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Population status of Anubis baboons and Grivet monkeys and their conflicts with humans in Humbo Community Managed Forest: implications for primate conservation, Wolaita, Southern Ethiopia

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Abstract

Approximately 60% of the non-human primate species have been threatened with extinction and many species have also persisted in small populations in forest fragments. The aim of this study was to estimate the population size of Anubis baboons and grivet monkeys and their conflicts with the local people around Humbo community managed forest. The study area was classified into two habitat types: dense forest and open forest. The total counting method was implemented to determine the number of the non-human primates in the area coverage of 29km^2. Identification of sex and age categories was carried out based on body size, pelage, and external genitalia. A questionnaire was used to collect the data among the households about the human–primate conflicts. The estimated number of Anubis baboon was 424 individuals with a population density of 14.6/km^2 and the estimated grivet monkeys were 256 individuals with a population density of 8.8/km^2. The major types of Anubis baboon and grivet monkey conflicts in the area include crop raiding and livestock predation. The majority (59.01%) of the farmers faced crop raiding. More than half of the respondents replied that guarding was an effective measure to protect the crop damage by the primates. Although the estimated population size of the Anubis baboons and grivet monkeys was lower in the present study area as compared with the studies in other parts of Ethiopia, the frequencies of conflicts of the Anubis baboons and grivet monkeys were increased. Therefore, it is essential to increase the involvement of the local people for the implementation of effective conflict avoiding strategies and primate conservation.

Keywords: Crop damage, Depredation, Non-human primate's management, *Papio anubis* and *Ceropithecus aethiops*

Introduction

Africa has the largest primate fauna in the world, and comprises approximately 175 species (Grubb, 2006). Among these, approximately 25 species of primates are classified as "at risk", ten as "vulnerable" and more than two as “endangered" (Lehman and Fleagle, 2006). In Ethiopia, there are twelve species and two subspecies of primates. Out of the mammals found in Ethiopia, non-human primates consist of about 10.5% species and subspecies (Groves, 2005). Of these, the Gelada baboons (*Theropithecus gelada*) and the Bale monkeys (*Chlorocebus djamdjamensis*) are endemic to Ethiopia (Gippoliti, 2010). However, due to the impacts of human beings, the overall habitats of the wildlife of the country and their biological diversities are decreasing (Afework and Yalden, 2013).

Among the baboon species, *Papio anubis* is the most commonly distributed species, ranging through most of the central sub-Saharan Africa (Groves, 2001; Jolly, 2001). They are highly social animals with a complex multi-male and multi-female social structure. Members of troop travel forage and sleep together (Fedurek and Lehmann, 2017). Crop-raiding occurs mainly at times when few or no fruits are available in the forest. They also feed upon various invertebrates, rodents and chicken on some of the farms adjacent to the forest (Johnson et al., 2012; Kunz and Linsenmair, 2008). Grivet monkeys are also among the most widespread of the African primates and inhabit large parts of sub-Saharan Africa (Pasternak et.al, 2013). They are found across the continent from north-west Senegal to Eritrea, Djibouti and Somalia as well as southward over much of southern Africa (Grubb, 2006; Groves 2005; Shimada et al., 2002; Groves, 2001).

Due to the rapid agricultural activities and declining of the forest, the conflicts between human and non-human primate wildlife are the most interesting problems in countries that depend on agriculture (Demeke and Afework, 2013). In a developing country like Ethiopia, where there is a high degree of dependency on agriculture for subsistence, the conflicts arise (Gebeyehu and Bekele, 2009). As the human population increases and the demand for resources grows, the frequency and intensity of conflicts between wildlife and local people increase (Aberahm et al., 2017; Hockings and Sousa, 2012; Distefano 2010). This can be manifested by increasing encroachments into wildlife habitats. The species that are unable to adapt altered and fragmented habitats are forced to decrease their number and invade marginal habitats (Naughton-Treves, 1997). However, those species that are able to adapt to the changing land-use patterns survive in agricultural systems and become involved in direct competition with humans (Kristin and

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Struhsaker, 1999). Research conducted by Leta et al. (2015) and Mekonnen et al. (2012) showed that habitat destruction, proximity to the natural forest, and increased subsistence utilization are the major causes of human-monkey conflicts. Though many species of animals raid cultivated crops, primates, in particular, can be significant pests because of their opportunism, adaptability, intelligence, and manipulative abilities (Wallace and Hill, 2012).

