

**Human-wildlife conflicts and their associated livelihood impacts in and around Chebera-
Churchura National Park, Ethiopia**

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Abstract

Human-wildlife conflict is one of the major challenges in conservation biology. Here, we investigated the human-wildlife conflicts and their impacts in and around Chebera-Churchura National Park (CCNP), Ethiopia. We conducted semi-structured interview for 300 people and five focus group discussions from November 2010 through January 2011. Additionally, scats of sixty spotted hyenas were collected and analyzed. Totally, 12 carnivores, 6 herbivores and 2 primate species posing a significant problem were identified. Intensive human-conflict was observed in Churchura, Sere and Chebera villages which were very close to the park. The carnivore's attacks during 2007 to 2011 had caused about 30.49% of livestock losses. The overall economic loss by wildlife attacks was estimated to be US\$ 75,234 (US\$ 83/household/year). Scat analysis confirmed a substantial contribution (59%) of livestock to spotted hyena's diet. Thus, combined strategies like improving livestock husbandries and strengthen the capacity of managers are imperative to mitigate the problems.

Keywords: Focal carnivores; Human-wildlife conflict; Livestock depredation; Livestock husbandry; Livelihood

Introduction

Human-wildlife conflict is any interaction between human and wildlife animals, which may cause harm to human, wildlife or property (Ladan 2014). This often happens due to the competition between human and wildlife for shared and limited resources (Graham et al. 2005). It can cause a significant loss of economy and human life, especially in and around protected areas (Palmeira et al. 2008). Human-wildlife conflict ranges from crop raiding herbivores to livestock raiding large carnivores (Dickman 2008). Large carnivores are causing intensive conflicts due to their obligate carnivore habits, which lead them into competition with humans (Baldus 2004; Sillero-Zubiri and Laurenson 2001). Now a day, human-wildlife conflict is a serious challenge in conservation biology (Madden 2008).

As several findings revealed, there is a significant variation in the levels of human-wildlife conflict in different parts of the world. Some parts have a very few or no problem of human-wildlife conflict, while major parts of the world are facing a serious problem of human-wildlife conflicts (Stahl et al. 2002). Some underlying agents may initiate the problem of human-wildlife conflict. Factors, such as the seasonal pattern of species distribution, environmental conditions and livestock husbandry practices in the area may aggravate the problem (Ogada et al. 2003; Patterson et al. 2004). A better understanding of human-wildlife conflicts and its root cause is very important for conservation of wildlife resources and mitigate the problem (Dickman 2008).

In Ethiopia, there are more than 40 protected areas, which cover about 16.4% of the country's land area (Tessema et al. 2007). Population expansion, destructions of natural resources and human-wildlife conflict are the major challenges being observed around the protected areas (Ashenafi et al. 2005; Tessema et al. 2007). Competition for resources between human and

wildlife animals has been reported in various conservation areas of Ethiopia (Kumsa and Bekele, 2014; Tessema et al. 2007). Wild carnivores are the most problematic animals reported in these areas (Yihune et al. 2009). Mainly, spotted hyena (*Crocuta crocuta*), leopard (*Panthera pardus*), common jackal (*Canis aureus aureus*), serval (*Leptailurus serval*) and Ethiopian wolf (*Canis simensis*) are the most problematic animals (Atickem et al. 2010; Gidey and Bauer 2010b; Yihune et al. 2009). Lack of knowledge on interactions between wildlife and humans is the major reason for large carnivore's threat (Sillero 2009). Because of their conflict with human, these animals are facing a serious threat to their survival (Yihune et al. 2009). However, the nature and magnitude of the problem varies from area to area depending on population growth rate, destruction of natural resources and scarcity of grazing and farm land around the protected areas (Kumsa and Bekele 2014).

Chebera-Churchura National Park (CCNP) is one of these protected areas established in 2005 by the Southern Nation, Nationalities and People (SNNP) regional government. The park is located in the highest livestock producing areas of the region, and the poorest parts of the country (Datiko and Bekele 2013). Population growth, agricultural expansion, settlement and deforestation are the major problem being observed around the park, and had causing the profound cumulative impacts on the park (Timer 2005). As a result, human-wildlife conflict is the major concern in and around of the park (Datiko and Bekele 2013). However, the level of conflict and its associated impacts on the livelihood of surrounding societies is not well known. Therefore, here we aimed to fill the gap of scientific data on human-wildlife conflict and their associated livelihood impacts in and around CCNP, Ethiopia. The objective of the study was to assess the magnitude of human-wildlife conflict and their associated impacts in the livelihood of societies living in and around CCNP, south-western Ethiopia.

