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Livestock Depredation of the Spotted Hyena (*Crocuta crocuta*) in Southern Tigray, Northern Ethiopia

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ABSTRACT

A household survey was conducted with an intention to quantify livestock losses resulted from depredation of the spotted hyena (*Crocuta crocuta*), diseases and theft in southern Tigray, Ethiopia from October to December, 2009. Our intensive survey canvassed 1100 randomly selected households from two sub-districts (Debri and Felege Selam) of the Endreta district. Respondents were asked questions relating number of livestock owned, livestock management, number of livestock lost to predation by hyenas, diseases and theft between 2005 and 2009, human attacks and vulnerable livestock species to hyena predation. To quantify the economic cost of livestock lost, the species, age, number and sex of livestock losses were recorded and estimates of current average market values of these classes of livestock species were obtained from traders. Values were translated in to US$ at the exchange rate of the time of the study. Surveyed households reported losses of 1039 domestic animals due to predation, disease and theft over the last five years. The average annual depredation resulted in an estimated economic loss of about US$ 5401. Hyena attacks on livestock represent an economic concern for livestock owners which were blamed for 11.8% of all reported livestock losses. The total estimated economic loss caused by diseases, theft and depredation was about US$ 229,104, representing 85.5%, 2.7% and 11.8%, respectively. On average, US$ 45,820 per year (US$ 125 per day) has been lost. Hyena attacks reported were not in proportion to the relative abundance of livestock species. Donkeys were significantly more likely to be reported as lost to hyena predation, representing 67.8%, followed by goats (16.7%) and sheep (10.5%). Our results suggested that simple improvements in livestock management practices would help mitigate human-hyena conflicts.

Key Words: Diseases, Economic loses, Livestock, Spotted hyena, Depredation

INTRODUCTION

Spotted hyenas (*Crocuta crocuta*) are common, large (45-80 kg), gregarious predators that occur throughout sub-Saharan Africa outside of tropical forests, alpine areas and true deserts (Frank et al. 1995, Mills and Harvey 2001). *Crocuta crocuta* is a common predator on domestic livestock in Africa. In addition, they have also been known to attack and kill humans, especially during human disease outbreaks (Kingdon 1977, Hofer 2002).

The species is sport hunted in some places in Africa, although hyenas are not much in demand from trophy hunters because they are not viewed as very attractive. They are also hunted sometimes for food or medicine (Kruuk 1972, Hofer 2002).

Predation on domestic livestock and poultry by carnivores is a historical and continuing problem faced by agricultural producers throughout; the world (Harris and Szunders 1993). Conflict between people and wildlife is a major issue in both wildlife conservation and rural development. The damage that conflict can cause to conservation and rural development initiatives has prompted a considerable amount of research into conflict between carnivores and people (Weber and Rabinowitz 1996, Sillero-Zubiri and Laurenson 2001, Macdonald and Sillero-Zubiri 2002).

People's perceptions are often negative when it relates to damage-causing predators and efforts to conserve large carnivores may fail without the support of neighboring communities (Sillero-Zubiri and Laurenson 2001, Kruuk 2002). Livestock predation of the spotted hyenas affects a minority of farms and has an insignificant impact on the agricultural sector (Rigg and Fin 2000). However, predation can cause significant economic damage to individual households especially subsistence farmers.

In Tigray, northern Ethiopia spotted hyenas kill livestock and are themselves killed by local pastoralists. Such conflict may lead to the extirpation of the species from and also impacts the livelihoods of local livestock farmers. The problem of depredation of domestic animals is primarily caused by the spotted hyena, and, as a consequence, there is an intense persecution of these animals on the part of livestock owing people. Spotted hyena is the leading causes of depredations on domestic livestock in the region. Although originally considered a scavenger, it is now well known that spotted hyenas are active hunters (Kruuk 1966), scavenging only one-third of their diet (Kruuk 1972).

Studies addressing human-hyena conflict in the region where the economic impact of spotted hyena on people's livelihoods is likely to be most significant are scarce. Human-hyena conflict issues are poorly known and documented. Livestock herders are confronted with substantial stock losses from spotted hyena, although these have yet not quantified. Therefore, quantifying livestock depredation is fundamental to allow the implementation of management actions so as to minimize losses and to guarantee the conservation of the spotted hyena. In this context, the main objectives of this study were to: (1) determine the actual proportion of livestock killed by spotted hyena; (2) estimate economic losses of livestock depredation, disease and theft in the past five years; (3) asses human attack; and (4) identify vulnerable livestock species to spotted hyena predation in the study area.