The mitigations in view of conflicts require a comprehensive record of crop-raiding activity, patterns of raiding, farmers and raiders behavior, crop losses, and the parameters of raiding events (Strum, 2010; Wallace, 2010). Therefore, understanding and addressing the conflicts between humans and primates due to crop-raiding and domestic animals are crucial conservation issues. Globally, traditional methods, such as guarding, chasing, fencing, scarecrows and trapping are used by the community to control their crop damage and domestic animal predation (Kassahun and Afework, 2016; Hockings, 2015).

Effective conservation measures cannot be achieved successfully in the absence of clear information about the details of the population size and conflict of the non-human primates in the area. Therefore, this study provides baseline information on the non-human-primate population size and their conflict to the nearby community in the present study area. This will help conservationists for monitoring population trends and to propose appropriate measures for mitigation of the human-primate conflicts.

Methods and materials

The study area

The study area, i.e. Humbo Community Managed Forest, is located between 6º 43' 48.47" to 6º 48' 04.28" N latitudes and 37°47' 35.47" to 37°57' 14.51" E longitudes with an altitudinal ranges from 1100 to 2300 m. It is found 18km far away from Sodo town, which is the administrative city of Wolaita zone, and 408 km far away from Addis Ababa, the capital city of Ethiopia. The total area of the forest is 29km^2 (Fig. 1). The forest is surrounded by seven Peasant Associations with a total number of 7,560 households. These Peasant Associations are: Bosa Wanche, Bola Wanche, Hobich Bongota, Hobicha Bada, Abala Longena, Abala Gefeta and Abala Shoya.

The socio-economic condition of the people in the study area is mainly agro-pastoralist. The main crops are cereals, such as maize (*Zea mays*), sorghum (*Sorghum bicolor)*, teff (*Eragros*

tistef), pea (*Pisum sativum*), beans (*Faba vulgaris)* cash crops like coffee (*Coffea arabica L.*) root crops like potato (*Solanum tuberosum*), Enset (*Ensete ventricosum*) and sweet potato (*Ipomoea batatas*) and fruits like banana (*Musa paradisca L.*) mango (*Mangofera indica*) and avocado (*Persea americana*), while livestock predominantly include cattle, sheep, goats, chicken and donkeys. The rainfall pattern is bimodal type. There is a short rainy season from March to April while the main rainy season is from June to September. The total annual rainfall in the area varies between 725 mm and 1195 mm with the mean annual rainfall of 1123.2 mm. The dry season of the study area extends from December to February. The average temperature ranges between 24 ^{o}C and 28 ^{o}C and the soil types in the Humbo area have been identified as nitosols (Biryahwaho, et.al, 2012).

