

CAUSES AND MITIGATION MEASURES OF ELEPHANT (*Loxodonta africana*) MORTALITY IN NAROK COUNTY, KENYA

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ABSTRACT

Narok County supports a large number of elephants both in the protected area and the adjacent dispersal areas. Despite this, the ecosystem is undergoing a tremendous transformation that may be detrimental to the survival and conservation of elephants. Incidences of increasing elephant deaths are common. This study therefore aimed at identifying the causes of elephant mortality, rank these causes and find out the possible mitigation measures. Data were collected from field monitoring of elephant death incidences, questionnaire surveys, focus group discussion and interviews. Statistical Package for Social Sciences (SPSS Version 18) was used during data analysis. In this study, a 0.05 level of significance was used to determine the relationship between various data categories. The results showed that the total number of elephants that died between September 2010 and October 2011 due to trophy poaching, conflicts, unknown reasons, euthanasia, natural cause, control, and accidents were significantly different ($\chi^2 = 35.161$, $df = 6$, $p < 0.001$). More elephant deaths were as a result of trophy poaching (45%) followed by conflict (29%); natural (10%), accident (7%) and the least were control, euthanasia and accidents (3%), respectively. We conclude that trophy poaching is the main cause of elephant mortality. Hence, stringent anti-poaching measure should be employed including regular patrols as well as incorporating local communities in elephant conservation. Appropriate conflict mitigation strategies should be employed among other strategies like benefit sharing, awareness raising through education and extension, fencing of intensive farming areas, compensation, among other strategies.

INTRODUCTION

The average life span of an elephant is 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 among other causes of elephant mortality.

In Africa, it has become increasingly significant as human populations expand and encroach on elephant habitat (Hoare and du Toit, 1999; Hoare, 2000), and as elephant populations expand from protected refuges into unprotected historical range conflicts continue to accelerate. 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). 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). HEC is especially prevalent in areas of cultivation where crop raiding is the most widespread problem for example in NC.

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). 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.

Elephants can have profound impacts on the ecosystems they occupy, as well as other species. These impacts could be ecological, economic and or cultural, for instance 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).

MATERIALS AND METHODS

Study Area

The study was undertaken in Narok County, which lies on the south-western part of Kenya. The county consists of the famous Maasai Mara and Transmara ecosystems. It covers an area of about 17,987 km². The temperatures range from 5°C to 28°C. Long rains occur between February and June, while short rains occur between November and December. The mean annual rainfall is about 1500 mm.

Land ownership in Narok County falls under three categories; communal land, group ranches, and individual land holdings. The increasing human population, the need to raise capital and the fear of marginalization by stronger group has resulted to individual land holdings in the county (Kituyi 1990). The main land uses in the county include semi-nomadic pastoralism, arable farming, sedentary livestock rearing, wildlife conservation and forestry. Pastoralism is the main source of livelihood for the Maasai community.

The moderate climatic conditions and moderately fertile soils have resulted to increase of area under crop farming. These conditions support the production of cash and food crops, as well as fodder for livestock.

Research design

The research was descriptive whereby a description for a certain opinion was explored or examined so as to use the information generated to infer about the entire population from which the sample is drawn. Two study population included elephant and local people, all elephant deaths cases from 2000 to 2011 were collected from KWS OB and WWF-HEC project reports. Sample size target of 600 respondents were supplied with the questionnaires after being classified into three clusters of Farmers not benefiting (FNB), Pastoralists not benefiting (PNB) and pastoralists benefiting from conservation (PB).

There was field monitoring of elephant death incidences whereby any dead elephants found during the course of fieldwork was recorded. Primary data were generated using questionnaires, Focus group discussions, key informants, and interviews and monitoring. The questionnaires were distributed to local community members to gauge their opinion on causes of elephant death.

Monitoring data collected included that on the locality where death occurred, date of death, geographic location, and cause of death and sex of the carcass. Causes of elephant mortality were categorized as poaching, control, conflict, accident, natural, euthanasia, and unknown. The state of the carcass was recorded as fresh (Immediately-seven days old carcass), recent (two-three weeks old), old (Four weeks old) very old (Five weeks and beyond).

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. In this study, a 0.05 level of significance was used to determine the relationship existing between data categories and drawing conclusions about the research. Statistical testing for this study was performed only on those variables that answered the stipulated objectives. Results are presented in form of maps, figures and tables.

