there are a lot of elephant mortality cases particularly when there is competition for pastures and water between wildlife and livestock thus leading to many HEC cases. During long rain seasons, the distribution of mortality is uniform across NC compared to the dry season. The vegetation cover/land use activity also plays a major role in the cases of elephant mortality, most mortality occurred near or in agricultural areas. The kernel density analysis showed that Olesentu and Sitoka in TM District, and Lemek in Narok District as hotspot areas for elephant mortality due to trophy poaching.

Elephant mortality due to poaching and conflict has escalated in recent years, confirming that it is a serious issue in NC. Mortality is not restricted to specific geographical regions or climatic conditions but is common in all areas where elephants and dense human populations have to coexist and share limited resources.

More male elephants died compared to females. This could mean that either poachers target large males for their big tusks or they are the most conflict causing compared to female elephants. Most mortality cases were recorded in the old Narok District and this could be due to the size of the district compared to the TM side, poor state security, increased land use activities which are not compatible with elephant and wildlife conservation, and lack of benefit sharing among other factors.

This research has shown that although there are various causes of elephant mortality in NC, the most common causes that are likely to threaten the future of elephants in the County are poaching and conflict (illegal killing). There has been an increase in elephant population since the ban on trophy hunting in Kenya. However, increase in elephant population means an increase in HEC cases and more mortality as people have encroached on elephant habitats.

Increase in the PIKE between 2009 and 2011 could be attributed to factors such as increased prices of ivory, and increased demand in Asiatic countries. Most illegal killings take place outside MMNR and in forested areas like Nyakweri and Laila which provide cover and act as suitable hideouts for poachers as well as providing easy escape. Human habitation in Aitong and Lemek areas has contributed to increased elephant mortality as elephants compete with humans for limited resources. The influx of immigrants who are less conservation-oriented in NC has further exacerbated this problem.

Social-economic activities undertaken play a very big role in shaping or influencing the attitudes and perceptions of local residents alongside the benefits accrued from conservation. There is a difference in the local community's willingness to support elephant conservation in the three clusters sampled. In the FNB cluster, most respondents did not support conservation, as they viewed elephants as crop raiders, unlike in PNB and PB clusters where majority of the local respondents supported elephant conservation. Most respondents did not benefit directly from elephant conservation, and if they benefit equally and directly they will be ready to share land resources with elephants.

To address the main cause of elephant mortality due to illegal killing and the negative attitude in the FNB cluster, several mitigation measures were highlighted. Notable among these are equitable benefit sharing, and education and extension services on elephant conservation and its importance to the community. The latter is critical to arousing local peoples' conservation awareness as well as appreciation of elephant conservation.

6.2 RECOMMENDATIONS

6.2.1 Recommendations for Policy makers

Accelerated conflicts have been witnessed in Narok and other areas with abundant wildlife such as Samburu, Taita, Laikipia and Kwale due to intensified land use, fragmentation and the development of farming activities that are incompatible with conservation. The future of elephants in NC depends largely on how the local community utilizes their land and non-Maasais migrate and settle into the ecosystem. To control land use and migration in NC, there is a need for the government of Kenya to develop clear land use policy that can reconcile and harmonize divergent land use activities and practices for conservation. This will also curb the issue of shrinking wildlife habitats/ species habitat loss especially in areas like NC ecosystem where wildlife habitats have greatly reduced due to the Maasai community leasing out land to non Maasai communities from other districts for agricultural purposes. Increase in human population has led to encroachment on wildlife habitats leading to forests being cleared for settlement and arable farming.

The government should establish more boarding schools to reduce cases of pupils being attacked by elephants while on their way to and from school. There is need to intensify efforts to promote conservation awareness among school going children through drama. The Ndovu football tournament promoted to inculcate conservation values in pupils and change their attitudes and perceptions. Bursaries funded from NCC and TCC revenue should be given to needy, poor and deserving pupils to ensure they get admission in school.