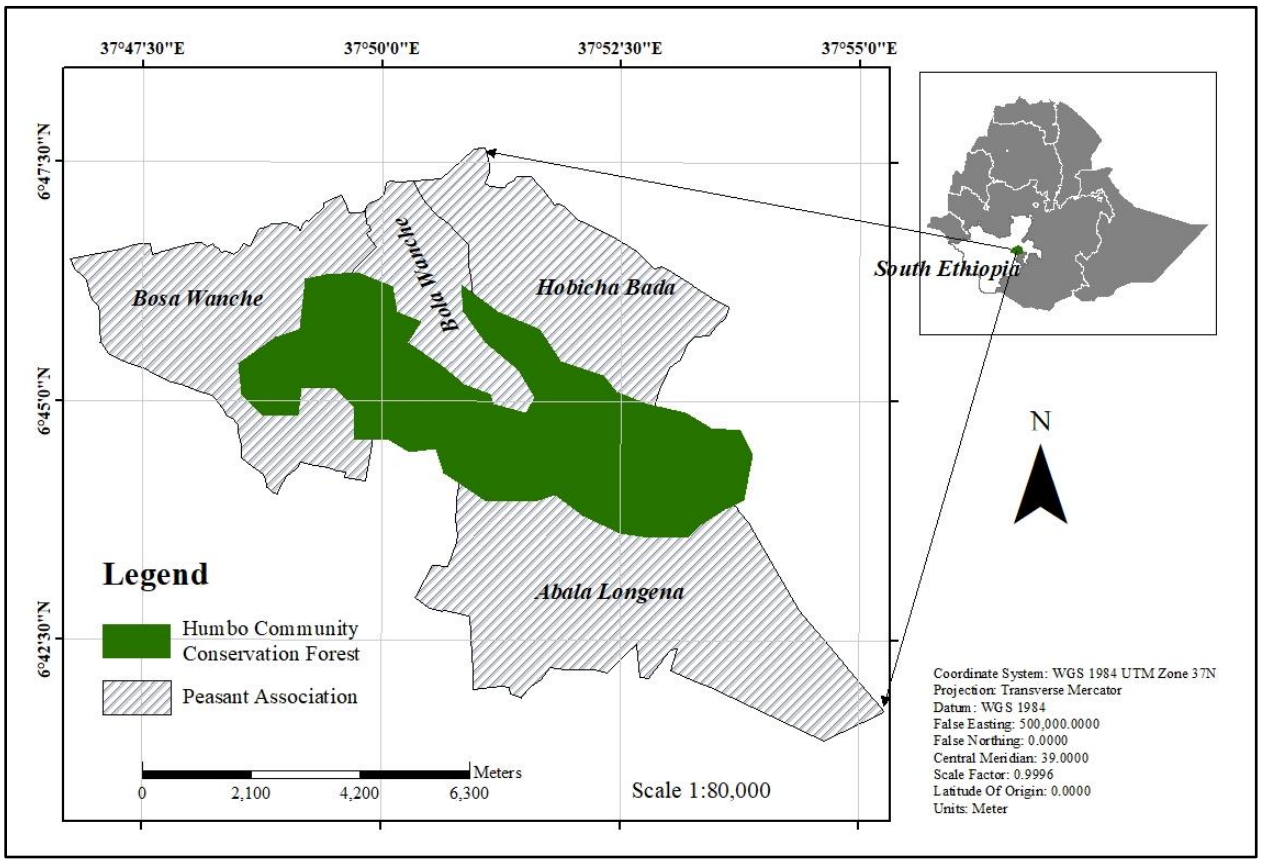

Figure 1. Map of the study area

Humbo Community Managed Forest supports a wide range of wildlife species. The preliminary survey in the area indicated that large mammalian species, such as warthog (*Phacochoerus africanus*), bushbuck (*Tragelaphus scriptus*), common duiker (*Sylvicapra grimmia*), bush pig

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(*Potamocherus larvatus*), leopard *(Panthera pardus),* spotted hyena (*Crocuta crocuta*) and two species of primates; Anubis baboons *(Papio anubis)* and grivet monkeys (*Ceropithecus aethiops*). The area is believed to possess a good diversity of birds, reptiles, amphibians and rodents species. Plant species like *terminalia* spp, *Croton macrostachys* and *Grewia flavescens* are some of the common plant species in the area (Markos, 2016).

Population estimate

The total count method was used to estimate the population size of the non-human primates was adopted by Sutherland (1996); Caughley and Sinclair (1994) and Norton-Griffiths (1978). The study area was stratified into two habitat types, viz., dense forest (the trees crowd together to form a thick canopy) (21 km^2) and open forest (8 km^2). The total study area was divided into four blocks depending on the vegetation cover, artificial and natural boundaries marking as adopted by Burnham et al. (1980). The count at each block was carried out simultaneously by using line-transect method. A total of 28 transects were used. Among these, twenty were in the dense forest and eight were in the open forest habitats. The number of transects in each of the census zones varied depending on visibility. Thus, survey was conducted using subsidiary tracks guided by GPS and compass in each block along selected transects. The length of transects varied from 4.5 to 5 km, and the width of transect from 100m to 150m depending on the habitat type (Burnham et al., 1980). Consecutive transects were at a distance of 1.0–1.5 km. Transect lines were delineated by GPS coordinates or natural signs, such as watercourses, mountain ranges and other natural landmarks. Each transect line was clearly distinguished by its unique number. Transects were surveyed systematically with the help of 56 trained and experienced field assistants at a constant speed to maximize the probability of seeing all individuals on the transect (Norton-Griffiths, 1978). Observers started at the same time, and walked slowly along transects at a speed of approximately 1.5 km per hour and stopped every 100m to search the surrounding area for duration of two minutes before proceeding. Transect counts were carried out for each month during both the dry (December to February) and wet (March to May) seasons, from 06:00 to 10:00 hrs in the morning and 16:00 to 18:00 hrs in the late afternoon when the animals were active and visibility good. During counting, each of the individuals was grouped into its respective sex and age classes and their group size, time of observation, GPS location, habitat type in which the study species dwell in were recorded. The age and sex