Materials and Methods

Description of the study area

CCNP is located in SNNP administrative region, Ethiopia between Dawro zone and Konta special district on 580 km from Addis Ababa towards the south at the center of Omo-Gibe river basin. The park covers about 1,250 km² areas. The altitude of the park is found in between range of 550 to 2000 m a.s.l. The Park was established in 2005 by the regional government to conserve the wildlife resources found in the park. Highly undulating to rolling plains with incised river, lakes and perennial streams, valley and gorges and savanna grassland characterizes the region of the park (Datiko and Bekele, 2013; Timer, 2005). The vegetation cover of the area is categorized into four major types. These are woody grassland (62.5%), woodland (8%), mountains covered by forest (29.5%) and riverine forest (3%) (Admasu, 2006). In addition, more than thirty seven large mammals and 237 bird species have been recorded in different habitats of the park (Timer, 2005).

Study design and site selection

The study was conducted from November 2010 through January 2011. Before the starting of data collection, preliminary survey was conducted in the mid of December, 2010. This helped us to identify boundary of the park, to know the number of villages/ sites and to have a general understanding of the overall situations of human-wildlife conflicts in and around the park. In addition, questionnaires were pre-tested in some groups of population, which is not included in the main sample groups.

Seven villages were selected for questionnaires survey. All villages were different from one another in their geographical locations and household sizes. Churchura village is located inside of the park, Agare and Koisha villages are relatively far from the park (>11 km), Dalba and Yora villages are found on the distance between 2-10 km away from the park, and Sere and Chebera villages are found on <1 km distance away from the park (Figure. 1). A total of 300 households (220 male and 80 female) were selected for interview from the selected villages (about 15% of the total number of households). Due to the dominance of male household heads role in most activities of livestock husbandry and their small exposure to human-wildlife conflict, the number of females included in the interview were very small. We did systematic random sampling technique for household heads selection. In order to get appropriate information, household heads aged between 18 to 80 years old were considered for interview. The number of interviewee from each sampling sites were based on the number of households in the villages (15% from each village). All native ethnic groups (Dawro, Konta, Tsara, Menja and Bacha Nationalities) and other ethnic groups inhabited due to resettlement (Hadiya and Wolaita) in and around the park were included in interview.

Methods of data collection

The primary data were collected through administration of open and closed ended questionnaires. Questionnaires were designed to explore the respondents' opinion about the wildlife population, utilization and importance of CCNP, human-wildlife conflicts, livestock depredation and human attacks, the impacts of human-wildlife conflicts on their livelihood and the trends of wildlife population in the study area. In addition, five focus group discussions were conducted to explore their experiences on human-carnivore conflicts and the associated impacts on their livelihood. The focus groups were created from each village based on their experiences

of human-wildlife conflict in the area and their approaches to the park. The group sizes in each discussion group were varied from 10-15 people. To assess the levels of conflict, respondents had shown the hide and picture of 20 animal species living in the park, which had taken from the park management office. Thereafter, they were asked whether they know the species or not (Dickman 2008; Maddox 2002). Then, they classified them as either posing no problem, small problem or big problem. The average problem scores for all species were calculated and used as the main index of conflicts for each village and species. Finally, data on the statistics of livestock depredation by wildlife was taken from Isera and Konta special district offices. The collected information was summarized by text analysis and presented in a narrative way.

Collection and identification of scats of spotted hyena

Scats of sixty spotted hyena were collected by systematic random sampling methods from each of the surveyed villages; sun dried and washed using hot water to separate hairs, bones and other prey components (Ogara et al. 2010). The separated hairs were washed in acetone, dehydrated in 98 % ethanol, dried on filter paper and identified by stereomicroscope based on form, length and color of the hairs (Breuer 2005; Gidey and Bauer 2010a). The hairs were compared with the reference hairs of live cattle, goats and sheep collected from survey villages and wild prey species of study area which was taken from Konta Special district Museum (Breuer 2005).

Data analysis

The collected data were analyzed statistically by the SPSS software version 16.0. We did descriptive statistics and Chi- square test to determine the significance difference between independent variables (distance, village, perception, economic impacts and species) and

dependent variable (human-wildlife conflict and their impacts) in the study area. Chi-square test at $P < 0.05$ (2-tailed) was considered as significant.

Results

Socio-economic status of respondents

We interviewed a total of 300 respondents (n=300), 73.33% (n=220) males and 26.67% (n=80) females. The age of respondents ranged from 18–80 years old. Of these, two hundred five of the respondents (68.33%) were 18-39 years old (henceforth called young), while 95 (31.67%) were 40-80 years old (henceforth called old). About 52% (n=156) of them were illiterate, 16% (n=48) had received some form of adult education, 23% (n=69) completed primary school, 7% (n=21) completed high school and 2% (n=6) of them were university graduated. In addition, 62 people categorized under five groups were involved in the focus group discussion. Of these, 18 (29.03%) of them were female and 44 (70.96%) were male. The primary sources of their economy was livestock rearing (86% (n=258)) followed by other agricultural productions (9.33% (n=28)). They cultivate cereals, enset, coffee, fruits and root crops extensively. Fishing, poaching and wild honey collection were their additional sources of income (4.67% (n=14)) (Table-1).

