International Journal of Ecology and Environmental Sciences 49: 31-40, 2023
ISSN: 2320-5199 (Online); https://doi.org/10.55863/ijees.2023.2451

Population Status of Gelada and its Conflict with Human Around Debre Berhan, Ethiopia

DEREJE YAZEZEW[1,*] AND AFEWORK BEKELE[2]

[1]*Department of Biology, College of Natural and Computational Science, Debre Berhan University, P. O. Box 445, Debre Berhan, Ethiopia*

[2]*Department of Zoological Sciences, College of Natural Sciences, Addis Ababa University, P. O. Box 1176, Addis Ababa, Ethiopia*

Email: deredbu2003@gmail.com; afeworksimegn@gmail.com

ORCIDiD: 0000-0001-7492-5370 (DY)

[*]**Corresponding Author**

ABSTRACT

Theropithecus gelada is endemic to Ethiopia, mainly in the northern part of the Ethiopian plateau. Despite the relatively long-term research efforts on the population and behavioural ecology of geladas, and its conflict with humans in protected areas, these data are lacking in unprotected areas. Accordingly, this study was conducted to determine population status and to assess human-gelada conflicts around Debre Berhan town. The total count method was adopted during November 2013 - April 2014 to assess population status and data on human-gelada conflicts were collected based on a direct questionnaire survey. A total of 438 geladas were counted during the study period. The number of females was significantly higher than the number of males ($\div^2$ =45.48, df =1, P < 0.05) with a ratio of 1:2.3 males to females. The mean group size of gelada was 43. Fifty seven percent of respondents had negative attitude towards geladas, whereas 30.0% had a negative attitude and 12.3% had neutral attitudes. The average annual crop loss by gelada was 2 quintal per household. The trend of crop damage by geladas is increasing significantly in the study site during the last ten years ($\div$2 = 44.47, df = 2, P < 0.05). The study helps future conservation of species in unprotected areas in the vicinity of agricultural lands.

Key words: Crop Damage, Endemic, Geladas, Population Status, Total Count, Unprotected Areas.

INTRODUCTION

Although Ethiopia is among the world's leader in terms of the richness and endemism of mammalian species, efforts made to their conservation in unprotected areas is questionable due to high pressure of human interference (Tedla 1995). Sadly, over the past century populations and distribution of mammals have been reduced through loss of habitat, hunting, agricultural expansion, logging, overgrazing and intense land degradation (Fernando et al. 2005, Tefera 2011). Ethiopia has endemic primate species and subspecies such as the Bale monkey (*Chlorocebus djamdjamensis*), Boutourlini's blue monkey (*Cercopithecus mitis boutourlinii*) and the gelada *(Theropithecus gelada).*

T. gelada is endemic to Ethiopia, mainly in the northern part of the western Ethiopian plateau. It occurs in the provinces of Tigray, Wollo, Gondar, and Shewa (Fig. 1) between latitudes 9° and 14° N in rocky gorges and precipices at altitudes between 2350- 4400 m asl (Abie et al. 2017, Abu et al. 2018, Amera 2019, Girmay and Tesfay 2020, Trede et al. 2020, Yalden et al. 1977, Zinner et al. 2018). According to Gippoliti (2010), the full extent of the gelada distribution is still unknown at the moment, and apparent gaps in its distribution range warrant further field research. The study showed three

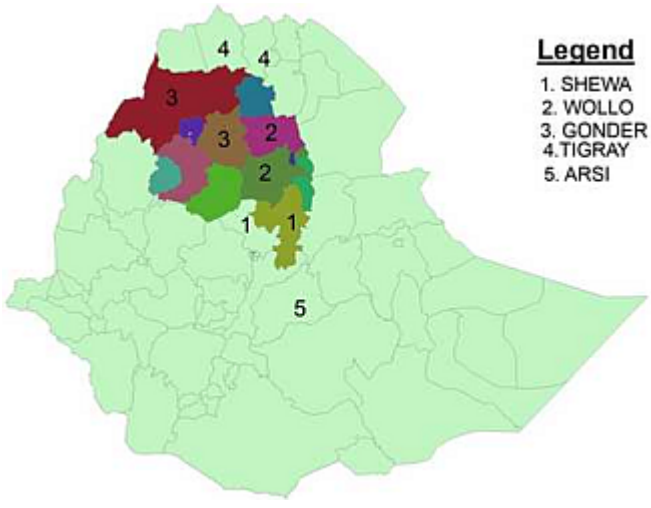

Figure 1. Distribution map of geladas in Ethiopia

evolutionary units of geladas based on the correspondence of the mitochondrial and microsatellite analyses and the allopatric ranges of these three populations (Trede et al. 2020). *Theropithecus gelada gelada* occurrs north of Lake Tana, west of Tekezzie River and *Theropithecus gelada obscurus* (the subject of this study) is found southeast of Lake Tana, East of Tekezzie River (Groves 2005, Yalden 1983) and the southern (tentatively *T. g. arsi*) subspecies located in the extreme south of the Rift valley, on the bank of Wabi Shebelle River (Amera 2019, Belay and Mori 2006, Mori et al. 1999, Shotake et al. 2016).