categorization were done based on the physical appearance of the primates. External genital organs, body size and pelage were used to classify them as adult, sub-adult, juvenile, and also classified as males or females. Adult males were distinguished from others by their large body size compared to adult females and sub-adult males. Adult females were different from sub-adult females by their larger size. Juveniles were smaller than adults but not carried by their mothers, while infants were carried by their mothers at least occasionally (Gonedele et al., 2009). Silent detection method was followed to minimize disturbances (Wilson et al., 1996). Repeated counting of the same groups was avoided using recognizable features, such as group size, composition and distinct individuals with deformities on different part of the body. The individuals observed per transect were pooled together to estimate the population for the whole study area. Densities of Anubis baboons and grivet monkeys were calculated.

Conflicts between human and Anubis baboons and Grivet monkeys

Data for the conflicts between human-Anubis baboons and grivet monkeys were collected using questionnaire to get primary data among the households. The questionnaire had both open and closed ended questions to obtain information about the conflicts between Anubis baboons and grivet monkeys in the study area. The questionnaire was pretested for 47 randomly selected individuals from all twelve villages of varying age, sex and educational background which were not included in the main sample group. This helped to modify the questionnaire accordingly. Among the seven Peasant Associations around the forest, four were selected (Bola Wanche, Bosa Wanche, Hobicha Bada and Abala Longena) based on their distance from the forest. Twelve villages from the four Peasant Associations were selected purposely based on the information gathered through the preliminary survey, the distance from the forest, problems related to crop loss, livestock depredation and encroachment within the community conservation forest area.

From the total population of 4,320 households in the four Peasant Associations, 366 households were selected randomly for the questionnaire survey based on Yamane (1967) formula.

$n= N/1+N (e)^2$

Where: n= sample size

N= is the population size

e= is the level of precision (%)

$n = 4320/ (1+4320) (0.05)^2 = 366$

These households were randomly selected by following a pattern of skipping one household, and the second household was interviewed. The questionnaire was administered to all households. The questionnaire was written in English, but all questions were translated into and conducted in the "Wolaytegna" local language to reduce misunderstandings during the interviews due to cultural and language differences through back-translation of the script (Müller, 2007). Twenty four local people, consisting of two residents in each of the twelve study villages, were recruited and trained to administer the questionnaires. Each interview occurred for an average of 43 min (ranged: 35–50 min). The covered villages were Shosha (n=32), Lewit (n=29), Hagaze (n=32), Andinet (n=30), Tesfa (n=29), Tiya (n=31), Suriya (n=30), Shako (n=29), Womba (n= 31), Torojiya (n=32), Fana (n=31) and Korobita (n=30), ranging from 0 to 3.5 km apart from the boundary of the forest. The questionnaire consisted of a series of structured questions focusing on two main areas of interest, namely, human–Anubis baboon and grivet monkey conflicts and damage control methods. Data were analyzed using SPSS 20 (SPSS, 2011).

Appropriate statistical methods such as the chi-square test and correlation analysis were used. Chi-square test was used to compare the mean population size, age and sex classes of primate between seasons and the number of predation events between the villages. Correlation analysis was used to find out the relation between the distance of the forest and crop damage and livestock depredation by primates.

Results

Population estimate of Anubis baboon

A mean of 347 $\pm$ 33.1 and 500 $\pm$ 44.4 individuals were recorded during the dry and wet seasons, respectively. The mean population of the Anubis baboons counted for both the wet and dry seasons was 424 $\pm$ 38.72 individuals. The mean population density estimated was 14.16/km^2. Among them, females constituted 216 (57.5%) and males constituted 487 (25.5%) of the population. The ratio of male to female was 1.0: 2.3. Among the observed individuals, 283 (33.4%) was adults, 420 (49.6%) sub adults and 144 (17.0%) was juveniles. The ratio of sub adults to adults was 1.5:1.0. There was significant difference between the number of male and female baboons in the present study area (χ^2 = 82.026, df = 1, $p < 0.05$) (Table 1). The mean group size of Anubis baboons during the dry and wet seasons was 17.5± 1.42 and 25.5± 1.90,

respectively. Sixteen groups of Anubis baboons were recorded during the wet season and 21 for the dry season.