Level of human-wildlife conflict in and around CCNP

The wild species collected in the present study comprises 12 carnivores, 6 herbivores and 2 primate species. Of these, large carnivores were mentioned as the most problematic animals followed by herbivores and primates. Lions (*Panthera leo*), spotted hyenas (*Crocuta crocuta*) and leopards (*Panthera pardus*) were the major problematic large carnivores that causing a significant livestock depredation in the study area, while Baboons (*Simia hamadryas*) and Vervet

monkeys (*Chlorocebus pygerythrus*) were the major problematic species in crop raiding (Table-2). Livestock depredation was a major reason for the human-wildlife conflict followed by crop damage and human attacks, respectively (Table-3).

Level of human-wild carnivores' conflict in and around CCNP

Our result shows that lions were the most problematic focal species followed by spotted hyenas and leopards, respectively. The mean scored problems among the three focal carnivore species were significantly different ($\chi^2=6.78$, DF=2, $P<0.005$). Churchura, Sere and Chebera villages had high level conflict intensity (Table-4). The intensities of these large carnivores attack decreased as the distance from the park increased ($\chi^2=22.33$, df=6, $P<0.05$ for lions, $\chi^2=32.45$, df=6, $p<0.05$ for leopards and $\chi^2=55.59$, df=6, $P<0.05$ for hyenas).

Livestock losses by wildlife depredation in and around CCNP

Among the surveyed households, about 48.33% (n=145) of them were owned cattle, 4% (n=12) were owned small livestock and 47.67% (n=143) were owned both cattle and small livestock. Generally, a total of 4,474 livestock (cattle (*Bovinae taurus*), sheep (*Ovis aries*) and goats (*Capra aegagrus hircus*) were owned by the interviewees during the data collection, but none of them had donkeys (*Equus africanus asinus*), horses (*Equus ferus caballus*) and mules (*Equus mulus*) due to the risk of tsetse flies. Of these, about 1364 (30.49%) of them were depredated by wildlife depredation within three years (November, 2007 to January, 2011). High livestock depredation was observed in Churchura and Sere villages (Table-5). Most of the reported livestock attacks (68.6% (n=936)) were occurred at night time. However, majority of the attacks by lions was took place during the daytime including the time when livestock return from

herding place. In other words, attacks by spotted hyenas and leopards were observed both in the day and at night times. The level of livestock depredations among the villages were highly significant ($\chi^2=65.86$, $df=6$, $P<0.05$). Majority of the respondents felt that the population of all focal carnivores and their attacks on livestock had been increasing (Table-6).

Method of livestock husbandry in and around CCNP

About 55% (n=165) of the respondents were keep all of their stocks in grass huts (livestock kraals) at the night that can be easily penetrated by hyenas, 35.67% (n=107) of them were keep their livestock in a tiny houses built for all of their livestock types. However, 9.33% (n=28) of them which was exclusively belongs to Agare village were keep their livestock outside of their home over night. The enclosure construction for livestock among the villages were significantly different ($\chi^2=50.4$, $df=6$, $P<0.05$) (Table-7). In addition, about 9.33% (28) of them were use other additional strategies like guard dogs, collars to frustrate the animals, move around collars with torches and throw stones, and use traditional sound producing weapons during the night time.

During daytime, most respondents (92% (n=277)) keep their livestock in a group within a pasture areas. Of these, about 85.67% (n=257) of them keep their livestock by two or three adults, 3.33% (n=10) were keep by mixing adults. Of those who attend their livestock in group, 3.66% (11) of them were keep their livestock by burning fires around the herding places and produce the sound of whips like that of guns to frighten off predators. In addition, about 11.33% (34) of them attend their livestock by shouting loudly when return from pasture place. However, some respondents (11% (n=33)) leave their livestock in the pastures without attending. The herding systems among the villages were significantly different ($\chi^2=89.65$, $df=6$, $P<0.005$) (Table-8).

Scat analysis of spotted hyena (*Crocuta crocuta*)

Scats of sixty spotted hyenas examined had shown that the diet composition of hyenas contain both domestic (58.62% (n=35)) and wildlife (41.38% (n=25)) preys (Table 9). The result showed a significant variation in spotted hyena preys among the villages ($\chi^2=3.18$, df=6, $P>0.005$).

Economic loss by wildlife animal's depredation

From November 2007 to January 2011, the estimated direct economic losses from all of the depredated livestock by wildlife animals (1364) was estimated to be about US\$ 75,234 \pm 10.6 (Table-10). By extrapolation of the costs for the entire surveyed area, the estimated cost accounted for about US\$ 423,564 per village (Table-11). When analyzed for the households, it is equivalent to US\$83 per household per year. Generally, focal carnivores were most responsible animals for 91.21% of the reported economic losses.

