

Full Length Research Paper

Farmers' perception of leopard (*Panthera pardus*) conservation in a human dominated landscape in northern Ethiopian highlands

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Attitudes toward leopard (*Panthera pardus*) conservation were surveyed in two sub districts; May Anbesa (relatively high leopard density area) and Egriwonber (area with no leopard) in the northern Ethiopian highlands. This district is a completely human dominated landscape, where conflict has manifested in terms of livestock depredation. Spotted hyena (*Crocuta crocuta*), leopard (*P. pardus*) and common jackal (*Canis aureus aureus*) are common in this landscape but all other large carnivores are virtually absent. A structured survey instruction was prepared in the form of an interview-based questionnaire. We interviewed 519 randomly selected households. Majority of the respondents (64.6%) had positive feelings and only 10.2% had negative feelings in the core area, whereas majority of the respondents (52.3%) had neutral feelings and only 9.1% had negative feelings towards leopard in the control area. The mean attitude score in both areas was 3.53: neutral to positive. The majority of respondents (72.3%), including 88.6% in the core area and 46.5% in the control area, thought that compensation should be paid to farmers whose livestock had been killed. Only 34.7% of all participants, including 25.9% in the core area and 48.5% in the control area, agreed that killing of leopards should be strictly regulated. Farmers of the core area reported losses of 85 domestic animals due to leopard depredation causing an estimated financial loss of about US\$ 3,470 over the last five years. Of all the respondents in core area only 12% of the people had suffered from leopard depredation. Goats were the most depredated livestock species (49.4%). The findings indicated that tolerance for depredation is high for that further efforts could improve support for carnivore conservation.

Key words: Leopard, conservation, financial impacts, Ethiopian highlands.

INTRODUCTION

The common leopard (*Panthera pardus*) is the most widespread carnivore (Myers, 1986), occurring throughout sub-Saharan Africa, India and southern Asia (Nowell and Jackson, 1996) mainly due to its highly adaptable hunting and feeding behavior (Bertram, 1999). It can live wherever there is sufficient cover and adequately sized prey animals (Bertram, 1999). Leopards are known to live in human dominated landscapes (Athreya et al., 2004). This close proximity to humans

often results in conflict when the resources concerned have economic value such as livestock depredation (Graham et al., 2005). In general carnivores have disappeared from areas of high human density (Woodroffe, 2001). They have been perceived as a threat to human survival because of danger to human life and to livestock. People respond to livestock depredation by poisoning carnivores, habitat destruction and direct killing. Local people often hold negative attitudes, when carnivores prey upon livestock (Oli et al., 1994; Lenihan, 1996). In most landscapes large carnivores need to coexist with humans who require knowledge about people and their attitudes towards large carnivore

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conservation. It is therefore quite important to investigate public opinion and knowledge of large carnivore conservation.

Leopard is one of the vulnerable species owing to predation of large number of domesticated animals in Ethiopia; however least concern in terms of its conservation is given in the country. In the country, the public is poorly informed about issues of large carnivore conservation. No research on public attitudes to carnivores has been published yet. Attitudes of farmers towards the predation problem are poorly understood in Tigray, regional states of Ethiopia. Hence, the present study aimed to understand farmers' perceptions and attitudes towards leopard occurring in the area.

Study area

The study was conducted in northern Ethiopian highlands particularly Endrta district that lies between 12° 13' and 14° 54' North and 56° 27' and 40° 18' East with an area of approximately 10,000 km² at an altitude of 2300 m.a.s.l. The rainfall of the area is bimodal with a short rainy season occurring between January and April, and a long rainy season from June to August. Average annual rainfall is about 550 mm. The mean maximum temperature ranges between 12°C (November and December) and 27°C (January and March). The total rural human and livestock population is about 115,000 and 56,000, respectively (Bureau of agricultural and natural resources development (BOANR), 2009). Two sub districts were selected with the assistance of local administrators. The first is May Anbesa (Core area) with a total human and livestock population of about 6,387 and 7,579, respectively with annual rainfall of 400 to 600 mm. It is about 12 km from Mekelle located at 1500 to 2300 m.a.s.l and hosts hyena (*Crocuta crocuta*), leopard (*P. pardus*), common jackal (*Canis aureus aureus*) and low density of small prey species, example Red-fronted gazelle (*Eudorcas rufifrons*). Secondly, Egri Wonber (Control area), is situated at about 2303 m.a.s.l at 8 km from Mekele, with total human and livestock population of about 7,994 and 1,424, respectively. This area hosts hyenas, common jackal etc but no leopard.