RESULTS

Respondents' view of state of elephants' population

Most of the respondents interviewed feel that the population of elephants in the study area is increasing 498 (83%) while only 102 (17%) feels that the population of elephants is decreasing ($\chi^2 = 261.360$, $df = 1$, $p = 0.000$). However, according to clusters, most FNB 173 (86%) respondents feel that the population is increasing while 27 (14%) feel that the population of elephants is decreasing ($\chi^2 = 1.066$, $df = 1$, $p = 0.000$), PNB 171 (85%) respondents feel that the population is increasing while 29 (15%) feel that the population is decreasing ($\chi^2 = 1.008$, $df = 1$, $p = 0.000$) and in PB Cluster 154 (77%) respondents feel that the population is increasing while 46 (23%) feel that the population is decreasing ($\chi^2 = 58.320$, $df = 1$, $p = 0.000$).

Table 1: The state of elephant population and respondents' witness of elephant death

	Description	FNB		PNB		PB		Chi-square
		Freq	%	Freq	%	Freq	%	
Population State	Increasing	173	86	171	85	154	77	$\chi^2 = 261.36$, df = 1, p=0.000
	Decreasing	27	14	29	15	46	23	
Elephant death	Yes	59	29	81	40	85	42	$\chi^2 = 37.500$, df = 1, p=0.000
	No	141	71	119	60	115	58	

From field monitoring and observation during the study period, several cases of elephant death were reported. Narok district had 27 (71%) elephant death cases while TM District had 11 (29%) cases only.

Causes of elephant deaths in 2011

The total number of elephants that died from September 2010 to October 2011 due to trophy poaching, conflicts, unknown reasons, euthanasia, natural cause, control, and accidents were significantly different ($\chi^2 = 35.161$, df = 6, p < 0.000). More elephants deaths were as a result of trophy poaching 14 (45%) followed by those that died by conflict 9 (29%), natural death 3 (10%), accident 2 (7%) and the least were problem animal control, euthanasia and accidents with 1 (3%) cases (Figure 1 and 2). The proportion of illegally killed elephants (PIKE) for September 2010 to October 2011 was 74%.