Human attacks by wildlife animals in and around CCNP

Human killing and injuries by large carnivores were also the other observed problems in the study area. According to the focus group discussants, there were seven human attacks by lions, five attacks by hyenas and six injuries by leopards from 2007 to present in and around the park. In addition, four people were injured by buffalos (*Syncerus caffer*) and one child was killed by baboon in 2010 and 2011, respectively. Most discussants (78% (n=234)) agreed that these attacks were happened during people cross the deep forests from their villages to another village.

Methods of carnivores' removal in and around CCNP

People were killing large carnivores as a revenge of their livestock losses and human attacks. Lethal control methods like trapping and shooting have been using in all villages. Lions killing

were the most acute problem in the area. People shifted from direct hunting to trapping due to oppression from government. Generally, we observed two lions, six spotted hyenas and two leopards killed by local people during data collection directly.

Discussion

Human-wildlife conflict arises from a range of direct and indirect negative interaction between humans and wildlife animals (Ocholla et al. 2013). This results a potential harm to both human and wildlife animals, which leads to negative attitudes towards the wild animals (Nyhus et al. 2000). The present study indicates that large carnivores are the most problematic wildlife followed by primates and herbivores (Table-2). Lion was detected as the most problematic carnivores, which is similar with the findings of Datiko and Bekele (2013) in southern Ethiopia, Ogra and Badola (2008) in India and Sogbohossou et al. (2011) in Benin. According to Andrew et al. (2014), severity of the wild animal's conflict increases with the increasing of species body mass. In other words, Dickman (2008) reported that the availabilities of many stocks type in the area can cause a powerful antagonism of pastoralists towards the lions and other large carnivores. However, it contradicts with the finding of Ogara et al. (2010) who reported spotted hyenas as the most problematic carnivores in Kenya. According to Sinclair et al (2003), the prey selection behavior of carnivores is influenced by habitats, and prey density, dispersion and richness of the carnivores. In addition, the surplus killing behavior of lions (breaking into a fenced enclosure and kill domestic animals) can be another reason for the conflict in the area. This trait certainly exacerbates human hostilities towards the lions and conflicts with them (Chardonnet et al. 2010).

The intensive human-wildlife conflict was observed in Churchura and Sere villages (Table-4). This may be due to their very proximity to the park (Dickman 2008). High anthropogenic activities such as agricultural expansion, illegal herding in the park area, burning of bushes and hunting for wildlife are the major factors that may aggravate the intensities of human-wildlife conflict in these villages (Andrew et al. 2014). Simultaneously, poor husbandry methods or changes in human behavior against the wildlife may boost the burden of high human-carnivores conflict (Treves and Karanth 2003). Similar results were reported in Kenya (Patterson et al. 2004), Tanzania (Dickman 2008) and Benin (Sogbohossou et al. 2011).

Livestock depredation was the major consequence of human-wild life conflicts in the study area (Table-3). The result indicated that about 1,364 (30.49%) of livestock were depredated within three years (November 2007 to January 2011) (Table-5). Most of the discussants agreed that livestock depredation is increasing from time to time (Table-6). Behavioral changes of prey animals, habitat encroachment and poor husbandry methods can be the factors for the high livestock depredation in the area (Dickman 2008). Ladan (2014) stated that population expansion in many of African countries has led to uncontrolled encroachment into wildlife habitats, which resulting high intensity of human-wildlife conflict. In addition, poor constructions of night enclosures are associated with the high losses of livestock (Ogada et al. 2003).

Crop raiding is the other major factor for human-wildlife conflict in the present study (Table-3). Primates were the major crops raiding animals. This may be because of their high population density in the study area. Our finding is similar with Mojo et al. (2014) in Gurage Zone, Ethiopia, but it contradicts with that of most east African reports, which claim elephants as the most problematic wild animals in crops damaging (Mariki et al. 2015; Okello et al. 2014). The

difference may be due to their less population densities than primates in the area. According to Parker et al. (2005), the impact of wild animals on crop damage is depends on the multitude of conditions like the availabilities, variability and types of food sources, population density of animals and the types of crop cultivated in the area.

Our results revealed that most of the reported attacks during night were associated with poor management and poor quality of huts (livestock kraals). Therefore, constructing huts or tin enclosures from strong wood and increase protection at night time is very important to reduce the conflict as suggested for other African countries (Butler 2000). In addition, using well-trained domestic dogs can also be a good method to alert herders by the approaching of carnivores (Atickem et al. 2010; Dickman 2008; Hemson 2003). Similar results were reported by Yehune et al. (2009) in Semien mountains, Ethiopia, Bauer and Kari (2001) in Cameroon, Holmern et al. (2007) in Tanzania and Sogbohossou et al. (2011) in Benin.