STUDY AREA

The study sites (Debri and Felege Selam) are located in Endrta district, southern Tigray (Figure 1), northern Ethiopia. The district lies between 12^0 13' and 14^0 54' North and 56^0 27' and 40^0 18' East with an area of approximately 10,000 km^2 at an altitude of 2,300m.a.s.l. The rain fall of the area is bimodal with a short rainy season occurring between January and April, and a long rainy season from June to August. The average annual rainfall of the area is 530 mm. with maximum and minimum temperatures of 26.52 and 11.92 ^{0}C, respectively. The area is dominated by Eucalyptus (*Eucalyptus camaldulensis*) and cactus (*Opuntia ficus indica*). The study sites were chosen due to the known presence of spotted hyena with relatively high levels of reported livestock losses to predation.

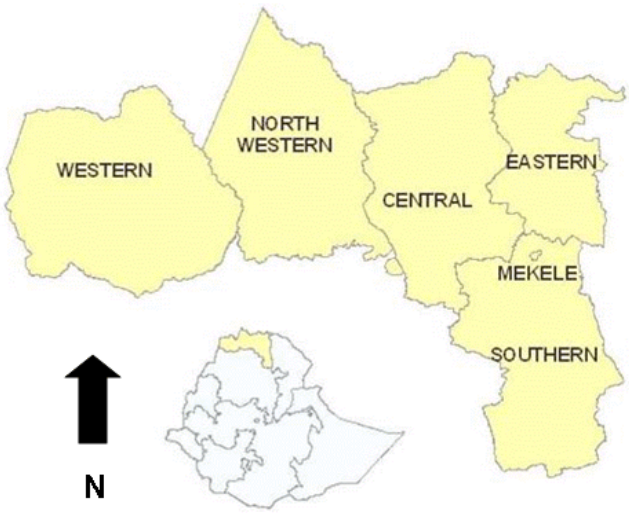

Figure 1. Location of the study site, Southern Tigray, in Ethiopia

METHODS

Our intensive survey canvassed 1100 randomly selected households from two sub-districts (Debri, n=600) and (Felege Selam, n=500) of the Endreta district. The study sites were chosen due to the known presence of spotted hyena with relatively high levels of livestock losses with the assistant of local authorities. Respondents (the head of the household or their spouse) were asked questions relating number of livestock owned, livestock management, number of livestock lost to predation, diseases and theft from 2005-2009, human attack, government support, etc. To quantify the economic cost of livestock lost due to depredation, disease and theft, the species, age, number and sex of livestock losses were recorded. Estimates of current average market values of different classes of livestock species by age and sex were obtained from people who frequently involved in trading of livestock species. Values were translated in to US$ at the exchange rate of the time of the study. Tools used for

data analysis and presentation were descriptive statistics, frequencies and percentages. Regression and correlation analysis were performed through JMP-5 Software. Any data/information that could not be captured through quantitative analysis was analyzed qualitatively.

RESULTS

Livestock Losses

Livestock losses were classified into three major categories based on causes: depredation, diseases and theft. Livestock loss by hyena depredation was lower than the accumulated losses by diseases and theft (364 and 675, respectively) (Table 1). Average annual depredation was 72.8 livestock, equivalent to 4% of the average annual stock in the area.

The linear regression analysis model explained (Depredation = 20.613 + 0.0107 Stock; $p < 0.39$; R^2 adj -0.016; df =12) the relationship between depredation and stock number. The relationship between diseases and stock number is explained by the model diseases = 20.507 + 0.0288 stock ($p < 0.0127$; R^2 adj 0.395; df =12).

Table 1. Total livestock species lost due to diseases, theft and spotted hyena predation from 2005 to 2009 in Village Felege Selam (n= 500) and Debri (n=600), southern Tigray

Species	Stock	Diseases	Theft	Depredation
Donkeys	1089	88	29	116
Sheep	247	44	2	39
Goats	439	45	8	53
Cows	1010	66	9	37
Poultry	2726	65	31	27
Dogs	578	23	6	21
Bulls	343	21	7	28
Oxen	1537	105	3	21
Calves	129	42	0	12
Mules	90	2	0	6
Horses	10	8	1	3
Camels	133	8	3	1
Cats	677	9	7	0
Total	9008	569	106	364

Surveyed households reported losses of 1039 domestic animals due to depredation, disease and theft over the past five years (Table 1). Pairwise correlation of losses of livestock reveals that theft and stock were relatively highly positively correlated (R=0.7680, P=0.0022), followed by diseases and stock (R=0.6672, P=0.0127). However, depredation and stock has been found to have weak positive correlation(R=0.2618, P=0.3876). A total of 364 hyena depredations were reported (Table 1), causing an estimated financial loss of about US$ 27007 (Table 2). The average annual depredation resulted in an estimated economic loss of about US$ 5401. Hyena attacks on livestock represent an economic concern for livestock owners which were blamed for 11.8% of all reported livestock losses. The total estimated economic loss caused by diseases, theft and depredation was about US$ 229104, representing 85.5%, 2.7% and 11.8%, respectively. On average US$ 45820.9 per year (US$ 125 per day) has been lost over the past five years.