Primate populations are being impacted globally by human activities such as logging, deforestation, hunting, and other such factors (Fufa et al. 2020, Kifle and Bekele 2020). Nonhuman primates are unanimously and increasingly threatened in tropical forests (Cowlishaw and Dunbar 2000, Rovero et al. 2012) stressing the conservation relevance of data on temporal trends in the abundance of populations (Chapman et al. 2000, Chapman et al. 2010, Yazezew et al. 2022). The land-use systems, particularly the presence of settlements and crop farming, have a major effect on the distribution and abundance of wildlife, mostly causing wildlife populations to decline (Fritz et al. 2003). Research on primates revealed that populations vulnerable to hunting declining in the unprotected areas and have smaller group size as compared to protected areas depicting an effect of human disturbance on population demography (Araldi et al. 2014, Rovero et al. 2015).

The genera *Cercopithicus, Theropithecus, Papio* and *Macaca* are some of the most chronic crop pests because of their intelligence, adaptability, manipulative abilities, wide dietary range, opportunism, complex social organization and aggression (Caselli et al. 2021, Kifle and Bekele 2020, Lee and Priston 2005, Naughton Treves 1998, Sillero-Zubiri and Swetzer 2001). There is a general perception that primates living in human-modified landscapes are often agricultural pests and pose a considerable cost to living in their vicinity (Hill 2000). Factors such as age and gender of farmers, location and type of activity undertaken, and behavioural and ecological characteristics of the animals influence the willingness of individuals to take action in mitigating problems caused by the animals (Hill 2000, Hill and Webber 2010).

Accordingly, much of the challenges in mitigating conflict lie in understanding the human dimensions. The attitude of people concerning the degree of damage is one such dimension, important in establishing an effective conûict mitigation plan (Kansky and Knight 2014). Despite the relatively long-term research effort on population and behavioural ecology of geladas, and its conflict with human in protected areas, information on the assessments of the population trends and conflict with humans is patchy in unprotected areas.

The present study aims to investigate the population status and human-gelada conflicts in unprotected natural habitats. Thus, the study helps to understand the nature of human geladas conflict, the type of crops being raided, the causes of crop raids, its effects on the livelihoods of local farmers and mitigation strategies against crop-raiding by geladas.

MATERIALS AND METHODS

Study area

This study was carried out in North Shewa Zone of Amhara Regional State around Debre Berhan, Ethiopia (Fig. 2). The area is situated between 9° 40'-9°44'N latitude and 39°28'-39°32'E longitude about 135 km north of Addis Ababa. It lies west of the main road leading from Addis Ababa through Debre Berhan to Dessie. The topography of the area is steep and dissected by ravines and gorges through which rivers and streams flow eventually joining the Blue Nile (Yazezew et al. 2020). The census zone covers a total area of 17 km^2 and the topography is undulated with gorges and cliffs.

The annual pattern of rainfall in the area is bimodal with a long rainy season during June-September (big rain) and a short rainy season during January–April (small rain). The mean annual temperature ranges between 5°C and 23°C, and the mean annual precipitation is 874 mm (Seyoum 2007). The altitude of the study area ranges between 2735 and 2847 m asl.

In addition to *T. gelada*, there are also a variety of wildlife populations in the study area including grivet monkey (*Cercopithecus aethiopes)*, common duiker (*Sylvicapra grimmia)*, crested porcupine (*Hystrix cristata)*, Ethiopian highland hare (*Lepus starcki*), rock hyrax (*Procavia capensis*), spotted