In other way, the livestock attacks during daytime were associated with poor herding methods of livestock. Therefore, livestock breeders can reduce the problem by simple measures such as strengthening herd composition (Chardonnet et al. 2010; Ogada et al., 2003) and by using guard animals like dogs (Smith et al. 2000). Specially, increasing the number of herders during the severe seasons of conflicts can be the most effective method (Ogada et al. 2003). In addition, creating buffer zones by clearing woodlands along pasture boundaries can also make it easier to detect the approaching of wildlife and may act as a deterrent (Chardonnet et al., 2010). Similar results were reported by Atickem et al. (2010) in Bale mountains, Ethiopia, and Bauer (2009) and Gidey and Bauer (2010b) in Tigray, Northern Ethiopia.

The study of scat analysis in present study confirmed that spotted hyena preys more on domestic animals (58.62%) than wild animals (Table-9). This may be due to the poor livestock husbandries and herding methods in the study area (Kissu, 2008). The diets of spotted hyenas included scavenge of the dead animals including livestock. Our finding was compatible with that of Gidey and Bauer (2010a) in northern Ethiopia. However, it was contradicted with the findings of Ogara et al. (2010). This could be due to the difference in preys and predators' abundance, husbandry methods or relative abundances of different livestock (Hemson 2003; Kolowski and Holekamp 2006).

Our finding also shows that there was a significant economic loss by wildlife depredation in the study area. The direct economic loss within three years (November 2007-January 2011) was estimated to be 75,234 US\$ (Table-7), by extrapolation, it was accounted for 423,564 US\$ (Table-8). Butler (2000) reported about 12% of average annual income economic losses from livestock predation per household in Gokwe communal land, Zimbabwe. Similarly, wildlife predation resulted about 2.6% of estimated economic loss of herders per ranch in Kenya (Patterson et al. 2004), and US\$12/ year in Wabe valley of the Bale mountains, Ethiopia (Atickem et al. 2010). The investigated economic losses in the present study can be substantial for the poorest communities. Thus, improving the livestock husbandry methods can be a very important measure to reduce the problem (Gidey and Bauer 2010b).

In addition, certain human attacks by wildlife animals were observed in the area. Human attacks were occasional situation, which resembled with the finding elsewhere in Ethiopia (Bauer and Kari 2001). Factors associated with the attacks were walking alone in the early morning and evening hours when carnivores are active. Thus, encourage people not to walk alone for long distance during high-risk times can be a good measure to mitigate the problem (Frank et al.

2006). In addition, Peterhans and Gnoske (2001) stated that change in environmental conditions and prey availability can cause the likelihood of attacks by the large carnivores. The studies show that human attacks by large carnivores is a serious problem in most of African countries (Bauer and Kari 2001; Gidey and Bauer 2010b; Treves and Karanth 2003). Ethiopia, Mozambique and Tanzania were countries in which serious human attacks by large carnivores were reported (Frank et al. 2006). The intensive human attacks by lions in southern Ethiopia (Bauer 2009) and by spotted hyenas in northern Ethiopia (Gidey and Bauer 2010b) can be the best examples. However, the rate of present report was not so much devastating as compared to other east African countries report (Baldus 2004).

Killing of large carnivores as a revenge of livestock losses and human attacks were a serious problem observed in this study area. Lethal control methods like trapping and shooting have been used in all villages illegally. According to Woodroffe et al. (2005), a threat of livestock losses drives a considerable killing of wild animals. The continuous killing of wild animals as a revenge of their attacks can contribute to the future decline of their population. Similar results were reported in Wabe valley of Bale, Ethiopia (Atickem et al. 2010). Therefore, additional efforts to quantify illegal removals are imperative method to control the problem (Dickman 2008). Strengthen the capacity of protected area managers, stakeholders and communities are also very important to mitigate the human-wildlife conflict in a safe way (Tesemma et al. 2007).

Conclusion

Our study shows that there is an intensive human-wildlife conflict especially with focal carnivores in and around CCNP. Livestock depredations, crop riding and human attacks were the main reasons for the conflicts. Thus, improving methods of livestock husbandries, creating awareness on how to mitigate the problems, strengthen capacity of the concerned bodies to do on

the problem and identify the underlying and deep-rooted drivers of the conflict are the good measures for the conflict resolution.