Table 2. Estimates of economic loss (n=1100) in US$ due to diseases, theft and predation of livestock species by spotted hyena from 2005 to 2009 in Village Felege Selam and Debri, southern Tigray.

Species	Depredation	Diseases	Theft	Total
Donkeys	7273.52	5389.44	1528.8	14191.76
Sheep	1552.08	1872.88	91.36	3516.32
Goats	1676	1456.8	273.6	3406.35
Cows	4485.29	9614.56	1088	15187.85
Poultry	49.12	120.64	58	227.76
Dogs	21.06	25.44	7.04	53.54
Bulls	1872.64	1404.48	468.16	3745.28
Oxen	8064	169344	1152	178560
Calves	360	1260	0	1620
Mules	549.76	405.76	0	955.36
Horses	864	2156	140	3160
Camels	240	2826.56	1399.92	4466.48
Cats	0	12.32	1.44	13.76
Total	27007.47	195888.9	6208.32	229104.5

Human Attacks

Ten human attacks including nine males and a female were reported during the survey. All were injured and

were between the ages of 26 and 60. A majority (50%) of people attack was induced when people sleep outdoors at night, while the remaining occurred when people go to toilet at night; support others during an attack, or when hyenas enter into a house. Predominantly attacks were at night (90%). Most (80%) attacks were reported to have occurred inside traditional kraals.

Livestock Species Vulnerable to Predation of Spotted Hyena

Hyena attacks reported were not in proportion to the relative abundance of livestock species (Table 1). Donkeys were significantly more likely to be reported as lost to hyena predation, representing 67.8%, followed by goats (16.7%) and sheep (10.5%). Taking advantage of almost the entire spectrum of domestic prey available in the study area four species of livestock have been identified during the household survey as most vulnerable to predation of spotted hyena (Table 3).

Table 3. Ranking of livestock species based on vulnerability to predation of spotted hyena according to respondents (n= 1100) in the village Felege Selam and Debri, Southern Tigray, Ethiopia

Species	Respondents	Rank	Percentage (frequency)
Donkey	746	1	67.8
Goats	184	2	16.7
Sheep	115	3	10.5
Calves	22	4	2
Cow	13	5	1.2
Ox	8	6	0.7
Others	12	7	1.1
Total	1100		100

DISCUSSION

Although the economic impact caused by depredation of spotted hyena on large-scale ranches is not of great concern, it can mean economic ruin for a small rancher, for whom the depredation of a few animals a year represents a considerable loss, difficult to replace.

The total estimated economic loss caused by spotted hyena depredation, diseases and theft, worth about US$ 229104, representing US$ 27007.47, US$ 195888.9 and US$ 6208.32, respectively (Table 2). Predation on livestock is an important cause of human-wildlife conflict (Frank 1998, Ogada et al. 2003). Generally speaking, predators' are responsible for the loss of up to 3% of annual domestic stocks (Jackson and Nowell 1996).

Our intensive survey of human-hyena conflicts revealed that livestock losses caused by the spotted hyena represent an economic concern for livestock owners in southern Tigray. Studies elsewhere have shown that tolerance of predators by local communities usually depends on the extent of predation on their livestock (Rasmussen 1999, Patterson et al. 2004, Woodroffe et al. 2005, Kolowski and Holekamp 2006, Holmern et al. 2007).

In the present study, ten people were attacked, majority (50%) were induced when people sleep outdoors at night, while the remaining occurred when people go to toilet at night; support others during an attack, or when hyena inters into kraal. Predominantly attacks were at night. Spotted hyenas are nocturnal hunters, possibly because of their improved night vision compared with their prey (Bertram 1979). The findings are in line with studies elsewhere. For example, a sleeping boy was attacked by a spotted hyena in northern Kenya, losing his nose (Flying Doctors Society of Africa 2002). Other stories of hyenas include an attack on an elderly patient at Shinyanga hospital in Tanzania or regular attacks on sleeping people or children in Malawai (Kruuk 1972). However, 90% of the victims were males. This is because when hyena bites livestock or human men are involved than women or children to help victims. Yet, this result is inconsistent with two reports from Loliondo in Tanzania. The first was reported on 22 January 1968 in the Tanzania Standard, describing hyenas biting over 60 people, mostly women and children (Kruuk 1972). The second occurred in 1999 at the village of Olorien, one of the villages in this study, when a hyena subsequently discovered to be rabid attacked several people, including a young girl who needed major plastic surgery provided by the Flying Doctors Society of Africa.

