# FARMERS' PERCEPTION OF LEOPARD (*PANTHERA PARDUS*) CONSERVATION IN A HUMAN DOMINATED LANDSCAPE IN NORTHERN ETHIOPIAN HIGHLANDS

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## ABSTRACT

Attitudes toward large carnivores were surveyed in two sub districts May Anbesa (relatively high leopard density are) 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 (*Panthera 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 containing 23 items arranged in three sections: attitudes and perceptions; management issues; and economic impact. We interviewed 519 randomly selected households (core area, n=317 and control area, n=202). 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% 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 by leopards. 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$ 51,673 over the last five years, or an annual mean of 0.4% of stock worth US$ 10,334. 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 indicate that tolerance for depredation is high for that further efforts could improve support for carnivore conservation.

**Keywords:** leopard, conservation**,** financial impacts, Ethiopian highlands

## INTRODUCTION

The common leopard (*Panthera pardus*) is the most widespread  large carnivore (Myers, 1986), occurring throughout sub-Saharan Africa, India and southern Asia (Nowell and Jackson, 1996) 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 inhabit croplands in human dominated landscapes (Athreya et al., 2004). This close proximity to humans often results in conflict and can be particularly controversial when the resources concerned have economic value such as livestock depredation and the predators involved have a high conservation profile (Graham et al., 2005).  In general carnivores have disappeared from areas of high human density (Woodroffe, 2001), and the species most exposed to conflicts with people are the most prone to extinction. They have been perceived as a threat to human survival because of danger to human life and to livestock. People retaliate to livestock depredation by poisoning carnivores, habitat destruction and direct killing which have led to extinction of many species and significant reductions in carnivore populations. Local people often hold negative attitudes, when carnivores prey upon livestock as reported for snow leopards (*Panthera uncia*) by Oli et al. (1994) and wolves (*Canis lupus*) by Lenihan (1996). In most landscapes large carnivores will need to coexist with humans. This coexistence requires knowledge about people and their attitudes towards large carnivore conservation. Hence, study of public opinion and knowledge becomes an important element of large carnivore conservation.

Leopard is one of the vulnerable species owing to predation 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 wildlife 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 stats 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 Endrta district (northern Ethiopian highlands) that lies between $12^0$ $13^1$ and $14^0$ $54^1$ North and $56^0$ $27^1$ and $40^0$ $18^1$ East with an area of approximately 10,000 km$^2$ at an altitude of 2,300 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$^o$ C (November and December) and 27$^o$ C (January and March).  The rural population is extremely poor and chronically dependent on food aid. 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 400-600mm. It is about 12km from Mekelle located at 1500-2300m.a.s.l and hosts hyena (*Crocuta crocuta*), leopard (*Panthera 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 2,303 m.a.s.l at 8km 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

Interviews are a widely used technique for surveying 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 containing 23 items arranged in three sections: attitudes and perceptions; management issues; and economic impact. 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.

According to Storck et al., (1991), the size of the sample depends on the available fund, time and other reasons and not necessarily on the total population. Accordingly, 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 2006-2010 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 chi-square test of association was used to test the null hypothesis that row and column variables were independent. A high $\chi^2$ 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 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$ 51,673 over the last five years, or an annual mean of 0.4% of stock worth US$ 10,334 (Table. 2). We don't have any report of attacks on humans. Only 12% of the respondents in core area indicated the incidence of livestock depredation.

**DISCUSSION**

Farmers' attitude is an important consideration in conservation of large carnivores. 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 doesn't seem to affect peoples' attitude toward them negatively. A more detailed study using anthropological insights and methodologies is required to better understand the feelings of famers to large carnivores. 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, as well as by past and present interactions with that species (Kellert et al., 1996). Human acceptance is very important for conservation of large carnivores.