Table 1. Number of the Anubis baboons counted during the dry and wet seasons at Humbo Community Managed Forest

Age and sex structure	Season	Number of observed individuals in each habitat type		
		Dense forest	Open forest	Total
Adult male	Dry	13	18	31
	Wet	16	27	43
Adult female	Dry	38	52	90
	Wet	50	69	119
Sub adult male	Dry	26	28	54
	Wet	34	54	88
Sub adult female	Dry	56	59	115
	Wet	73	90	163
Juveniles	Dry	21	36	57
	Wet	30	57	87
Total	Dry	154	193	347
	Wet	203	297	500
Mean $\pm$ SD		178.5$\pm$59.12	245$\pm$81.89	423.5$\pm$ 38.72

Population estimate of Grivet monkeys

A mean of 256 $\pm$ 23.64 individuals of grivet monkeys was recorded in the present study area. The population size and their structure varied between the wet and dry seasons. A mean of 191 $\pm$ 15.29 and 320 $\pm$ 24.65 individuals was recorded during the dry and wet seasons, respectively. The mean population density estimated was 8.8/km^2. Among them, females constituted 247 (48.3%) and males constituted 121 (23.7%) of the population. The ratio of male to female was 1.0: 2.0. Among the observed individuals, 190 (37.2%) was adults, 178 (34.8%) sub adults and 143 (28.0%) was juveniles. There was significant difference between the number of grivet monkeys counted during the dry and wet seasons (χ^2 = 86.975, df=1, $p<0.05$) (Table 2). The mean group size of grivet monkeys during the dry and wet seasons was 8.6 and 15.2,

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respectively. Nine groups of grivet monkeys were recorded during the wet season and 13 for the dry season.

Table 2. Number of the grivet monkeys counted during the dry and wet seasons at Humbo Community Managed Forest

Age and sex structure	Season	Number of observed individuals in each habitat type		
		Dense forest	Open forest	Total
Adult male	Dry	10	12	22
	Wet	14	20	34
Adult female	Dry	24	29	53
	Wet	33	48	81
Sub adult male	Dry	10`	13	23
	Wet	17	25	42
Sub adult female	Dry	17	23	40
	Wet	30	43	73
Juveniles	Dry	21	32	53
	Wet	33	57	90
Total	Dry	82	109	191
	Wet	127	193	320
Mean $\pm$ SD		104.5$\pm$8.82	151$\pm$14.96	255.5 $\pm$ 23.64

Human– Anubis baboons and Grivet monkey conflicts

Crop damage and domestic animal predation were the major problems identified in the study area. Among the respondents, 59.01% of them reported as they faced crop damage, 25.13% stated domestic animal predation, where as 11.74% reported for both crop damage and domestic animal predation by the primates. Only 4.10% informed that they did not face any problem caused by the Anubis baboons and Grivet monkeys (Table 3). There was a significant differences in the problem caused by Anubis baboons and grivet monkeys (χ^2= 36.25, df = 3, $p < 0.05$).

Table 3. Problems caused by the Anubis baboons and grivet monkeys to the local people around Humbo Community Managed Forest

Village	n=366	Respondents (%)			
		No conflict	Crop damage	Domestic animal predation	Crop damage and domestic animal predation
Shosha	32	0.00	19(59.37)	8(25.00)	5(15.63)
Lewit	29	0.00	18(62.06)	9(31.05)	2(06.89)
Andinet	30	2(6.67)	18(60.00)	6(20.00)	4(13.30)
Hagaza	32	0.00	19(59.37)	8(25.00)	5(15.63)
Tesfa	29	0.00	16(55.17)	7(24.13)	6(20.68)
Tiya	31	2(6.45)	19(61.29)	8(25.80)	2(06.45)
Suriya	30	0.00	19(63.33)	8(26.66)	3(10.00)
Shako	29	2(6.89)	17(58.62)	7(24.13)	3(10.34)
Womba	31	3(9.67)	16(51.61)	8(25.80)	4(12.90)
Torojiya	32	0.00	20(62.50)	10(31.25)	2(06.25)
Fana	31	4(12.9)	17(54.83)	6(19.35)	4(12.90)
Korbita	30	2(6.70)	18(60.00)	7(23.30)	3(10.00)
Mean		4.10±1.42	59.01±1.28	25.13±1.15	11.74±1.31

Types of crops damaged by Anubis baboon and Grivet monkeys

Majority of the respondents (62.05%) described that maize was the most raided crop followed by banana (20.2%), mangoes (15.04%), legumes (5.92%) and sweet potato (3.19%) (Table 4). According to the respondents, the season of crop damage varies with the cropping practices, but most of the crop raiding occurs during the wet season. Most of the respondents, 75.6% revealed as the damage of the crop was sever in the wet season;11.3% of them as it was sever in the dry season and the rest 13.1% of the respondents described that it was serious in both the wet and dry seasons.