METHODS

Interview is a widely used technique for surveying of mammals, especially carnivores, and for understanding people's perceptions (Dietrich, 1995; Rabinowitz, 1997; Brooks et al., 1999; Conforti and de Azevedo, 2003; Marino, 2003). A structured survey instruction was prepared in the form of an interview-based questionnaire arranged in three sections: attitudes and perceptions (1) management issues (2) and economic impact (3). Most questions were measured on a 5-point scale ranging from "strongly disagree" to "strongly agree". Two sub districts May Anbesa (core area with relatively high leopard density) and Egriwonber (control area, with no leopard) were selected with the help of local administrators of the district. We interviewed 519 randomly selected households from two sub-districts (core area, n = 317 and control area, n = 202).

Respondents (the head of the household or their spouse) were also asked questions relating to number of livestock owned, livestock management, number of livestock lost to predation from 2006 to 2010 and human attack by leopard. To quantify the economic cost of livestock depredation in core area, 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 traders. Values were translated to US\$ at the exchange rate of the time of the study.

Statistical evaluation

For the statistical analyses, data were entered into JMP 5 Software. Analyses were conducted using Pearson's chi-square test. A high χ^2 value and $P < 0.05$ indicated significant differences.

RESULTS

Socio-demographic characteristics

Overall, slightly more males (57.8%) than females (42.2%) participated in this household survey. Approximately 46.6% of the respondents were between the ages of 21 and 35 years, 26.4% were 36-50 year-olds, 16.2% were 51-60 years old and 10.8% were above 60 years old (Table 1). The proportion of farmers over 50 years old was 27%. More than half of the respondents (61.5%) were illiterate and only 5% were college graduates.

Our expectation that attitudes would be most negative in core areas was not confirmed. A majority of the respondents (64.6%) had positive feelings and only 10.2% had negative feelings in the cores area, whereas majority of the respondents (52.3%) had neutral feelings and only 9.1% negative feelings towards leopard in the control area (Table 3). Overall six times more respondents had positive feelings (54.5%) than had negative feelings (9.8%). The mean attitude score in both areas was 3.53: neutral to positive. The majority of respondents (72.3%), including 88.6% in the core area and 46.5% in the control area, thought that compensation should be paid to farmers whose livestock had been killed by leopards. A lack of education was identified as the most important current issue that should be considered in large carnivores conservation work. Only 34.7% of all participants, including 25.9% in the core area and 48.5% in the control area, agreed that killing of leopards should be strictly regulated.

Mean attitude scores were 3.7 and 3.36 in core and control areas, respectively. Similarly, mean management scores were respectively 3.36 and 3.32 in core and control areas. An attitude and opinion about leopard management score was calculated using 7 and 8 items, respectively (Tables 3 and 4). A mean attitude score of 1 indicates strongly negative feelings, a score of 3 neutral and of 5 strongly positive feelings toward leopards. In general none of them had really negative feelings toward leopards. Participants of the survey generally held neutral

Table 1. Socio-demographic characteristics of sample respondents.

Socio-demographic	Core area	Control area
Age structure		
21-35	150	92
36-50	90	47
51-60	47	37
>60	30	26
Sex ratio		
Female	135	84
Male	182	118
Education		
Illiterate	196	123
Primary	40	14
Junior	44	22
Secondary	31	23
College	6	20

Table 2. Stock number, depredation and economic impact of leopard from 2006-2010 in May Anbesa (core area) in Endrta district.