We don't have any 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 famers 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 and partly on inherent human prejudices (Kellert, 1985). However, attitudes can change considerably over time (Fritts et al., 2003). Assessing the attitudes of people is a complex issue (Dickman, 2005) owing to cultural, social, ecological and economic factors. The presence of large carnivores in human landscapes can have different consequences such as fear evoked by its very presence (Quammen, 2003) to fatal attacks on humans (Loe, 2004). The most reported consequence of the presence of carnivores in human dominated landscape is livestock depredation (Patterson et al., 2004) which often results in undermining the conservation effort. However, depredation is often preventable by employing efficient livestock management practices (Ogada et al., 2003). In our case, mitigation is for social, not conservation motives.

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. Compensating for livestock depredation has been used as mitigation measures. This might help in reducing the impact of conflict and increasing the 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). If we want to conserve carnivores in human dominated landscapes we have to look for options that might benefit communities of this area. For the large carnivore like leopards to survive in a human dominated landscape there is a need of efficient management practices to be employed, both on the part of wildlife managers as well as the local people (Linnell et al., 2001). Carnivore conservation in such landscape is as much a policy issue as a scientific and ecological one ( Treves and Karanth, 2003) and science can help us in formulating better and efficient management policy that will help in reducing the impact of conflict on people (Primm and Clark, 1996).

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, lax guarding practices, favorable cover and habitat conditions were the primary reasons for the livestock depredation in the area. Some amount of 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 (Yirga et al., subm.). In the present study, for example, farmers of the core area reported losses of 85 domestic animals due to leopard depredation causing an estimated financial loss of about US$ 51,673 over the last five years. 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). The impact of this predation might be serious as 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 address the problem of livestock depredation in order to obtain the wider support of the local communities. Farmers indicated a lack of education as the most important problem in current management of leopard. Around 52.6 % (51.6% in core area and 53.5% in control area) thought that people need to be given more information about large carnivores' conservation. Hence, awareness creations on the need for carnivores at the grass hoot level would be so important for carnivores' conservation.

## ACKNOWLEDGMENTS

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**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, predated biomass and economic impact of leopard from 2006-2010 in May Anbesa (core area) in Endrta district**

| Species | Stock | Depredation (%) | Predated Biomass(kg) | Economic loss(US$) |
|---------|-------|-----------------|----------------------|--------------------|
| Donkeys | 327 | 0(0) | 0 | 0 |
| Sheep | 172 | 9(10.6) | 585 | 466.6 |
| Goats | 742 | 42(49.4) | 2940 | 14,838.6 |
| Cows | 500 | 5(5.9) | 1250 | 9,500 |
| Poultry | 868 | 9(10.6) | 12.6 | 495 |
| Dogs | 313 | 7(8.2) | 245 | 140 |
| Bulls | 248 | 5(5.9) | 1250 | 12,500 |
| Oxen | 556 | 5(5.9) | 1750 | 10,833 |
| Calves | 123 | 3(3.5) | 180 | 2,899.8 |
| Mules | 9 | 0(0) | 0 | 0 |
| Camels | 11 | 0(0) | 0 | 0 |
| Cats | 228 | 0(0) | 0 | 0 |
| **Total** | **4097** | **85(100)** | **8212.6** | **51,673** |

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

| Leopard is bad animal | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Core area n=317 | 4.7% | 11% | 31.6% | 41.6% | 11% | P=0.000l |
| 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=0.000l |
| 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=0.000l |
| 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=0.000l |
| Control area | 0.5% | 17.8% | 77.2% | 3.9% | 0.5% | $X^2$=362 |
| **I would be afraid to go into the forest/filed if there are leopard** | | | | | | |
| Core area | 0.3% | 5.7% | 15.1% | 43.5% | 35.3% | P=0.000l |
| 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=0.000l |
| 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=0.000l |
| **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**

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

| There should be leopard in Tigray 1 | | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| 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% | $X^2$=42 |
| **Leopard should present in my villge** | | | | | | |
| Core area | 23% | 24.9% | 32.8% | 15.1% | 4.1% | P=0.0001 |
| Control area | 3.5% | 7.9% | 49% | 39% | 0.5% | $X^2$=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% | $X^2$=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% | $X^2$=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% | $X^2$=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% | $X^2$=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% | $X^2$=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% | $X^2$=30 |

**1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly agree**