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Table 4. Type of crops damaged by the Anubis baboons and Grivet monkeys in the selected villages

Villages	Respondents (%)				
	Maize	Banana	Mango	Legumes	Sweet potato
Shosha	89.80	42.25	32.25	16.75	1.90
Lewit	76.75	13.25	9.75	8.25	2.20
Andinet	48.50	7.02	5.05	0.75	1.90
Hagaza	95.50	49.50	36.75	7.35	5.25
Tesfa	89.80	47.90	34.50	14.25	8.25
Tiya	38.25	4.50	3.25	0.60	0.72
Suriya	47.00	13.50	12.20	0.80	0.90
Shako	93.00	49.75	37.00	14.75	9.25
Womba	12.00	0.00	0.00	0.00	0.00
Torojiya	44.00	8.75	9.25	7.00	0.30
Fana	38.00	2.80	0.40	0.30	0.10
Korbita	72.00	3.25	0.10	0.25	0.20
Mean	62.05±27.50	20.20±20.51	15.04±15.38	5.92±6.42	3.19±3.23

(Total percentage exceeds 100 because the respondents were allowed to give multiple answers)

Distance of the villages and domestic animal depredation

A total of 456 predator attacks were reported by the respondents in the last three years. The number of predation events was different between the villages. There was a significant difference among villages in the total number of domestic animals killed by Anubis baboon ($\chi 2 = 65.32$, df =11, $p < 0.05$). There was a negative correlation ($r = -0.52$, df= 11, $P < 0.05$) between domestic animal loss by the Anubis baboon and the distance of villages from the forest (Table 5).

Table 5. The number of domestic animals killed by Anubis baboons in the last three years (2017-2019)

Villages (n =366)		Number of domestic animals killed by Anubis baboons				
		Distance to the forest	Chickens	Goat	Sheep	Total
Shosha	32	0.5-1 km	32	15	9	56
Lewit	29	1-2.5 km	15	6	2	23
Andinet	30	2.5-3.5 km	11	1	0	12
Hagaza	32	0.5-1 km	43	10	10	63
Tesfa	29	0.5-1 km	37	11	3	51
Tiya	31	2.5-3.5 km	20	0	2	22
Suriya	30	1-2.5 km	26	3	1	30
Shako	29	0.5-1 km	45	12	5	62
Womba	31	3.5 km	19	0	1	20
Torojiya	32	1-2.5 km	30	5	3	38
Fana	31	2.5-3.5 km	10	1	0	11
Korbita	30	0.5-1 km	48	12	8	68
Total			336	76	44	456

Source: Questionnaire survey

Trend of crop damage and domestic animal predation by Anubis baboons and Grivet monkeys

Eighty-three percent of the respondents responded that, the trend in crop damage and domestic animal depredation by non-human primate is increasing. While 17.42% of the respondents noted that the trend is decreasing. Villages that are close to the forest are more affected than those living far from the forest (Table 6).

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Table 6. The trend of crop damage and domestic animal depredations by Anubis baboons and Grivet monkeys in the last three years (2017-2019)

Villages (n =366)		Distance from the forest	Respondents, %		
			Increased	Decreased	Unknown
Shosha	32	0.5-1.0 km	32	0	0
Lewit	29	1.0-2.5 km	25	4	0
Andinet	30	2.5-3.5 km	20	10	0
Hagaza	32	0.5-1.0 km	32	0	0
Tesfa	29	0.5-1.0 km	29	0	0
Tiya	31	2.5-3.5 km	20	11	0
Suriya	30	1.0-2.5 km	26	4	0
Shako	29	0.5-1.0 km	29	0	0
Womba	31	3.5km	20	11	0
Torojiya	32	1.0-2.5 km	25	7	0
Fana	31	2.5-3.5 km	20	11	0
Korbita	30	0.5-1.0 km	29	0	0
Total			275	58	0

Source: Questionnaire survey

Mitigation methods for the impacts of the non-human primates

Villagers adopted different methods to minimize the crop damages and domestic animal depredations by the Anubis baboons and grivet monkeys in the study area. The major techniques deployed were guarding, scarecrow, chasing by dogs and hunting. Most of the respondents (54.42%) reported that guarding was an effective method in all of the villages followed by chasing using guarding dogs (25.7%) (Table 7). There was a significant difference in the use of different traditional techniques to control the crop damage and domestic animal depredation among the villages in the study area ($\chi 2 = 121.31$, df =3, $P < 0.05$).