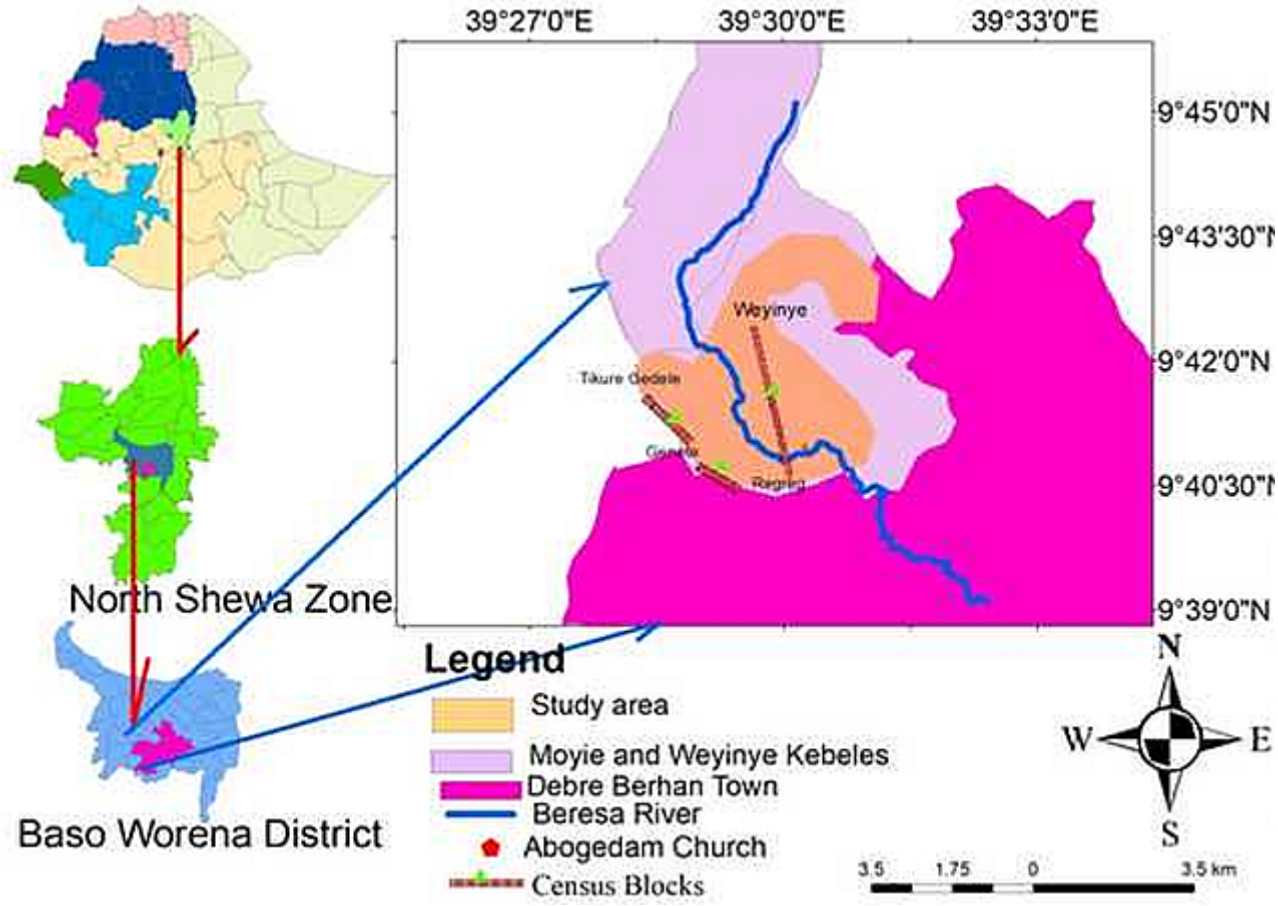

Figure 2. Map of the study area

hyaena (*Crocuta crocuta)*, serval (*Leptailurus serval)* and honey badger (*Mellivora capensis)* (Yazezew et al. 2020). The vegetation type of the study area is mainly scattered shrubs interspersed with annual and perennial herbs in the sloppy area. The main plant species in the area are *Maytenus arbutifolia, Juniperus procera*, *Aloe* spp., *Dodonaea angustifoli*, *Dovyalis abyssinica, Carissa edulis*, *Rosa abyssinica* and *Olinia rochetiana. C*ommunities in the study area are engaged in subsistence agriculture on small plots of lands, extending up to the edge of the cliff. Thus, it is very common to encounter geladas raiding crops.

Study design and site selection

A reconnaissance survey was conducted on foot in the study area in November 2013. During this period, information on climatic conditions, vegetation types, fauna, topography, infrastructure, water sources, and geladas occupancy and distribution in the area were compiled. The preliminary survey helped to identify three gelada census blocks namely, Tikur Gedel-Genete, Genete-Beressa valley/Regreg and Beressa valley/Regreg-Woyinye Afaf (Fig. 2). Data concerning group size (number of individuals) and composition of gelada were recorded from November 2013 to April 2014 while data on human-gelada conflict was collected by questionnaire method.

Data colletion

Population estimate

Total population count method was applied to estimate the population size of geladas at the study site, as the area is open habitat (Beehner et al. 2007, Sutherland 1996). As the undulating terrain of the area is difficult to conduct transect count, gelada population census was made by classifying the study site into three blocks based on the suitability of the area for walking. As a result, all gelada counts were conducted on the same day each season in all geladas known habitats to avoid double counting. Moreover, suitable vantage points (Refera and Bekele 2006) were selected at the border of nearby blocks and trained field assistants were assigned to these sites to check and count if geladas cross from one block

to another. Group size and individual markings or identities such as injuries or swellings on the body parts were used to avoid double counting within a single counting block (Kifle et al. 2013). Three observers were engaged in counting at the same time. Training on the identification of the sex and age categories was given for the personnel involved in geladas counting. The census commenced at 07:00 hour when geladas left their sleeping cliff and move to the plateau for foraging up to 16:00 hour, when geladas begun to move to their sleeping sites in both dry and wet seasons.

The size of the group of geladas was recorded before grouping individuals into their respective age and sex categories. Binoculars were used for better observation and proper sex and age identification. The sex and age category determinations were made based on body size and shape, hair on the back, size of whiskers, and chest and ano-genital skin colour (Beehner et al. 2007, Mori et al. 1999). In line with this, the categories used were adult male, sub-adult male, adult female, sub-adult female, juvenile and infant. Adult males were defined as males with visible manes and overall size about twice that of adult females whereas; sub-adult males were those similar in size to adult females with the early development of mane. Adult and sub-adult females were identified based on body size (Beehner et al. 2007). Juveniles were smaller than sub-adults but larger than infants and not carried by their mothers. Infants were small-sized gelada still being carried by and clinging to the mother in all of the group movements (Fig. 3c).

Human gelada conflict

In order to assess the conflict between human and geladas, questionnaire survey of households was employed and administered for 102 households selected from five villages (Tikur Gedel, Genete, Regreg, Beressa and Woyinye Afaf). Out of these respondents, 35 were females and the rest 67 were males. The households who are most likely to be affected are those living in remote villages or have their fields near or surrounded by escarpments where geladas live (Fig. 3a,b) (Merkebu and Yazezew 2021). These households were randomly selected by following a pattern of skipping one household, and interviewing the second household. The interviewees were selected based on chance encounter (Newmark et al. 1993). A single person was taken to represent their household. The questionnaire was designed to include both open-ended and fixed responses. Participants were interviewed on the types of crops raided, their level of tolerance, how they perceived geladas problem, animals involved in crop-raiding, effects and mitigation strategies against crop-raiding.