6.2.2 Recommendations for management

There is need to increase the 19% community wildlife benefit sharing dividend from MMNR through support for more schools, hospitals and other social amenities using finances from conservation. This will endear communities to wildlife conservation, and win more wildlife space through the establishment of community based conservancies. It will also ensure that wildlife is conserved and communities will develop alternative livelihood activities like eco-tourism that are more compatible with conservation. Ecotourism will be an incentive for landowners not to convert land into farming; logging and charcoal production activities should be discouraged, and will promote livestock and wildlife as alternative land use options to cultivation. This should be complemented with translocation of elephants from conflict zones in order to mitigate human-elephant conflict and reduce elephant mortalities.

Both NCC and TCC should initiate and support alternative community-based tourism activities such as bird watching, horseback safaris and escarpment climbing in the forest and the escarpment to ensure the flow of benefits from wildlife-related activities.

Some of the existing KWS stations and outposts should be relocated, to high conflict zones, establishment of temporary stations or a mobile HEC mitigation unit that could be deployed to front line areas during high conflict seasons for rapid response. The unit should be provided with a motorbike, handset radios, powerful torches, enough ammunition and other necessary equipment. The management should train and utilize game scouts and retired military personnel in elephant areas to assist in carrying out patrol work. Besides minimising the cost of hiring more rangers, these measures will promote community policing.

6.2.3 Recommendations for further research

In areas like Lemek, Aitong, Olesentu and Sitoka, where there are high cases of elephant mortality due to illegal killing, more research needs to be done to determine the best mitigation measures to curb mortality and improve local communities attitude towards elephant conservation.

Research on the impact of climate change on elephant conservation should also be carried out to establish how it contributes to elephant mortality especially when this study area experiences long droughts like in the year 2007.

The attitudes and perceptions of the local community change over time depending on various factors among them mitigation measures employed. Therefore, there is need for further research on the attitudes and perceptions of the local community towards elephant conservation in Siyaipei area since KWS is currently carrying out translocation of elephants to MMNR.

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APPENDICES

APPENDIX I: FOCUS GROUP DISCUSSION GUIDE QUESTIONS

1. How many elephants are in this area?
2. Has the population of elephants been increasing or decreasing and why?
3. Have there been any cases of elephant death in the past one year?
4. What are the main causes of elephant death in this area?
5. What are your views towards elephant mortality in this area?
6. What measures can be put in place to minimize elephant mortality?
7. Do you benefit from elephant conservation?
8. What is the future of elephants in this area?

APPENDIX II: QUESTIONNAIRE FOR THE COMMUNITY

Questionnaire No…..….. Division……..... Date.....

I am Elizabeth Wakoli, a student undertaking a Master of Science Degree in Wildlife Management at Moi University, Eldoret. I am undertaking this research as part of the partial fulfillment for my Masters Degree. This research is aimed at determining elephant death in NC. Any information provided will be highly regarded as confidential and used only for academic purposes.

SECTION A: PERSONAL DETAILS

(Tick the appropriate box or fill in the blank spaces)

1. What is your gender?

[ ] Male [ ] Female

2. What is your age bracket?

(i) [ ] Below 20 **(ii)** [ ] 21-30 **(iii)** [ ] 31-40 **(iv)** [ ] 41-50 **(v)** 51 and above

3. Level of education:

(i) [ ] Informal **(ii)** [ ] Primary **(iii)** [ ] Secondary **(iv)** [ ] Tertiary **(v)** [ ] University

4. Occupation:

(i) [ ] Employed **(ii)** [ ] Self-employed **(iii)** [ ] Un employed **(iv)** [ ] Any other

5. Residence by:

(i) Birth **(ii)** Immigrant

6. What forms of land use activity do you practice? **(Tick appropriately)**

Activity	**Agree**	**Disagree**
(i) Agriculture/farming		
(ii) Livestock keeping		
(iii) Mining		
(iv) Wildlife		
(v) Any other (specify)		

SECTION B: CAUSES OF ELEPHANT MORTALITY

7. How is the population of elephants in this area?

(i) [ ] Increasing **(ii)** [ ] Decreasing

8 (a) Have any elephants died in this area in the last one year?