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Table 1: Number of surveyed pastoralists in the different villages of CCNP

Villages	Total number interviewee		Total
	Male	Female	
Agare	24	11	35
Koisha	43	15	58
Dalba	28	12	40
Sere	29	9	38
Chebera	32	12	44
Yora	25	10	35
Churchura	39	11	50
Total	220	80	300

Table 2. Percentage of species ranked by interviewees and focus group discussion that posing a significant problem in and around CCNP from November 2010 to January 2011

Common name	Scientific name	No problem (n (%))	A small problem (n (%))	A big problem (n (%))
Baboon	<i>Simia hamadryas</i>	0 (0.00)	166 (55.33)	134 (44.67)
Buffalo	<i>Syncerus caffer</i>	92 (30.67)	99 (33.0)	109 (36.33)
Bush Pig	<i>Potamochoerus larvatus</i>	51 (17.00)	150 (50.00)	99 (33.00)
Caracal	<i>Caracal caracal</i>	89 (29.67)	201 (67.00)	10 (3.33)
Cheetah	<i>Acinonyx jubatus</i>	129 (43.00)	138 (46.00)	33 (11.00)
Common dicker	<i>Sylvicapra grimmia</i>	75 (25.00)	225 (75.00)	0 (0.00)
Crocodile	<i>Crocodylinae</i>	115 (38.33)	153 (51.00)	32 (10.67)
Elephant	<i>Loxodonta africana</i>	161 (53.67)	53 (17.67)	86 (28.67)
Hippo	<i>Hippopotamus amphibius</i>	119 (39.67)	140 (46.67)	41 (13.67)
Jackal	<i>Canis aureus</i>	106 (35.33)	194 (64.67)	0 (0.00)
Leopard	<i>Panthera pardus</i>	26 (8.67)	70 (23.33)	204 (68.00)
Lion	<i>Panthera leo</i>	10 (3.33)	59 (19.67)	231 (77.00)
Monkey	<i>Chlorocebus pygerythrus</i>	0 (0.00)	233 (77.67)	67 (22.33)
Serval	<i>Leptailurus serval</i>	84 (28.00)	181 (60.33)	35 (11.67)
Snake	<i>Serpentes</i>	42 (14.00)	211 (70.33)	47 (15.67)
Spotted hyena	<i>Crocuta crocuta</i>	20 (6.67)	64 (21.33)	216 (72.00)
Striped hyena	<i>Hyaena hyaena</i>	31 (10.33)	184 (61.33)	85 (28.33)
Warthog	<i>Phacochoerus africanus</i>	32 (10.67)	181 (80.33)	87 (29.00)
Wild cat	<i>Felis silvestris</i>	56 (18.67)	227 (75.67)	17 (5.67)
Wild dog	<i>Lycaon pictus</i>	91 (30.33)	170 (56.67)	39 (13.00)

Table 3. Reasons given by respondents and focus group discussion for considering surveyed species problematic in and around CCNP from November 2010 to January 2011

Percent (%) of Respondents citing main reason for problem											
Species		N	Threat to stock					Threat to human			
Common name	Scientific name		Large stock	Small stock	Chickens	All stocks	Human only	Human & Stock	Human & crop	Threat to crops	Disease risk
Baboon	<i>Simia hamadryas</i>	300	0	45	8.2	0	2.8	0	0	44	0
Buffalo	<i>Syncerus caffer</i>	208	0	0	0	0	15.4	0	0	80.6	4
Bush pig	<i>Potamochoerus larvatus</i>	249	0	0	0	0	0	0	5	95	0
Caracal	<i>Caracal caracal</i>	211	10.9	72.1	0	17	0	0	0	0	0
Cheetah	<i>Acinonyx jubatus</i>	171	2.8	91.2	0	4.8	0	1.2	0	0	0
Common dicker	<i>Sylvicapra grimmia</i>	225	0	0	0	0	0	0	0	100	0
Crocodile	<i>Crocodylinae</i>	185	10	6	0	3	65.2	15.8	0	0	0
Elephant	<i>Loxodonta africana</i>	139	0	0	0	0	25	0	10	55	10
Hippopotamus	<i>Hippopotamus amphibius</i>	181	0	0	0	0	18.8	0	27.5	53.7	0
Jackal	<i>Canis aureus</i>	194	4.6	83.4	0	10.2	0	1.8	0	0	0
Leopard	<i>Panthera pardus</i>	274	1.8	89.2	0	6.7	0	2.3	0	0	0
Lion	<i>Panthera leo</i>	290	62.8	2.2	0	22.2	2.8	10	0	0	0
Serval	<i>Leptailurus serval</i>	216	0	2	96.1	1.9	0	0	0	0	0
Snake	<i>Serpentes</i>	258	5.2	76.8	0	3.9	2.1	14	0	0	0
Spotted hyena	<i>Crocuta crocuta</i>	280	25.7	49.3	0	20.2	0	4.8	0	0	0
Striped hyena	<i>Hyaena hyaena</i>	169	11.3	73.7	0	12	0	3	0	0	0
Warthog	<i>Phacochoerus africanus</i>	68	0	0	0	0	0	0	2	98	0
Wildcat	<i>Phacochoerus africanus</i>	244	0	0	100	0	0	0	0	0	0
Wild dog	<i>Phacochoerus africanus</i>	209	0	25	0	12.4	0	44.6	0	0	18
Vervet monkey	<i>Chlorocebus pygerythrus</i>	300	0	0	0	0	0	0	0	100	0