Figure 3. Illustration of field observation; (a) human-gelada conflict; b) geladas group foraging; c) gelada Infant and mother

Questionnaires were also designed to solicit information on the losses to farmers in the past 10 years due to geladas and preventative strategies taken to alleviate the problem. The questionnaire also sought to investigate the community's attitudes and perceptions towards geladas and feasible options to resolve the conflict.

The researchers familiarized themselves with local communities before the commencement of actual data collection in which the researchers briefed members of the local community on the purpose of the study to alleviate any suspicions. Ethical considerations of anonymity and right of refusal at any moment were also guaranteed to the participants for this study.

Data analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) software version 20. Descriptive statics and Pearson Chi-Square test had been used to analyze the data. Chi-square test was used to determine the differences among villages with regard to techniques used in protecting crop damage, attitude of local people towards geladas and perceived trends in crop damage. All statistical tests were two-tailed with 95% confidence intervals and level of rejection set at P=0.05.

RESULTS

Population estimate

A total of 438 geladas were recorded from 11 groups. The highest number of gelada individuals (189) was observed in Beressa Valley-Woyinye Afaf block among three groups followed by Genete-Beressa Valley (154). The least number (95) was from Tikur Gedel-Genete block in five groups (Table 1). The group composition investigation revealed that the larger group of gelada (79 individuals) had 8 adult males, 5 sub-adult males, 29 adult females, 15 sub-adult females, 5 young and 17 infants from Genete-Beressa valley block. The smaller group (5 individuals) had four adult males and one sub-adult male from Tikur Gedel-Genete block.

Table 1. Gelada groups with number of individuals at different sites

Site	No. of groups	Total no. per site	Mean group size
Tikur Gedel-genete	5	95	19
Genete-Beressa Valley	3	154	51.3
Beressa Valley- Woyinye	3	189	63
Total	**11**	**438**	**-**

The mean group size of gelada was 43±23. Sub-adult males and young were equally represented (3.7± 1.5) which is lower than other classes. Adult female individuals were higher than all age and sex classes (Fig. 4) followed by infants (9.7± 5.1), sub-adult females (7± 4.6) and adult males (5.3± 3.1). There was no significant difference in the age categories observed in the different census zone in the study area ($F_{2\,434}$= 0.114, P > 0.05). However, the number of females was significantly higher than the number of males (÷2 =45.48, P < 0.05) with a ratio of 1:2.3 males to females, respectively. The ratio of infants to adult females was 1:1.45.

Human-wildlife conflicts

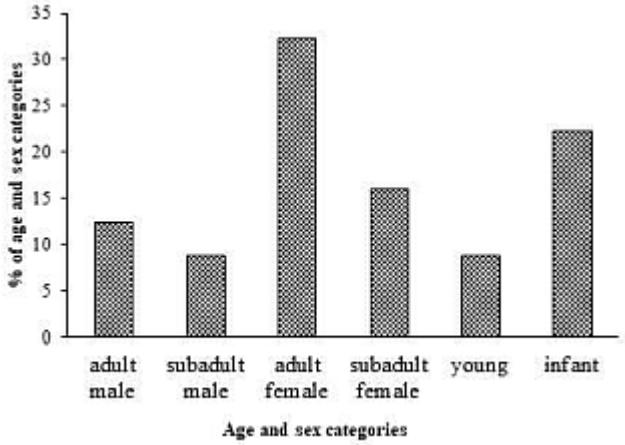

Figure 4. Age and sex distribution of geladas in the study area

A total of 102 respondents were involved in the questionnaire survey of which 67 (65.7%) were males and 35 (34.3%) were females (Fig. 5). Age of respondents ranged from 18 to 72 years. Older males participated more than older females (F_{596}= 94.5, P< 0.05). The age of the majority of the respondents (54%) ranged from 31 to 50 years, while 13.7% of the respondents were older than 60 years.

Most of the people were subsistence farmers on animal rearing, crop farming, or a mixture of both. The main crop growing months are July to December

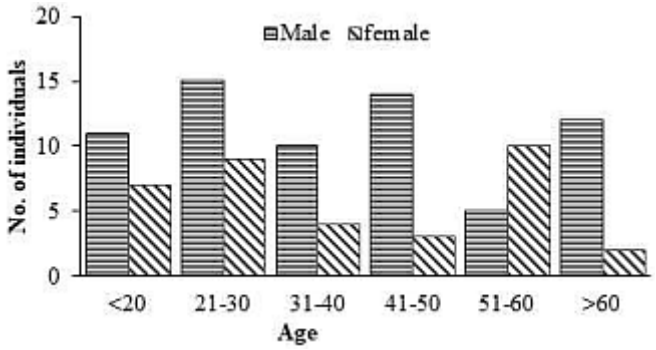

Figure 5. Age and sex classes of respondents in the study area

and the major crop types include barely, wheat, beans and peas. The size of farmlands owned by family heads ranged from two to six hectares with an overall mean of 2.74 ha (Table 2). There was a significant difference in the farmland sizes among villages ($\div^2$= 33.14, P < 0.05).

Geladas were the major crop raiders among others such as grivet monkeys, common duiker, crested porcupine and Abyssinian hare in the area. Among respondents, 75.7% reported that there was crop damage by geladas while 24.3% reported no crop damage. There was significant difference in responses to the question whether there is presence or absence of conflict with geladas ($\div^2$= 22.59, P < 0.05). The average crop loss by geladas per household per year was 2 quintal during the past 10 years (Table 3). There was no significant difference (F_{497}= 1.68, P > 0.05) among villages in terms of crop loss by geladas.