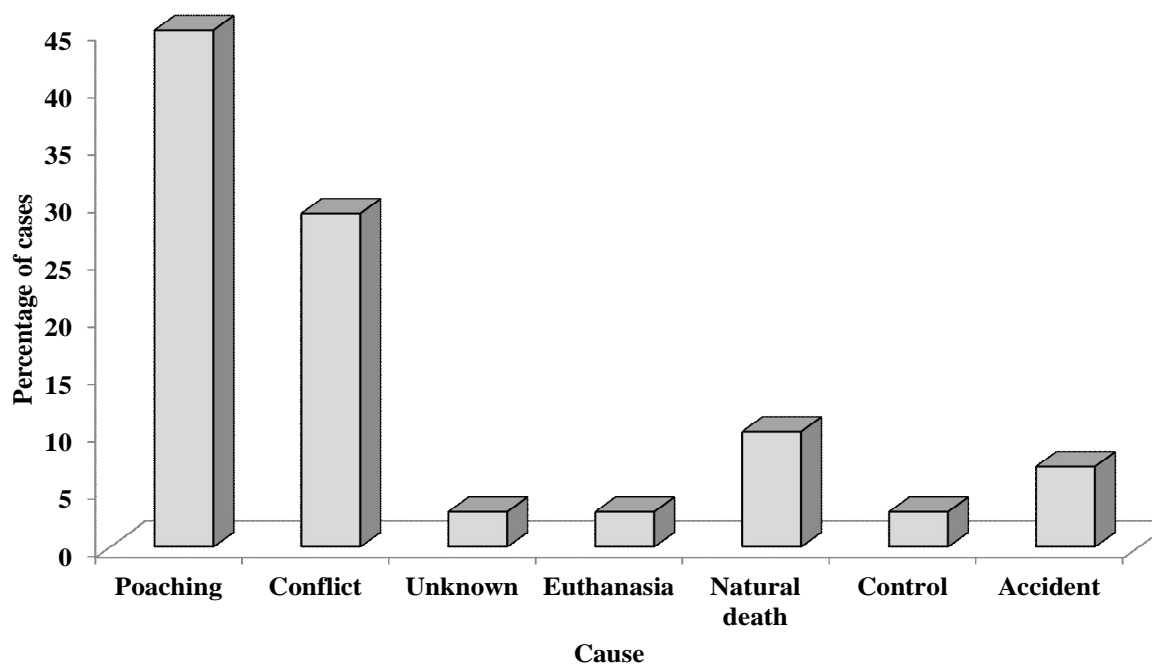


Figure 1: Causes of elephant death

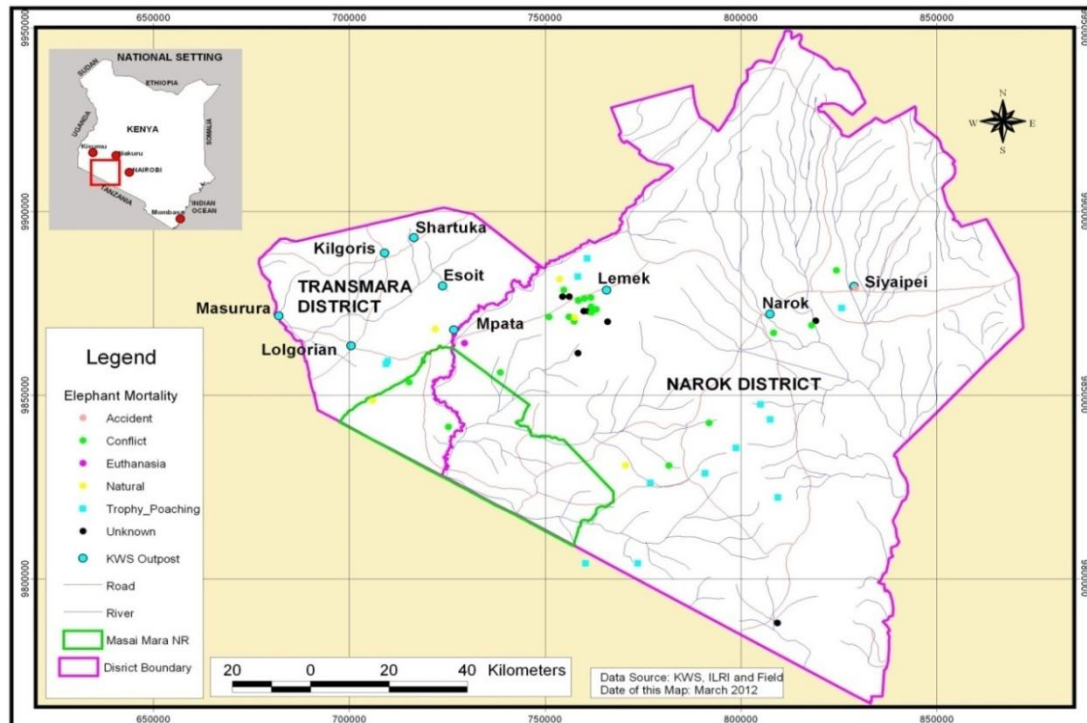


Figure 2: Distribution of elephant mortality in relation to causes for 2011

Sex of elephant carcass identified

In general male elephant carcasses were highly recorded 26 (68%), unknown gender carcasses 7 (18%) and the least was female with 5 (13%) cases. There was no significant difference in the sex of carcasses recorded in the whole study area ($\chi^2 = 21.211$, $df = 2$, $p = 0.000$). According to districts, Narok had the highest percentage of male elephant carcasses 20 (74%), followed by unknown with 5 (19%) and lastly female elephant carcasses were 2 (7%). In TM District male elephant carcasses were leading with 6 (55%) followed by female 3 (27%) and finally unknown had 2 (18%)

