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# Community perceptions of grivet monkey crop depredation in the Ethiopian Highlands: implications for primate conservation

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**Abstract:** Human–primate conflicts in Africa have been increasing due to increased human population growth and the resulting competition for forest resources. The Ethiopian Highlands in northern Ethiopia, home to the grivet monkey (*Chlorocebus aethiops*), once consisted of large forested areas. This region has been severely denuded and now exhibits only small forest patches remaining at sites with special cultural significance in the immediate vicinity of churches. These forest patches, surrounded by agricultural crops, provide refugia habitat for the grivet monkey. We randomly surveyed 50 villagers living near the Batiero Church Forest, a 45-ha forest patch located in northern Ethiopia, to determine villagers' perceptions of the crop damage caused by the monkeys and mitigation measures to reduce crop loss. Most respondents expressed negative perceptions (74%) toward grivet monkeys, and 50% of respondents reported that crop damage was the most encountered problem in the study area. The perception of villagers to grivet monkeys differed based on farmland size ( $P = 0.00$ ). To reduce crop damage, 53% of households used dogs to guard their farmland and 44% employed methods to physically scare or harass monkeys to protect their crops. At present, the villagers do not receive any government compensation for crop depredation. Thus, the villagers we surveyed wanted to eliminate the grivet monkey populations. This study provided insight into villager perception regarding human–primate conflicts that can impact primate conservation efforts in other areas where human encroachment into primate habitats is increasing.

**Key words:** *Chlorocebus aethiops*, community perception, conservation, Ethiopia, grivet monkey, human–primate conflict, wildlife damage

**HUMAN–PRIMATE CONFLICT** has been a recurring problem in Africa due to increased human population and the resulting competition for forest resources (Hockings and Sousa 2012). The conversions of primate forest habitats to agricultural crops have impacted primates and other wildlife through habitat loss and fragmentation (Baranga et al. 2012). Habitat destruction also decreases the amount of available habitat, leading to restricted animal movement between habitable patches of land and decreasing gene flow between populations. Thus, inbreeding increases and genetic drift accelerates (Hockings and Sousa 2012).

Extension deforestation of native trees that are main food sources for primates and the planting of commercial tree species that do not provide food sources have also contributed to increased primate crop depredation, further exacerbating human–wildlife conflicts (Sillero-Zubiri and Switzer 2001, Ahsan and Uddin 2014). Primates that destroy agricultural cereals, fruit, and

crops may be beaten, injured, and killed by the local community (Peterson et al. 2010). Species conservation depends on the interaction of social and ecological factors; a better understanding of the perceptions of local people toward wildlife is a prerequisite in designing species management and conservation strategies (Chauhan and Pirta 2010). Ecological factors include destruction of natural habitat, isolation of forest areas, and agricultural expansion (Ahsan and Uddin 2014). Social factors include changing knowledge, attitudes, and traditional subsistence habits. Increased human–primate conflicts may pose a conservation threat for primate populations. Thus, the perception of local people toward the natural resources and the effects of interaction of people should be studied (Sharma et al. 2011).

In Ethiopia, human–primate conflicts have been previously studied in Semien Mountains National Park where crop raiding by Gelada baboons (*Theropithecus gelada*) seriously affects farmers (Mesele et al. 2008, Mojo et al. 2014).

Mekonnen et al. (2012) reported that the conversion of primate habitats into agricultural land, near the Bale Mountains National Park, resulted in increased crop depredation by the Bale monkey (*Chlorocebus djamdjamensis*) as their native foods were replaced by agricultural crops. Linkie et al. (2007) stated that crop damage by wild animals can make communities antagonistic and intolerant toward them, which may result in retaliation on the problem species.

However, few studies have been conducted in northern Ethiopia where the conflict may be severe due to a high rate of forest degradation and restriction of primates to patches of habitat surrounded by agricultural fields. No published paper is available about public perception of human–primate conflict in patch forests particularly for the grivet monkeys (*Chlorocebus aethiops*) in Ethiopia.

We surveyed villagers in Batiero Church Forest to assess their perceptions of crop damage caused by the grivet monkey and the mitigation measures to reduce crop loss. This study provided baseline information regarding villager perception of human–primate conflicts that could impact primate conservation efforts in areas where human encroachment into primate habitats is increasing.

### Study area

The study was conducted in Batiero Church Forest in the Ethiopian Highlands, Eastern zone of Tigray, northern Ethiopia. The forest is geographically located between 13°30′–13°45′N and 39°30′–39°45′ E. Altitude ranges from 1,800–3,000 m above sea level. The average temperature of the area is 18°C. Rainfall is erratic but usually intense during July and August, with an annual average of about 668 mm (Ethiopian National Meteorology Agency 2015). This region is severely denuded typified by patches of forest remaining at sites with special cultural significance, such as the immediate vicinity of churches (Aerts 2007). Local communities living near these forest patches use them to support their livelihood. Human activities include firewood collection, grazing, and making farming tools. The expansion of neighboring farm fields continues to encroach into the forest, reducing their size. We focused our study in adjacent villages around a forest patch commonly referred to as

the Batiero Church Forest, which has an area of 45 ha. It is situated in Atsibi, 65 km northeast of Mekelle, the regional capital city of Tigray Regional State.