Pearson's Chi-Square test showed that there was no significant difference among villages ($\div^2$= 4.44, P > 0.05) in their response concerning the trend in crop damage by geladas during the last ten years (Table 4). However, 64.2 % of the respondents reported that there was an increased tendency of crop raiding by gelada while 9.8% and 26% reported a decrease and unknown trend in crop damage, respectively. Thus, the perceived trend of crop damage by geladas is increasing significantly in the study site during the last ten years ($\div^2$ = 44.47, P < 0.05). All respondents who reported increasing trend of crop damage by gelada suggested that the reason for the increasing in crop damage was due to the increasing trend of geladas population though no previous population data to triangulate the conformity.

Farmers in the study area exercised different techniques of crop protection from geladas and other crop raiders. Over 52% of the respondents used a combination of guarding and scarecrow techniques most frequently (Table 5). Pearson Chi-Square test showed no significant difference among villages in techniques used to protect geladas from crop raiding ($\div^2$ = 10.91, P >0.05). However, a combination of

Table 2. Households' farmland size (hectare).

Village	Farmland size per household (ha)						
	n	2	2.5	3.5	4	6	Mean
Tikur Gedel	21	14	7	0	0	0	2.2
Genete	24	18	4	0	0	2	2.8
Regireg	29	17	6	0	5	1	2.6
Beressa	13	5	1	2	3	2	3.4
Woyinye-Afaf	15	8	2	0	4	1	2.9
Total	**102**	**62**	**20**	**2**	**12**	**6**	**2.8**

Table 3. Crop loss (in quintal) by geladas per household among villages during the past 10 years (2003-2012).

Villages	Annual crop loss by gelada per household in quintal						
	n	1	1.5	2	2.5	3	mean±SE
Tikur Gedel	14	4	2	3	2	3	1.9 ± 0.8
Genete	18	4	1	8	3	2	1.9 ± 0.6
Regireg	19	6	2	5	3	3	1.97 ± 0.7
Beressa	11	3	0	6	0	2	1.9 ± 0.7
Woyinye-Afaf	13	0	1	6	3	3	2.3 ± 0.5
Total		**17**	**6**	**28**	**11**	**13**	**2.0 ± 0.7**

Table 4. Perceived trends (%) of crop damage by geladas among villages.

Village	Trends in crop damage by gelada			
	n	Increasing	Decreasing	Unknown
Tikur Gedel	21	61.9	4.8	33.3
Genete	24	54.2	16.67	29.2
Regireg	29	62.1	6.9	31
Beressa	13	69.2	7.7	23.1
Woyinye-Afaf	15	73.33	13.33	13.3
Mean		**64.2**	**9.8**	**26**

Table 5. Techniques used in the protection of crop raiding at different villages. GA- Gaurding; GS - Gaurding and Scarecrow; PO - Poisioning; TR - Trapping and CAM - Combination of all methods

Villages		Methods (%)				
	n	GA	GS	PO	TR	CAM
Tikur Gedel	21	33.3	47.6	4.8	4.8	9.5
Genete	24	41.7	54.2	0	4.2	-
Regireg	29	44.8	51.7	3.5	0	-
Beressa	13	38.5	53.9	0	7.7	-
Woyinye-Afaf	15	26.7	53.3	6.7	6.7	6.7
Mean		**37**	**52.1**	**3**	**4.7**	**3.2**

guarding and scarecrow was used more than any other techniques used in combination or alone ($\div^2$ = 111.92, P < 0.05). Guarding is suggested to be the most effective technique among others.

Most of the respondents (57.7%) had negative attitude towards geladas, whereas 30.0% and 12.3% of the respondents had positive and neutral attitude, respectively (Table 6). There was a significant difference in the attitudes of respondents towards gelada ($\div^2$ = 26.88, P<0.05). However, there was no significant difference in the attitudes of respondents among the different villages ($\div^2$ = 7.23, P>0.05).

Table 6. Respondents attitude (%) towards geladas by villages.

Village	n	Negative	Positive	Neutral
Tikur Gedel	21	61.9	28.6	9.5
Genete	24	50	37.5	12.5
Regireg	29	55.2	27.6	17.2
Beressa	13	61.5	23.1	15.4
Woyinye Afaf	15	60	33.3	6.7
Mean		**57.7**	**30.0**	**12.3**

DISCUSSION

Knowledge of the sex ratio and age distribution of individual mammals is crucial for the evaluation of the viability of the species, because these variables reflect the structure and dynamics of the population (Wilson et al. 1996). Protection and eventual survival of an animal species can be successful only when its population dynamics are well understood and its economic and other values are recognized. For instance, information on the demographic composition and structure such as sex ratio and age class distribution of a population at any given time manifests the status of the population whether it is stable, increasing or decreasing and important to forecast the population trend in an area. The total number of individual geladas counted in the study area was 438 individuals in 11 groups in three census blocks. The population structure of gelada is female biased. This finding agrees with studies made in Simen Mountains National Park (Asfafaw and Subramanian 2013, Beehner et al. 2007). However, this finding goes against the report from Wonchit valley (Kifle et al. 2013) and Guassa Community Protected Area (Moges and Balakrishnan 2015). The possible reason for this sex imbalance might be due to the selective persecutions of males by farmers and emigration of subordinate and bachelor males to nearby escarpments while females remain in their reproductive units (Dunbar 1980). However, this finding is in line with the research made in Chenek, Simien Mountains National Park (Ejigu and Bekele 2017). The average ratio of infants to adult females (1:1.45) might suggest an increase in the population of gelada. The ratio also indicates higher percentage of breeding females or lower percentages of infant mortality (Fig. 6).