Table 7. Methods used by respondents of different villages to minimize the crop damages and livestock depredations

Villages	n (366)	Respondents, %			
		Hunting	Guarding	Scarecrow	Chasing by dogs
Shosha	32	4(12.32)	17(53.37)	4(11.32)	7(23.99)
Lewit	29	0.0(0%)	16(56.06)	2(6.81)	10(33.94)
Andinet	30	4(12.45)	18(59.37)	1(3.75)	7(24.25)
Hagaza	32	3(9.75)	19(59.37)	2(5.34)	8(25.54)
Tesfa	29	0.0(0%)	16(55.17)	8(27.31)	5(16.03)
Tiya	31	4(11.45)	18(58.34)	0.0(0%)	9(30.21)
Suriya	30	0.0(0%)	17(56.79)	4(14.12)	9(29.09)
Shako	29	4(13.8)	17(58.62)	1(4.32)	7(23.26)
Womba	31	3(9.67)	16(51.61)	6(19.32)	6(19.4)
Torojiya	32	0.0(0%)	19(59.45)	3(10.56)	10(30.9)
Fana	31	4(12.9)	17(54.83)	2(5.56)	8(26.71)
Korbita	30	4(13.8)	16(54.06)	2(6.32)	8(25.82)
Total		14.63	54.42	9.56	25.7

Discussions

The baseline information on the animal population size is fundamental to understand the status, demography, and trends of animals and the implementation of effective management strategies for the conservation of species. Therefore, it is essential to have a population estimate of the Anubis baboons and grivet monkeys from time to time in order to take suitable management and conservation decisions at Humbo Community Managed Forest. The wet season census showed high number of the Anubis baboon and grivet monkey population estimates compared to that of the dry season. This variation might be due to migration of the animals to the area and the better quality of food availability during the wet season. During the wet season, farmland across the forest was attractive and provided plenty of food sources for primates, and the availability of *Syzygium guineense* which is the dominant plant species in the study area produces more fruit during the rainy season that provide a better diet in the habitats. More young animals were also observed during the wet season (Dessalegn and Afework, 2014). The above cases might be the

reasons for the variation in the number of Anubis baboons and grivet monkeys during the wet and dry seasons. During the dry season, a high human disturbance and domestic animal pressure were observed in the open forest area and less agricultural activities around the forest. Thus, the Anubis baboons and grivet monkeys might move from the open forest to dense forest which made counting difficulties. The result of this study is in agreement with the study conducted by Kate (2012) in Hoima District, Uganda.

A balanced population structure should be maintained in any animal population for optimal productivity because deviation from such an age structure could adversely affect the population growth rate. Yet, the ratio of the age and sex classes in a population can be an indication of its current and expected reproductive status (Ankel, 2007). There were a high proportion of females in the population of Anubis baboons and grivet monkeys indicating that the primates had the potential to increase in number. In both Anubis baboons and grivet monkeys, females mostly stay in troops throughout their lives while males sometimes move from the groups and search for food. This behavior might expose males to predator attacks as indicated by Johnson, et.al (2015). The female-biased sex ratio among adults was reported in many primate populations (Eshetu and Balakrishnan, 2015; Zewdu et al., 2013).

Anubis baboons and grivet monkeys live in troops but the size varies in a different area. They were seen in smaller groups during the dry season and in larger groups in the wet season. The variation in the social group size might be related to the availability of food in the area. In the present study, during the dry season, food resources were poorly observed and this might result in the dispersal of the foraging group. The primates might adjust their group size to accommodate variations in the forage distribution and availability (Beehner et al., 2008). This might help them to get distributed food sources in all of the habitats. On the contrary, Ankle (2007) reported that the group size increases during the wet season. The availability of food, absence of competition, cover to escape from predators, the opportunity for reproduction, and escape from the climatic extremes, determine the preference of animals for a specific habitat type (Gonedele et al., 2012). The majority of the Anubis baboons and grivet monkeys were counted from the open forest habitat type both during the wet and dry seasons. This might be due to the relatively more availability of food in this habitat than that of the dense forest. However, their distribution was not uniform across the two habitats of the study area.