Aschalew et al. (2017) counted 57 (density ~1.3 ha<sup>-1</sup>) and 50 (density ~1.1 ha<sup>-1</sup>) grivet monkeys in post-rainy season and dry season in the forest, respectively. Because field crops contribute to a portion of the diet of the grivet monkeys in the post-rainy season, local farmers owning fields around the forest have expressed concerns about crop depredation.

There are a number of wild animals in Batiero Church Forest that coexist with the grivet monkey, including spotted hyena (*Crocuta crocuta*), common duiker (*Sylvicapra grimmia*), common jackal (*Canis aureus aureus*), and common hare (*Leporidae* spp.). In addition, the forest contains several species of rodents, birds, amphibians, and snakes. The forest is predominantly composed of indigenous trees including the Family Cupressaceae (*Juniperus procera*), Family Fabaceae (*Acacia sieberiana*), and Family Sapindaceae (*Dodonaea angustifolia*). The Family Myrtaceae (*Eucalyptus* spp.) was planted in and around the study area to rehabilitate land degradation.

### Methods

We surveyed villagers living near the Batiero Church Forest from December 2014 to September 2015 to assess their perceptions about grivet monkeys. We randomly selected 50 respondents from 150 households located near the forest to conduct the study. Based on our sampling design, a respondent was selected from every third household from an alphabetized list.

The survey questionnaires included both open-ended and closed questions designed and presented by the researcher. Interviews were conducted with the assistance of a local guide. The average interview session was 30–45 min per sampled household. All interviewed persons were >18 years old. A series of supplementary questions was also used in the questionnaire to gather personal and socioeconomic information at the level of individual respondents.

We interviewed local communities about grivet monkeys, their socioeconomic situation, and asked about their: 1) perceptions of overall conflict with grivet monkeys, 2) perceptions

of the extent of crop damage due to grivet monkeys, 3) steps they took to mitigate losses, and 4) interventions they prefer the government to take (culling, paying for damage).

### Data analysis

The data obtained from the surveys were analyzed by using (SPSS version 20.0). The result was calculated using descriptive statistics

and compared the significant difference between variables by using a Chi-square test at 95% confidence interval.

## Results

### Respondent demographics

Fifty percent of the respondents do not have a formal education, and the marital status of the respondents showed that 70% were married

**Table 1.** Demographic characteristics of respondents, Batiero Church Forest, Ethiopian Highlands, Eastern zone of Tigray, northern Ethiopia, 2014–2015.

Demographic characteristics	Category	Number	Percent
Age	18–30 years	15	30
	30–40 years	15	30
	>40 years	20	40
Sex	Male	25	50
	Female	25	50
Marital status	Single	12	24
	Married	35	70
	Divorced	3	6
Education status	No formal education	25	50
	Primary education	15	30
	Secondary education	10	20

**Table 2.** Household economy and activities of local community, Batiero Church Forest, Ethiopian Highlands, Eastern zone of Tigray, northern Ethiopia, 2014–2015.

Factor	Response	Number	Percent
Farmland size	<0.25 ha	12	24
	0.25–1 ha	27	54
	>1 ha	11	22
Crops grown	Wheat ( <i>Triticum aestivum</i> L.)	18	36
	Barley ( <i>Hordeum vulgare</i> L.)	7	14
	Barley and bean ( <i>Vicia faba</i> L.)	12	24
	Pea ( <i>Pisum sativum</i> L.) and lentil ( <i>Lens culinaris</i> Medikus)	8	16
	All crops listed	5	10
Crops produced	<2.5 quintal	13	26
	2.5–5 quintal	28	56
	>5 quintal	8	16
Firewood collection <sup>a</sup>	Inside the study area	7	14
	Other areas (out of the forest)	43	86

<sup>a</sup>There is a regulation against gathering firewood in the study area. If respondents collect firewood from the forest, they will be punished by the local administrator.

**Table 3.** Community perceptions toward grivet monkeys (*Chlorocebus aethiops*) and crop damage, Batiero Church Forest, Ethiopian Highlands, Eastern zone of Tigray, northern Ethiopia, 2014–2015.