There was variation in the number of geladas among the different census blocks. The possible reason for this variation among sites might be the inhospitality of the cliffy area in some blocks over others associated with highest human disturbance along with their agricultural activities and domestic

Figure 6. More females of geladas carried infants in the group

animal competition pressure (Yazezew et al. 2020). Accordingly, understanding the relationship between human agriculture development and wildlife is important to assess the threat to wildlife diversity, and to define areas for potential human-animal conflict (Fritz et al. 2003).

The questionnaire survey result of this study has clearly revealed that there was a strong conflict between geladas and farmers living around Debre Berhan in all study sites. Crop raiding is becoming one of the most common conflicts affecting human-wildlife relationships in the study area due to the expansion of cultivated land into previous wildlife habitats (Caselli et al. 2021, Kifle and Bekele 2020, Merkebu and Yazezew 2021, Sillero-Zubiri and Swetzer 2001). Particularly, geladas have been mentioned as nuisance crop pests that raid crops from the time of sowing until harvesting. Primates are the high ranking wild animals among the species that cause damage to farmers' yield (Ndava and Nyika 2019, Wiafe 2019). There was no variation in the intensity of crop damage among villages which is contrary to the findings of Yihune et al. (2008). The situation will likely become worsen as the human population increases leading a demand for more land to cultivate that exacerbates the interface between people and wildlife. Thus food security and livelihoods of smallholder farmers' households is in a severe threat by wildlife such as primates that cause crop damage (Siljander et al. 2020).

Different techniques have been used to ameliorate crop damage by geladas. The most frequently used one in the study is a combination of guarding and scarecrow. Studies revealed that guarding is a popular method of protecting crops in different parts of Africa although it can be costly through time that could be spent elsewhere (e.g. women doing housework, children attending school, men doing farm activity) (Biset et al. 2019, Kifle et al. 2013, Sillero-Zubiri and Swetzer 2001, Yihune et al. 2008). However, some respondents in the present study disclosed that, they have killed geladas by poisoning. Besides poisoning, they also use trapping of gelada by snare and expose the dead animal as part of scarecrow to deter the live geladas from crop raiding. However, they claimed that such crop raiding prevention methods are currently being forbidden by the government. Crop raiding by geladas is becoming disastrous for farmers with small family size, as the population of gelada is unmanageable for individual farmers. Particularly, it is difficult for females and children to deter gelada during the months of October to December though not impossible. Majority (57.72%) of the respondents in the study area had negative attitude towards geladas. This finding is in line with the reports made by studies at Simien Mountains National Park and at Wenchit valley (Kifle et al. 2013, Yihune et al. 2008).

CONCLUSION

These studies provides relevant baseline information on gelada population status and its conflict with human around Debre Berhan. The population of gelada in the area is female biased. However, it is impossible to track trends of the population size of geladas whether as increasing, decreasing, or stable, in this single census. Thus it requires future study to track the trajectory of population status whereby this data will be deployed as a benchmark. Geladas are restricted to the bare cliffy habitat, which is left marginal due to its inaccessibility and soil infertility for cultivation. Conservation of geladas outside protected areas is difficult without the acknowledgement of the human dimension to problems of conflict with geladas. Whenever there is deficient resource in an area, people compete with wildlife for overlapped requirements such as space, food and other resources resulting in a conflict if the competition is severe. As human populations in the area increase, the demand for more land for agriculture and pastureland grow and the conflicts between humans and geladas become severe. Therefore, the government should create job opportunities for unemployed manpower that will be forced to cultivate the infertile escarpments exacerbating further human-gelada conflict. Stakeholders in the region should also engage in enhancing awareness to the local community on the conservation values of geladas and forward means of compensation for crop losses caused by geladas.

ACKNOWLEDGEMENTS

We sincerely thank Debre Berhan University and Addis Ababa University for facilities. We are grateful for Basona Werana Agricultural and Rural Development office for permission to conduct the

study.

Conflict of interest: The authors have no conflicts of interest to declare.

Authors' contributions: DY proposed the research idea and collected the data, organized the data in computer and did the analysis, interpretation, and identification, and wrote the manuscript. AB revised both the draft manuscript and the final versions for scientific content.

REFERENCES

Abie, K., Bekele, A. and Mekonen, A. 2017. Daily activity, feeding ecology and habitat association of Gelada baboon (*Theropithecus gelada*) around Debre-Libanos, Northwest Shewa Zone, Ethiopia. International Journal of Biodiversity and Conservation, 9(6), 232-238.

Abu, K., Makonnen, A., Bekele, A. and Fashing, P.J. 2018. Diet and activity patterns of Arsi geladas in low elevation disturbed habitat south of the Rift Valley at Indetu, Ethiopia. Primates, 59, 153–161.

Amera, M. 2019. Population Status, Diets, Activity Budget and Range Use by Arsi Gelada (*Theropithecus gelada arsi*) in Eastern Arsi, Ethiopia. PhD thesis, Zoological Science, Addis Ababa University, Addis Ababa, Ethiopia. 205 pages.

Araldi, A., Barelli, C., Hodges, K. and Rovero, F. 2014. Density estimation of the endangered Udzungwa red colobus (*Procolobus gordonorum*) and other arboreal primates in the Udzungwa Mountains using systematic distance sampling. International Journal of Primatology, 35, 941–956.