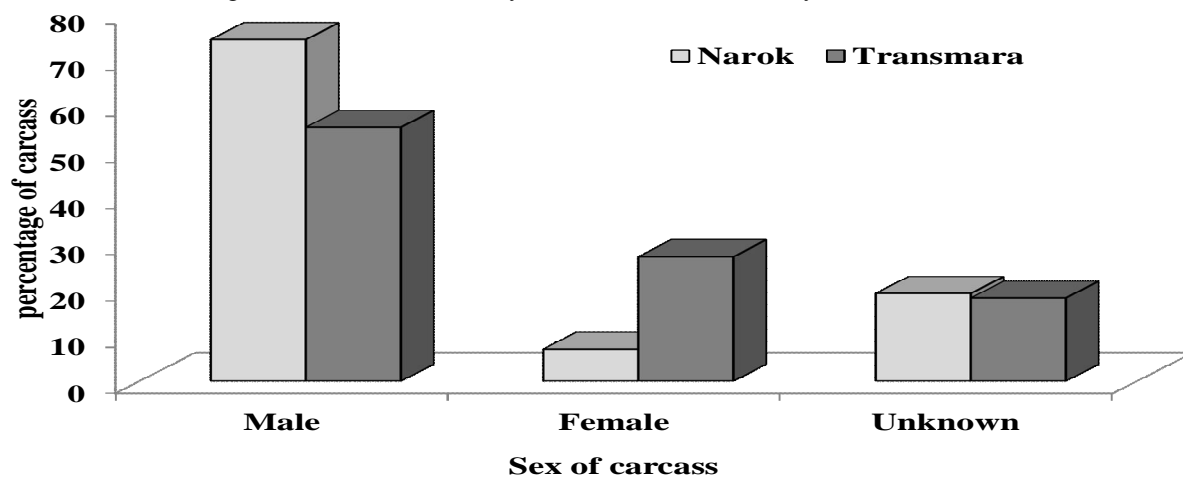


Figure 3: Sex of elephant carcass identified

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 ($\chi^2 = 2.364$, $df = 2$, $p = 0.0307$)

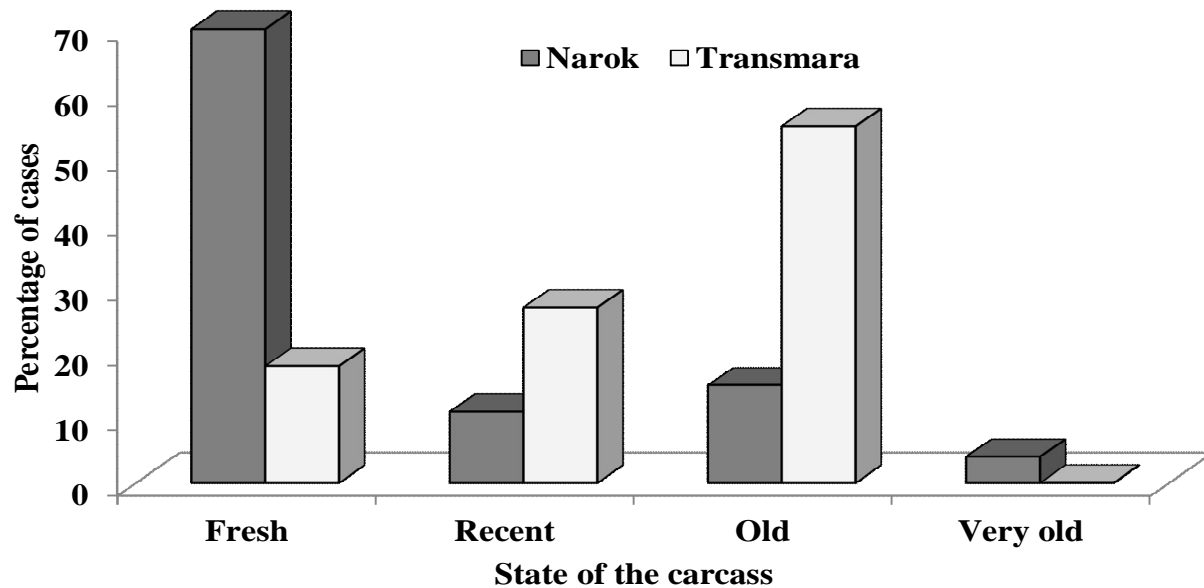


Figure 4: State of the carcass

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 ($\chi^2 = 10.158$, $df = 2$, $p = 0.006$). 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 2). The number of tusks recovered using different modes of recovery of tusks did not differ significantly ($\chi^2 = 10.667$, $df = 2$, $p = 0.05$). 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 ($\chi^2 = 0.818$, $df = 1$, $p = 0.036$).