Key: Large stock=Cattle, Small stock=Sheep, Goats

Table 4. The mean problem scores for focal carnivores broken down by villages in and around CCNP from November 2010 to January 2011

Species	Problem scores of focal carnivores species in each villages							
	Agare	Koisha	Dalba	Sere	Chebera	Yora	Churchura	Average
Leopard	1.04±15.6	1.70±9.6	1.80±11.4	1.19±7.8	1.80±9.5	2.00±23.1	1.81±33.5	1.61±9.4
Lion	1.22±19.1	1.43±45.0	1.68±7.8	2.00±6.5	2.00±9.2	1.13±5.5	2.00±42.2	1.64±17.2
Sp. Hyena	1.78±11.5	0.97±45.0	1.05±13.1	2.00±3.2	1.50±11.4	1.95±21.4	1.67±19.9	1.56±13.4
Mean	1.34±3.8	1.37±20.4	1.51±2.7	1.73±2.4	1.77±1.2	1.69±9.7	1.83±11.3	1.60±6.9

Table 5. Livestock loss by wildlife depredation among the surveyed villages in and around CCNP from November 2007-January 2011

Villages		Livestock loss by predators					
	Stock types	No. stock	Lion	Leopard	Sp. hyena	Others	Overall
Agare	Cattle	214	21	4	7	2	34
	Sheep	96	0	5	3	17	25
	Goat	112	3	13	9	4	29
	All stock	422	24	22	19	23	88 (6.455%)
Koisha	Cattle	189	3	8	4	2	17
	Sheep	123	0	5	2	23	30
	Goats	19	0	4	0	5	9
	All stock	331	3	17	6	30	56 (4.12%)
Dalba	Cattle	400	5	23	28	3	59
	Sheep	92	7	19	16	6	48
	Goats	127	4	34	16	11	65
	All stocks	619	16	76	60	20	172 (12.52%)
Sere	Cattle	794	107	13	23	8	151
	Sheep	95	3	12	14	7	36
	Goats	356	43	33	31	19	126
	All stock	1245	153	58	68	34	313 (22.95%)
Chebera	Cattle	703	83	33	54	9	179
	Sheep	45	0	5	6	1	12
	Goats	136	13	23	6	0	42
	All stocks	884	96	61	66	10	233 (17.08)
Yora	Cattle	106	11	8	13	8	40
	Sheep	96	0	6	5	4	15
	Goats	78	0	32	3	11	46
	All stock	280	11	46	21	23	101 (7.41%)
Churchura	Cattle	313	94	8	32	5	139
	Sheep	265	20	92	63	17	192
	Goats	115	15	35	11	9	70
	All stock	693	129	135	106	31	401 (29.39%)
All stocks		4474	432	415	346	171	1364 (30.49%)

Table 6. Respondents' opinions regarding the level of livestock depredation by large carnivores and populations of focal carnivore in and around CCNP from November 2010 to January 2011

Species	Level of livestock depredation			Populations of focal carnivore		
	Increased (n (%))	Decreased (n (%))	Don't know (n (%))	Increased (%)	Decreased (%)	Don't know (%)
Lion	236 (78.67)	57 (19.00)	7 (2.33)	169 (56.33)	94 (31.33)	37 (12.33)
Leopard	174 (58.00)	109 (36.33)	17 (5.67)	178 (59.33)	103 (34.33)	19 (6.33)
Sp. Hyena	193 (64.33)	96 (32.00)	11 (3.67)	193 (64.33)	101 (33.67)	6 (2.00)

Table7: The differences in enclosure construction methods for night time in and around CCNP

Villages	Method of husbandry			Total
	Keep in grass hut	Keep in tin house	Kept them outside	
Agare	5	2	28	35
Koisha	37	21		58
Dalba	26	14		40
Sere	23	15		38
Chebera	26	18		44
Yora	19	16		35
Churchura	29	21		50
Total	165	107	28	300

Table 8: Livestock herding methods during the day times in and around CCNP

Villages	Method of husbandry		Total
	Herd in a group	Leave their livestock	
Agare	43	2	35
Koisha	55	3	58
Dalba	35	5	40
Sere	34	4	38
Chebera	38	6	44
Yora	30	5	35
Churchura	42	8	50
Total	277	33	300

Table 9. Relative count (%) of domestic and wild prey types from analysis of spotted hyena scats (n=60) collected in and around CCNP from November 2010 to January 2011