Threat of personal injury due to large carnivores is one of the key concerns of people living with wildlife (Sillero-Zubiri and Laurenson 2001). Such concern does not represent actual levels of attacks, with human injury or death a relatively rare occurrence; however, it

demonstrates that even a low actual impact can have a large impact on local perceptions. However, hyena attacks on people do not regularly occur.

Surveyed households reported losses of 1039 domestic animals as result of hyena predation, disease and theft in the past five years (Table 1). Hyenas have been identified as major livestock predators in the study areas, often killing more valuable livestock. Predation and stock number has been found to have weak positive correlation(R=0.2618, P=0.3876). The reasons for hyena preying on livestock vary and are not fully understood. In some areas, it is thought that individual animals learn that livestock are easier to catch or are forced to switch prey species due to depletion of their natural prey choice (Mizutani 1993). In others, predation may occur simply because there is nothing to prevent it.

In Tigray, wild prey species have dramatically declined due to agricultural expansion, deforestation, human settlement and development projects. The great majority of cases of depredation of domestic animals by wild carnivores reflect some type of imbalance in the local ecosystem. The environment in which spotted hyenas live consists of areas with insufficient food resources and great human influence. Hence, these animals tend to attack man and livestock. For this reason, the depletion of natural prey animals can provoke the onset of attacks by hyenas on domestic animals where rural properties border each other. Livestock depredation might be in line with this issue. To maintain their condition hyenas need 3.8-4.0 kg of meat daily (Henschel and Tilson 1988).

The traditional response from households in cases of depredation has been to try to eradicate all the hyenas that subsist in the area, whether or not they are responsible for the depredation. At the same time, deforestation diminishes populations of available wild prey, thus increasing depredation of livestock in the absence of natural prey. The impact of livestock depredation tends to be aggravated in areas of strong human intervention. As human populations have expanded and developed, all of the world's large carnivores have experienced major contractions in their geographical ranges, often becoming confined to areas (particularly protected areas) where human densities are low (Linnell et al. 2001, Woodroffe 2001).

The use of protection measures to alleviate predation is poorly documented in Ethiopia despite people had been used them from time immemorial as a protection measures against predators throughout the country. Control techniques may be considered either corrective (after a depredation event) or preventive (before the event). Techniques can also be classed as lethal or non-lethal. Selectivity of the technique is extremely important. The regional government prohibited the killing of hyena; yet they are generally trapped, shot or poisoned or snared. However, no studies on conflict with livestock owners have been published. Livestock owners try to limit livestock loss primarily through enclosing livestock at night in an enclosure (kraal). Effective conservation of large carnivores demands the resolution of conflicts between people and predators. The extent to which this is achievable depends upon whether predators' impact on human lives and livelihoods can be reduced to a level that local people will tolerate, without reducing predator populations to unsustainably low levels. Evidence from East Africa suggests that static defenses are important when, as appears to be the case, all livestock are enclosed at night (Kruuk 1980, Ogada et al. 2003).

The relationship between people and wildlife is affected by a multitude of factors, such as financial benefits derived from wildlife, experiences with conservation authorities, level of education, and cultural background (Madden 2004). These factors can influence people's behavior and, as a result, may affect the outcome of conservation efforts. In the case of large carnivores, an additional aspect is concern over human safety.

It seems most likely that very few livestock species are free from the threat of spotted hyena predation and donkey is the most vulnerable species (Table 3). This might be due to the fact that donkeys are unable to defend during an attack. The study by Gonzalez-Fernandez (1995), determined that the level of depredation was related to the size of the herd. However, the present study indicated weak correlation (R=0.2618, P=0.3876) between livestock abundance and hyena depredation. Spotted hyenas do exhibit a significant preference for livestock species (Table 3), and this reflects that to satisfy their dietary requirements through predation they do attack donkeys and the small sized species. Other studies have shown that most predation by carnivores occurs on calves (Schaller 1983, Hoogesteijn et al. 1993, Childs 1998, Polisar et al. 2003, Michalski et al. 2006). On the other hand, studies on wild prey species indicated the non-specific nature of spotted hyena predation undoubtedly contributes to its relatively secure conservation status (Hofer 2002). Its morphology and behavioral opportunism allow it to capture anything it can overpower,

from spring hares to giraffes (Cooper 1990). Finally, regression analysis revealed that there were no factors that significantly predicted the predation value of spotted hyena domestic prey ($p < 0.39$).

In conclusion, adequately addressing human-hyena conflicts to lower costs and enhance benefits resulting from the presence of spotted hyena is expected to promote hyena conservation. Simple improvements in livestock management practices would help mitigate human-carnivore conflicts.

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