Table2: 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%)	$\chi^2 = 0.818$, $df = 1$, $p = 0.366$
Narok	17	63	5	18.5	5	18.5	27 (71%)	$\chi^2 = 10.667$, $df = 2$, $p = 0.05$
Total	21	55.3	12	31.6	5	13.2	38 (100%)	$\chi^2 = 10.158$, $df = 2$, $p = 0.006$

Local respondents' views on effects of elephant mortality

The views of the respondents on selected effects of elephant mortality in three clusters are shown in Table 3. 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 ($\chi^2 = 186.570$, $df = 2$, $p = 0.000$).

Table 3: 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	$\chi^2 = 186.570$, df =2, p=0.000
No employment	342	57	199	33.2	59	9.8	$\chi^2 = 200.230$, df =2, p=0.000
Enhanced poor living standards	295	49.2	250	41.7	55	9.2	$\chi^2 = 162.750$, df =2, p=0.000
No HEC	62	10.3	487	81.2	51	8.5	$\chi^2 = 1.681$, df =2, p=0.000
No effect	72	12	413	68.8	115	19.2	$\chi^2 = 3.449$, df =2, p=0.000

*Multiple response

Mitigation measures adopted to reduce elephant mortality

Various mitigation measures adopted to reduce elephant mortality in the study area are shown in Table 4. 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: 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

DISCUSSION

Elephant population in NC has increased as evident from the local community responses. 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 coming 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. The education in the area has declined because of the fear for 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. 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 for 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.

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 aerial and dung count elephant Census carried out by KWS and WWF respectively; the population of elephants in NC has increased (Kenya Wildlife Service, 2010) over the last 12 years. The population has also increased nationally despite the many challenges that face conservation.

The highest percentage of carcasses recorded in Narok District of elephants that caused HEC or were poached was males and those poached were 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 poisonous spear wound. 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 arrow poison tree (*Acokanthera schimperi*) of the family, Apocynaceae 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.

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 findings could be due to various factors such as NC bordering 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, and farming is reducing the elephant range, resource competition and conflict results (KWS, 1995). Such conflict threatens the survival of wildlife, especially elephants, outside protected areas (PAs) (Omo and Fadaka, 1989; 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). Mortalities due other causes such as PAC, euthanasia, natural and accidents were very few.

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 felt “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,” said Sammy Nkoitoi, the chairman of Siana Wildlife Conservancy. Other causes that were highlighted were: Problem animal control (PAC), natural, when bulls fight, snares and poison.

Respondents were also asked to rank several mitigation measures which can help reduce the number of elephant deaths and promote their conservation. Generally, most respondents either strongly agreed or agreed with the mitigation measures that were provided.

Education and awareness is an important tool in the conservation and management of wildlife. There are NGO's like WWF, Friends of Conservation (FOC) and IFAW that work in collaboration with KWS in NC to provide education and extension services on human-wildlife conflict (HWC), HEC and other related issues of conservation. However, there is a need for more education and awareness activities 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 of HEC.

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. 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 for. Compensation to all HEC cases and incentives can make the community appreciate elephants.

There are very little or no benefits accrued 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 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, employment of the local members as a result of conservation, but more needs to be done to change the community's attitude and perception towards conservation. As Sitati (2003) has contended, the negative attitude developed by the local community towards elephants is as a result of lack of wildlife-related monetary benefits. It is important to correct this by initiating entrepreneurial activities that can generate income to the local community to offset the costs incurred and at the same time discourage land use strategies that are incompatible with elephant conservation.

Some community members have given out their communal land (Mara West Conservancy, Enoonkishu, Siana) to conservancies 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 economy is so high. However, the establishment of more conservancy/sanctuary in the area for elephants and other wild animals to have a better place and be protected is viewed as a mitigation measure. Other mitigation measures that were suggested include during the FGDs included: Translocation of elephants to safer/ protected areas like MMNR, although it may be not only expensive, but may not be the long term solution since all elephant ranges are encroached on and are under cultivation.

To reduce cases of elephant mortality as a result of conflicts and poaching, the local feels that KWS to provide rangers to guard crops and the community throughout the year and tight security in the area to arrest poachers who are believed to come from the neighbouring country (Tanzania) and introduction of harsh penalties to these poachers. The local community members also suggested that KWS should transport to pupils to school in the morning for meanwhile before a long term solution like establishment of more boarding school is found to reduce cases of pupils being attacked by elephants while on their way to school in the morning. Establishment of a KWS outpost in areas like Siana to improve elephant security and 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 deficient to reduce pressure on the existing ones as well avoid competition with humans and livestock during long drought.

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