Asfafaw, H. and Subramanian, C. 2013. Population size and structure of gelada baboon (*Theropithecus gelada*, Ruppel, 1835) in Simien Mountains National Park, Ethiopia. Global Journal of Biological and Agricultural Health Sciences, 2, 102-106.

Beehner, J.C., Gebre, B., Bergman, T.J. and McCann, C. 2007. Population estimate for geladas (*Theropithecus gelada*) living in and around the Simien Mountains National Park, Ethiopia. SINET: Ethiopian Journal of Science, 30(2), 149-154.

Belay, G. and Mori, A. 2006. Intraspecific phylogeographic mitochondrial DNA (D-loop) variation of gelada baboon (*Theropithecus gelada*) in Ethiopia. Biochemical Systematics and Ecology, 34, 554-561.

Biset, A., Mengesha, G. and Girma, Z. 2019. Human–wildlife conûict in and around Borena Sayint National Park, northern Ethiopia. Human Wildlife Interactions, 13(1), 111-124.

Caselli, M., Zanoli, A., Dagradi, C., Gallo, A., Yazezew, D., Tadesse, A., Capasso, M., Ianniello, D., Rinaldi, L., Palagi, E. and Norscia, I. 2021. Wild geladas (*Theropithecus gelada*) in crops—more than in pasture areas—reduce aggression and affiliation. Primates, 62(4), 571-584.

Chapman, C.A., Balcomb, S.R., Gillespie, T.R., Skorupa, J.P. and Struhsaker, T.T. 2000. Long term effects of logging on African primate communities: a 28 year comparison from Kibale National Park, Uganda. Conservation Biology, 14, 207–217.

Chapman, C.A., Struhsaker, T.T., Skorupa, J.P., Snaith, T.V. and Rothman, J.M. 2010. Understanding long term primate community dynamics: implications of forest change. Ecological Applications, 20(1), 179-191.

Cowlishaw, G. and Dunbar, R. I. 2000. Primate conservation biology. University of Chicago Press, Chicago.

Dunbar, R.I.M. 1980. Demography and life history of a population of gelada baboon(*Theropithecus gelada*). Journal of Animal Ecology, 49(2), 485-506.

Ejigu, D. and Bekele, A. 2017. Population structure and group size of geladas (*Theropithecus gelada*) at Chenek, Simien Mountains National Park, Ethiopia. African Journal of Ecology, 55, 564-572.

Fernando, P., Wikramanayake, E., Weerakoon, D., Jayasinghe, A., Gunawardene, M. and Janaka, K. 2005. Perceptions and patterns of human - elephant conflict in old and new settlements in Sri Lanka: insights for mitigation and management. Biodiversity Conservation, 14, 2465-2481.

Fritz, H., Saïd, S., Pierre-Cyril, R., Mutake, S., Coid, C. and Monicat, F. 2003. The effects of agricultural fields and human settlements on the use of rivers by wildlife in the mid-Zambezi valley, Zimbabwe. Landscape Ecology, 18, 293-302.

Fufa, D., Yazezew, D., Degefe, G. and Gebrehiwot, S. 2020. Abundance, diversity, and distribution of primates at Welel Mountain, Kellem Wollega Zone, Oromia Region, Ethiopia. Scientific World Journal, 2020: org/10.1155/2020/5691324.

Gippoliti, S. 2010. *Theropithecus gelada* distribution and variations related to taxonomy: history, challenges and implications for conservation. Primates, 51(4), 291-297.

Girmay, T. and Tesfay, H. 2020. New geographical range of geladas (*Theropithecus gelada*) in Tigray Region, Northern Ethiopia. African Journal of Ecology, 59, 277-280.

Groves, C. P. 2005. Order primates. Pp. 111-184, In: Wilson, D.E. and Reeder, D.M. (Eds.), Mammal Species of the World: A Taxonomic and Geographic Reference. John Hopkins University Press, Baltimore.

Hill, C.M. 2000. Conûict of Interest between People and Baboons: Crop Raiding in Uganda. International Journal of Primatology, 2, 299-315.

Hill, C.M. and Webber, A.D. 2010. Perceptions of nonhuman primates in human–wildlife conûict scenarios. American Journal of Primatology, 72, 919-924.

Kansky, R. and Knight, A.T. 2014. Key factors driving attitudes towards large mammals in conûict with humans. Biological Conservation, 179, 93-105.

Kifle, Z. and Bekele, A. 2020. Human–Gelada Conflict and Attitude of the Local Community toward the Conservation of the Southern Gelada (*Theropithecus gelada obscurus*) around Borena Saynit National Park, Ethiopia. Environmental Management, 65(3), 399-409.

Kifle, Z., Belay, G. and Bekele, A. 2013. Population size, group composition and behavioural ecology of geladas (*Theropithecus gelada*) and human-gelada conflict in Wonchit Valley, Ethiopia. Pakistan Journal of Biological Science, 16, 1248-1259.

Lee, P. and Priston, N. 2005. Human attitudes to primates: perceptions of pests, conflict and consequences for conservation. Pp. 1-23, In: Paterson, J. (Ed.), Commensalism and Conflict: The Primate-Human Interface. Hignell Printing, Winnipeg (Manitoba).

Merkebu, S. and Yazezew, D. 2021. Assessment of human-wildlife conflict and the attitude of local communities to wild animal conservation around Borena Sayint National Park, Ethiopia. International Journal of Ecology, 2021, https://doi.org/10.1155/2021/6619757.

Moges, E. and Balakrishnan, M. 2015. Demographic structures of Gelada (Theropithecus gelada) in Guassa Community Protected Area, Ethiopia. Global Journal of Science Frontier Research (C), 15(1), 18-24.