Species	Relative count (%) in each villages							
	Agare	Koisha	Dalba	Sere	Chebera	Yora	Churchura	Average
Cattle	3 (42.90)	4 (40.0)	1 (25.0)	0 (0)	2 (22.22)	4 (40.0)	5 (50.0)	19 (32.76)
Sheep	2 (28.57)	0 (0.00)	1 (25.0)	1(12.5)	1 (11.11)	3 (30.0)	0 (0.00)	8 (13.80)
Goat	1 (14.28)	2 (20.0)	0 (0.00)	2 (25)	0 (0.00)	1 (10.0)	1 (10.0)	7 (12.06)
Waterbuck	0 (0.00)	2 (20.0)	0 (0.00)	1(12.5)	1 (11.11)	1 (10.0)	3 (30.0)	8 (13.8)
Bushbuck	0 (0.00)	0 (0.00)	1 (25.0)	1(12.5)	3 (33.33)	1 (10.0)	1 (10.0)	7 (12.06)
Kudu	0 (0.00)	1 (10.0)	1 (25.0)	2 (25.0)	2 (22.22)	0 (0.0)	0 (0.00)	6 (10.34)
Common dicker	1 (14.28)	1 (10.0)	0 (0.00)	1(12.5)	0 (0.00)	0 (0.0)	0 (0.00)	3 (5.17)
Unidentified	1 (12.50)	0 (0.00)	0 (0.00)	0 (0.0)	1 (10.0)	0 (0.0)	0 (0.00)	2 (3.33)
Identified	7 (87.50)	10 (100)	4 (100)	8 (100)	9 (90)	10(100)	10 (100)	58 (96.67)
Total	8	10	4	8	10	10	10	60(100)

Table 10. Details of economic loss by interviewed households due to depredation by wild carnivores from November 2007 to January 2011 in and around CCNP

Predators	Cattle		Sheep		Goat		Total	
	N	US\$	N	US\$	N	US\$	N	US\$
Lion	324	30,456	30	780	78	1560	432	32,796
Leopard	97	9,118	144	3,744	174	3480	415	16,342
Spotted hyena	161	15,134	109	2,834	76	1520	346	19,488
Others	37	3,478	75	1,950	59	1180	171	6,608
Total	619	58,186	358	9,308	387	7740	1364	75,234

Key: Calculations are based on local market prices in December 2010 for cattle (US\$94), Sheep (US\$26), Goat (US\$20).

Table 11. Details of economic loss for entire study area (extrapolated) due to depredation by wild carnivores from November 2007 to January 2011 in and around CCNP

Predators	Cattle		Sheep		Goat		Total	
	N	US\$	N	US\$	N	US\$	N	US\$
Lion	1742	163,748	210	5,460	568	11,360	2,520	180,568
Spotted hyena	1001	94,094	750	19,500	465	9,300	2,216	122,894
Leopard	397	37,318	816	21,216	1,011	20,220	2,224	78,754
Others	216	20,304	524	13,624	371	7,420	1,111	41,348
Total	3,356	315,464	2,300	59,800	2,415	48,300	8,071	423,564

Key: Calculations are based on local market prices in December 2010 for cattle (US\$94), Sheep (US\$26), Goat (US\$20).

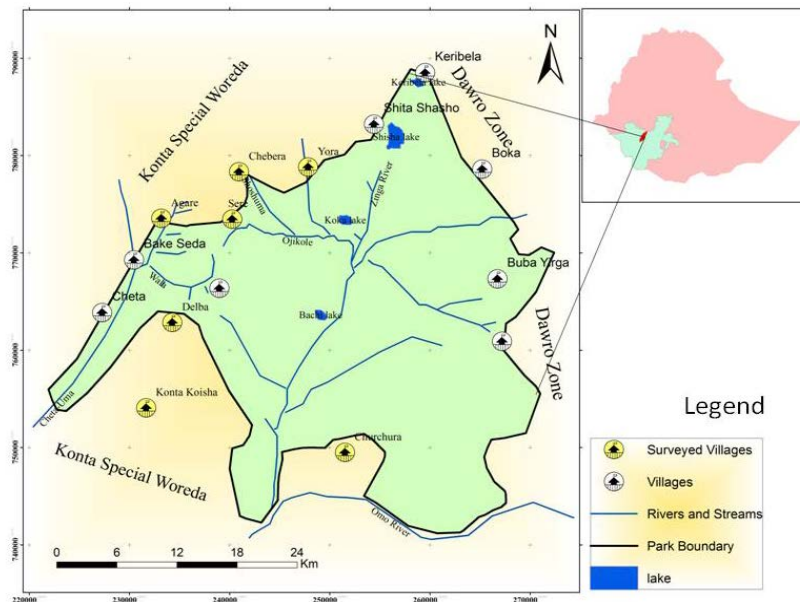


Figure-1. Map of the study area with surrounding villages