Species	Stock	Depredation (%)	Economic loss(US\$)
Donkeys	327	0(0)	0
Sheep	172	9(10.6)	281.6
Goats	742	42(49.4)	926.8
Cows	500	5(5.9)	593.8
Poultry	868	9(10.6)	19.7
Dogs	313	7(8.2)	8.8
Bulls	248	5(5.9)	781.3
Oxen	556	5(5.9)	677
Calves	123	3(3.5)	181.2
Mules	9	0(0)	0
Camels	11	0(0)	0
Cats	228	0(0)	0
Total	4097	85(100)	3,470.2

to positive attitudes toward carnivores (mean score 3.44). Farmers in both areas had neutral to positive attitudes toward leopard management.

Farmers of the core area reported losses of 85 domestic animals due to leopard depredation causing an estimated financial loss of about US\$ 3,470 over the last five years (Table 2). We do not have any report of attacks on humans. Only 12% of the respondents in core area indicated the incidence of livestock depredation.

DISCUSSION AND CONCLUSION

Farmers' attitude is an important consideration in conservation of leopard. Overall six times more

respondents had positive feelings (54.5%) than had negative feelings (9.8%). Previous studies have found that people in a carnivore-free area tended to be more positive than people in a carnivore area (Szinovatz, 1997). In the present study the presence of carnivores does not seem to affect peoples' attitude toward them negatively. Participants of the survey generally held neutral to positive attitudes toward leopard (mean score 3.44). Factors such as culture, education, economy, status, exposure to an event have been found to influence attitudes (Røskaft et al., 2003). Human attitudes towards carnivores tend to be shaped by understanding and knowledge of a particular species (Kellert et al., 1996). Human acceptance is very important for conservation of large carnivores. We do not have any

Table 3. Results for the items concerning attitude toward leopard by study area.

Items	1(%)	2(%)	3(%)	4(%)	5(%)	
Leopard is bad animal						
Core area (n = 317)	4.7	11	31.6	41.6	11	P = 0.0001
Control area (n = 202)	1.5	32.7	47	17.3	1.5	X ² = 114
The presence of leopard is a sign of a healthy environment						
Core area	0	1.6	34.4	52.7	11.4	P = 0.0001
Control area	0	0	22.8	67.8	9.4	X ² = 430
Leopard kills livestock						
Core area	0	0.6	8.5	58.7	32.2	P = 0.0001
Control area	0	1	27.2	65.8	5.9	X ² = 467
Leopard have been known to attack and injure people						
Core area	1.3	12.9	35.6	37.9	12.3	P = 0.0001
Control area	0.5	17.8	77.2	3.9	0.5	X ² = 362
I would be afraid to go into the forest/field if there are leopards						
Core area	0.3	5.7	15.1	43.5	35.3	P = 0.0001
Control area	0	1	55.9	24.8	18.3	X ² = 363
Leopard is dangerous to humans						
Core area	0	0.9	13.6	74.1	11.4	P = 0.0001
Control area	0	1	87.1	11.4	0.5	X ² = 496
Leopard should be protected						
Core area	6	26.5	37.2	19.9	10.4	P = 0.0001
Control area	0	7.9	49	33.2	9.9	X ² = 178

1 = Strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

report of attacks on humans. Only 12% of the respondents indicated the incidence of livestock depredation. Owing to the relatively low livestock depredation and absence of human attack farmers might have neutral attitudes about leopard in the study area. Variation in people's

attitudes towards large carnivores seems to be based partly on the extent to which different species conflict with human interests (Kellert, 1985). However, attitudes can change considerably over time (Fritts et al., 2003). Measuring the attitudes of people is a complex issue (Dickman,

2005) mainly due to traditional, ecological and economic factors. The presence of large carnivores in human landscapes can have different consequences such as fear due to its presence (Quammen, 2003) and fatal attacks on humans (Loe and Röskaft, 2004). The most sever

Table 4. Results for the items concerning opinion about leopard management.