The result of the present study has shown that there is a strong conflict between Anubis baboons and grivet monkeys and the local community in the study area. Baboons are the most destructive crop-raiding animals around Humbo community-managed forest. According to Sillero-Zubiri and Switzer (2001), Anubis baboons and grivet monkeys are notorious crop raiders across much of their range in Africa and Arabia. They came at any time during the day and consume whatever crop was in the field. They tended to raid fields surrounded by large trees and rocky hillocks which provided cover for them. These vantage points provide them with easy escape routes and made it difficult for guards to follow them. Baranga et al. (2012) noted that primates are particularly successful crop raiders due to their cooperative behaviors, opportunistic lifestyle, non-specialized, and omnivorous diet and their abilities to learn rapidly and change their behavior accordingly.

For farmers living in proximity to forest boundaries, crop loss and livestock predation represent a considerable barrier in securing a sustainable livelihood, especially crop loss as it is closely related to food security and income (Wallace and Hill, 2012). The present study showed that living in close proximity to protected areas imposed costs, such as loss of crops and livestock by the primates, and spent their time and resources by guarding their properties from the non-human-primates attack. An increasing of the distance of the villages from the forest boundary causes the decreasing of crop-raiding and predation on the livestock.

In the present study area, distance to the forest was strongly correlated with the crop losses and depredation risks. For instance, in villages, such as Shosha and Hagaza high levels of crop and domestic animal losses were observed. These villages were near to the forest than the other villages; therefore, they were affected more by the Anubis baboons and grivet monkeys. Hill (1997) also found that most of the farms which experienced severe crop-raiding in western Uganda were within 100 m of the forest area. Most of the respondents reported that the intensity of crop damage by the Anubis baboons and grivet monkeys has increased in recent years. This was probably associated with the increase of the Anubis baboon and grivet monkey populations and the number and extent of the farmlands close to the habitats of the Anubis baboons and grivet monkeys (Mesele et al., 2008). The Anubis baboons and Grivet monkeys frequently cause damage to the maize crop. This is because maize was the most common cultivated crop in the study area when compared to the other crops. Similarly, Saj et al. (2001) suggested that, some

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crops may receive more damage due to the fact that they are more widely grown than the other crops.

Human-wildlife conflict is a complex problem, requiring a combination of approaches to manage the conflict. The strategies aimed at one location may be ineffective in other locality. The farmers' choice of these interventions depends on a number of factors, such as the presence and severity of crop damages, the availability of local resources, and the specific type of animal causing the destruction (Kate, 2012). Farmers in the study area developed different strategies to prevent the damage of crops and predation of their livestock against the Anubis baboons and grivet monkeys. Among the mitigation techniques, guarding was the major method utilized by many of the farmers in protecting their crops from damage by pest primates. Similarly, guarding was a prominent method in different parts of Africa to protect their crop and livestock from wildlife attack (Eshetu and Balakrishnan, 2015).

Chasing by guarding dogs and making scarecrow were also common methods used in the study area. In these findings, men and children were mainly involved in guarding the crop from the damage by the pest primates. Similar study was carried out by Kate (2012) in Hoima district in Uganda showed that adults particularly women were least involved in the guard and two-third of all the crop guarding was performed by children. Losses might generate other costs to the household members including an increased need to the guard fields which create labor bottlenecks in certain seasons, disruption of schooling since children are needed to help guard family fields, increased risk of injury and contracting diseases from the wildlife.

Conclusions

The study provided relevant information on population status of Anubis baboons and grivet monkeys and their conflicts with local people around Humbo Community Managed Forest. The number of Anubis baboons and grivet monkeys varies based on their sex/age and their habitat types. The estimated population size of the Anubis baboons and grivet monkeys in the present study area was fewer than the studies in other localities of Ethiopia. The frequencies of conflicts were increased in the present study area. Therefore, to alleviate the existing problems, sustainable conservation measures are needed in collaboration with all the concerned stakeholders and further research should also be undertaken to save the Anubis baboons and grivet monkeys in this Managed Forest.

Conflict of interest

The authors declare that they have no conflict of interest.

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