(i) [ ] Yes **(ii)** [ ] No

9. How many have died in the last one year?

(i) [ ] None **(ii)** [ ] 1-3 **(iii)** [ ] 4-6 **(iv)** [ ] 7-9

(v) 10 and above

10. What are the causes of elephant deaths? (Tick appropriately)

	Causes	**Agree**	**Disagree**
a	Poaching		
b	Snares		
c	Poison		
d	Killed by KWS rangers		
e	During defense by people/conflict		
f	Fighting among themselves		
g	Unknown cause		
h	Any other specify		
I	Natural		

11. State some of the methods used by the community members to control problem elephants

……

……

SECTION C: ATTITUDES AND PERCEPTIONS TOWARDS ELEPHANTS

Tick (√) in the blank space or tick appropriate boxes

12. Elephants are important wildlife?

(i) [ ] Strongly Agree**(ii)** [ ] Agree **(iii)** [ ] Not Sure **(iv)** [ ] Disagree

(v) Strongly Disagree

13 (a) Are elephants of any importance to the community?

(i) [ ] Yes **(ii)** [ ] No

(b) Explain why……

14. Please indicate whether you agree or disagree with the following statements

	Agree	**Disagree**	**No idea**
(a) Money from elephants (tourism) has helped many schools			
(b) Money from elephants (tourism) has supported many children to get education/ scholarships			
(c) Money from elephants has helped to develop infrastructure and social amenities in the district			
(d) Elephant conservation has created employment for local people			
(e) Income through tourism			
(f) Income from elephant conservation and tourism has improved local community welfare			
(g) The future of elephants in NC is good/promising			
(h) I wish to continue living with elephants as before			

15. (a) Do you support the conservation of elephants in this area?

(i) [ ] Yes **(ii)** [ ] No

(b) If Yes or No explain why……

16. (a) What are the effects of elephant death in this area?

Mitigation	**Agree**	**Disagree**	**No idea**
(a) Revenue from tourism will be low/little			
(b) Little employment opportunity to local community			
(c) Poor living standards of the local community			
(d) No cases of Human-elephant conflict			
(e) No effect at all			

(b) State any other effect

i. ……

ii. ……

SECTION D: MEASURES TO MINIMIZE ELEPHANT MORTALITY

Tick (√) in the blank space or tick appropriate boxes

17. (a) What measures can be put in place to minimize elephant mortality in this area

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Education and awareness to the community					
Compensation for all conflicts caused by elephants					
Benefits from elephant conservation to be equally shared among community members					
Translocation					
Harsh penalty to poachers					
Quick response to human-elephant conflict cases by KWS					

(b) Any other measure…….

APPENDIX III: GUIDE QUESTIONS FOR KEY INFORMANTS

1. How many elephants are in this area?
2. Has the population of elephants been increasing or decreasing and why?
3. Have there been any cases of elephant death in the past one year?
4. What are the main causes of elephant death in this area?
5. Elephants are important wildlife?
6. Are elephants of any importance to the community?
7. What is the future of elephants in this area?
8. Do you support the conservation of elephants in this area?
9. What is your view on elephant mortality in this area?
10. What measures can be put in place to minimize elephant mortality in this area?

APPENDIX IV: MONITORING SHEET FOR ELEPHANT DEATHS IN NAROK COUNTY

Scouts Name…… Location……Form No……

District…… Division……. Area……..

Date	GPS X-Coo	GPS Y-Coo	Carcass*	Cause of Death	Sex*	Tusks*	Comment on reasons/Motivation for killing

- **Carcass:** 1: Fresh, 2: Recent, 3: Old, 4: Very old
- **Cause of death:** 1: Natural 2: Illegal/poaching 3: Killed by KWS 4: Unknown
- **Sex:** 1: Male, 2: Female, 3: Unknown
- **Tusks:** 1: Intact, 2: Chopped out, 3: Pulled out 4: Naturally absent