Items	1(%)	2(%)	3(%)	4(%)	5(%)	
There should be leopard in Tigray						
Core area	5.7	17.7	19.9	45.7	11	P = 0.0001
Control area	0	4.9	14.4	69.3	11.4	$\chi^2 = 42$
Leopard should present in my village						
Core area	23	24.9	32.8	15.1	4.1	P = 0.0001
Control area	3.5	7.9	49	39	0.5	$\chi^2 = 93$
Leopard should only live in restricted places in Tigray						
Core area	3.5	31.2	30.6	31.2	3.5	P = 0.0001
Control area	2	39.6	52.5	4.9	1	$\chi^2 = 62$
Farmers are responsible to protect their livestock from leopard depredation						
Core area	0.3	0.6	10.7	71.9	16.4	P = 0.2279
Control area	0	0.5	14.9	74.3	10.4	$\chi^2 = 6$
Money should be paid to farmers whose livestock is killed by leopard						
Core area	0	1.6	9.8	41.3	47.3	P = 0.0001
Control area	0.5	22.8	30.2	34.2	12.4	$\chi^2 = 133$
Killing of leopard should be strictly regulated						
Core area	1.9	24.6	47.6	22.1	3.8	P = 0.0001
Control area	0	2	49.5	47	1.5	$\chi^2 = 70$
Killing of leopard should be allowed						
Core area	3.2	17.4	47.3	29.7	2.5	P = 0.0001
Control area	5.5	47.5	43.7	3.5	0	$\chi^2 = 89$
It is necessary to give more people information about leopard						
Core area	2.2	12	34.4	38.8	12.6	P = 0.0001
Control area	0	1	45.6	44.6	8.9	$\chi^2 = 30$

1 = Strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

consequence of the presence of carnivores in human dominated landscape is livestock depredation (Patterson et al., 2004). Livestock depredation could be reduced by employing efficient livestock management practices (Ogada et al., 2003). The majority of respondents (72.3%), including 88.6% in the core area and 46.5% in the control area, thought that compensation should be paid to farmers whose livestock had been killed by leopards. With the particular circumstances compensation may not be effective in Ethiopia for conservation of large carnivores; instead other mitigation options for depredation of livestock and awareness creation on the need of conserving large carnivores is quit important. Conflict mitigation measures applied in one may not be important in the other area due to differences in socio-political, cultural, economic and geographic situations (Graham, 2003).

For large carnivores to survive in a human dominated landscape there is a need of efficient management practices to be employed (Linnell et al., 2001). Carnivore conservation is much a policy issue than a scientific and ecological one (Treves and Karanth, 2003). Formulating better and efficient management policy will help in reducing the impact of conflict on people (Primm and Clark, 1996). Compensating for livestock depredation has been used as mitigation measures in other countries. This might help in increasing tolerance of livestock depredation (Swenson and Andren, 2005). To mitigate the results of conflict between humans and carnivores, reactive and proactive measures need to be taken (Madhusudan and Mishra, 2003). Alternative benefits for local people might be an option for conservation of large carnivores in human dominated landscapes.

Goats appeared to be most vulnerable to leopards' depredation, assuming the reported depredation rate of 49.4% is valid. A similar pattern was noted by Kiran (2008) from India; dogs, goats and sheep primarily form the prey base of leopards in which depredation by leopards accounted for 80% of deaths in goats. Selection of prey by leopards depends on prey body size, with smaller and medium sized prey being preferred (Hayward, 2006). According to the informants, a sloppy guarding practice was the primary reasons for the livestock depredation in the area. Conflict is unavoidable when large carnivores inhabit human dominated landscapes (Namgial et al., 2007). In Tigray the wild prey base is small and often carnivores prey on livestock species (Abay et al., 2010). In the present study, for example, farmers of the core area reported losses of 85 domestic animals due to leopard depredation. Areas with good numbers of wild prey could face some degree of livestock depredation but where natural prey has been depleted, livestock depredation is likely to be inevitable (IUCN –CSG, 1992). Most of the cattle farmers in the region have very small herd size. The findings indicated that tolerance for depredation is high for that further efforts could improve support for carnivore conservation.

Large carnivores' conservation efforts should consider livestock depredation in order to achieve a wider support of farmers. Farmers indicated a lack of education as the most important problem in current management of leopard. Hence, awareness creations on the need for carnivores at the grass hoot level would be so important for carnivores' conservation.

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