Mori, A., Iwamoto, T., Mori, U. and Bekele, A. 1999. Sociological and demographic characteristics of a recently found Arsi gelada population in Ethiopia. Primates, 40(2), 365-381.

Naughton Treves, L. 1998. Predicting patterns of crop damage by wildlife around Kibale National Park, Uganda. Conservation Biology, 12(1), 156-168.

Ndava, J. and Nyika, E.H. 2019. Human-Baboon Conflict on Resettled Farms in Zimbabwe: Attitudes and Perceptions among local farmers. Current Journal of Applied Science and Technology, 33(1), 1-10.

Newmark, W.D.; Leonard, N.L.; Sarko, H.I. and Gemassa, D.M. 1993. Conservation attitude of local people living adjacent to five protected areas in Tanzania. Biological Conservation, 63, 177-183.

Refera, B. and Bekele, A. 2006. Population status and structure of Swayne's Hartebeest (*Alcelaphus buselaphus swaynei*) in Mazie National Park, Ethiopia. International Journal of Ecological and Environmental Sciences, 32, 259-264.

Rovero, F., Arafat, M., Amani, K., Philipo, J., Alessandro, A. and Simone, T. 2015. Primates decline rapidly in unprotected forests: Evidence from a monitoring programwith data constraints. PLoS ONE, 10 (2), e0118330.

Rovero, F., Mtui, A.S.; Kitegile, A.S. and Nielsen, M.R. 2012. Hunting or habitat degradation? Decline of primate populations in Udzungwa Mountains, Tanzania: An analysis of threats. Biological Conservation, 146(1), 89-96.

Seyoum, E. 2007. Assessment of the Physicochemical Parameters of River Beressa in Debre Berhan Town (North Shoa) for suitability of drinking water. MSC Thesis, Environmental Science, Addis Ababa University, Addis Ababa, Ethiopia. 73 pages.

Shotake, T., Saijuntha, W., Agatsuma, T. and Kawamoto, Y. 2016. Genetic diversity within and among gelada (*Theropithecus gelada*) populations based on mitochondrial DNA analysis. Anthropological Science, 124(3), 157-167.

Siljander, M., Kuronen, T., Johansson, T., Munyao, M.N., Petri, K. and Pellikka, E. 2020. Primates on the farm – spatial patterns of human–wildlife conûict in forest-agricultural landscape mosaic in Taita Hills, Kenya. Applied Geography, 117, 1-13.

Sillero-Zubiri, C. and Swetzer, D. 2001. Crop Raiding Primate: Searching for alternative, human ways to resolve conflict with farmer in Africa. Oxford University, Oxford, United Kingdom.

Sutherland, W.J. 1996. Ecological Census Techniques: A Hand book. Cambridge University Press, Cambridge.

Tedla, S. 1995. Protected area management crisis in Ethiopia. Walia, 16, 17-30.

Tefera, M. 2011. Wildlife in Ethiopia: Endemic large mammals. World Journal of Zoology, 6, 108-116.

Trede, F., Lemkul, A., Atickem, A., Beehner, J., Bergman, T., Burke, R., Fashing, P.J., Knauf, S., Mekonnen, A., Moges, A., Nguyen, N., Roos, C. and Zinner, D. 2020. Geographic distribution of microsatellite alleles in geladas (Primates, Cercopithecidae): Evidence for three evolutionary units. Zoologica Scripta, 46(6), 659-667.

Wiafe, E. D. 2019. Primates crop raiding situation on farmlands adjacent to South-West of Mole National Park, Ghana. Ghana Journal of Agricultural Science, 54(2), 58-67.

Wilson, D.E., Cole, F.R., Nichols, J.D., Rudran, R. and Foster, M. 1996. Measuring and Monitoring Biological Diversity. Standard Method for Mammals. Smithsonian Institute Press, Washington.

Yalden, D. 1983. The extent of high ground in Ethiopia compared to the rest of Africa. SINET: Ethiopian Journal of Science, 6(1), 35-39.

Yalden, D., Largenc, M. and Kock, D. 1977. Catalogue of the mammals of Ethiopia: 3. Primates. . Italian Jounrnal of Zoology, 9(1), 1-52.

Yazezew, D., Bekele, A., Fashing, P.J., Nguyen, N., Moges, A., Ibrahim, H., Burke, R.J., Eppley, T.M. and Mekonnen, A. 2022. Population size and habitat preference of the Omo River guereza (*Colobus guereza guereza*) in a multi habitat matrix in the central highlands of Ethiopia. Primates, 63, 151-160.

Yazezew, D., Bekele, A. and Ibrahim, H. 2020. Activity budget and feeding ecology of Geladas (*Theropithecus gelada obscurus*) around Abogedam Church west of Debre Berhan Town, Ethiopia. Scientific World Journal, 2020: https://doi.org/10.1155/2020/9829834.

Yihune, M., Bekele, A. and Tefera, Z. 2008. Human–gelada baboon conflict in and around the Simien Mountains National Park, Ethiopia. African Journal of Ecology, 47, 276-282.

Zinner, D., Atickem, A., Beehner, J.C., Bekele, A., Bergman, T.J., Burke, R., Dolotovskaya, S., Fashing, P.J., Gippoliti, S. and Knauf, S. 2018. Phylogeography, mitochondrial DNA diversity, and demographic history of geladas (*Theropithecus gelada*). PLoS ONE, 13(8), e0202303.

Received:9th February 2022
Accepted:16th July 2022