Factor	Response	Number	Percent
Community perceptions	Negative perception	37	74
	Positive perception	13	26
Trends of crop damage	Increased	35	70
	Decreased	15	30
Severity of crop damage	September	8	16
	October	25	50
	November	17	34

**Table 4.** Potential techniques or strategies used or recommended by survey respondents to mitigate grivet monkey (*Chlorocebus aethiops*) crop depredation, Batiero Church Forest, Ethiopian Highlands, Eastern zone of Tigray, northern Ethiopia, 2014–2015.

Factor	Response	Number	Percent
Most effective minimization methods of crop damage	Scare away by human	22	44
	Using dogs	26	52
	Fencing the farmland	2	4
Community expectation from government to reduce crop damage	Allowed to kill	15	30
	Provide compensation	17	34
	Relocate grivet monkeys	15	30
	Don't know	3	6

(Table 1). The major economic activity of the people living around Batiero Church Forest was subsistence agriculture. Local communities collected firewood, with most respondents (86%) collecting trees like Eucalyptus globules and cattle dung around their homes, while the remaining respondents (14%) collected indigenous plants including *Juniperus* in Batiero Church Forest.

The average land holding was 0.6 ha per household (Table 2). All respondents (100%) reported that grivet monkeys damage crops in the fields, but they did not attack people and have not been implicated in disease transmission to the local communities. The average crop damaged by grivet monkeys was estimated as 83.8 kg/ha per year but it varied according to the type of crops. Grivet monkeys were reported by local people to feed on cultivated crops like wheat (*Triticum aestivum*

*L.*), barley (*Hordeum vulgare L.*), bean (*Vicia faba L.*), pea (*Pisum sativum L.*), and lentil (*Lens culinaris Medikus*) around the study area.

All respondents (100%) had no private grazing land and wood plots. However, there is a communal grazing land for their cattle, which they fed crop residuals and weeds from their farmlands. The average crop production was 617 kg/ha around Batiero Church Forest but it varied according to the type of crops, and 36% of respondents only grow wheat.

### Community perception about grivet monkeys

Most respondents (74%) had negative perceptions toward grivet monkeys, and most respondents (70%) also reported the trend of crop damage by grivet monkeys increased in the last 5 years (Table 3). Villagers with smaller farms expressed more negative attitudes

toward grivet monkeys ( $P = 0.00$ ). Respondents used various methods to prevent crop raiding by grivet monkeys, with 52% using dogs (Table 4). All villagers commonly used dogs to scare away grivet monkeys from their farmland before the monkeys raided their crops.

All respondents (100%) reported they have never received any kind of compensation for crops damaged by grivet monkeys. The local communities reported that they would like to take some measures to reduce crop damage by grivet monkeys, including killing them (30%) and requesting financial compensation from the government (34%).

### Discussion

Most respondents expressed negative attitudes toward grivet monkeys around Batiero Church Forest. According to Hill (2000), attitudes toward wildlife vary among rural agricultural producers. In communities with a subsistence economy, even small losses can generate negative attitudes toward wildlife. The major economic activity of local communities around the church forest was subsistence agriculture with small land size. The income from their farmland was too small to sustain their livelihood. Hence, they were directly or indirectly dependent on the forest resources that were the main sources of food for grivet monkeys.

Because of habitat loss and fragmentation, the Batiero Church Forest grivet monkeys were forced to feed on agricultural crops, exacerbating human–grivet monkey conflicts. This led to conflict with communities living around the forest. Conversion of primate habitats into agricultural land creates the potential for conflict between hungry primates and local people (Mekonnen et al. 2012).

As reported by the community, grivet monkeys were often found on the edges of the forest surrounded by agricultural farmlands and human settlement. Robbins et al. (2006) stated that as habitats of primates shrink and become increasingly surrounded by human settlements, primates are forced into marginal habitats and become crop raiders. Naughton-Treves (1998) reported that almost all non-human primate families have been identified as crop raiders. The cercopithecoids, most notably macaques, monkeys, and baboons, are frequent

crop raiders. As the amount of forest conversion to agricultural farmlands increased, crops have become the main source of food for many non-human primates (Baranga et al. 2012).

Grivet monkeys are opportunistic feeders in the forest and agricultural farmlands. Almost all primates are opportunistic feeders with enhanced intelligence and manipulative capabilities, and many are forest-edge species. These feeding habits lead to conflict with local communities due to crop raiding (Naughton-Treves 1998). Thus, human–primate conflicts were exacerbated in October and November because the crops reached maturity and harvesting stages, and grivet monkeys preferred to feed on the crops. Therefore, farmers may be forced to take severe measures on the animals, including killing the grivet monkeys. Poor farmers who live in developing countries cannot tolerate crop damage by wild animals because communities cannot get any compensation for the damages (Linkie et al. 2007).

The habitat of the grivet monkeys in Batiero Church Forest may already be too small to sustain the current (Aschalew et al. 2017). The fate of the grivet monkey in our study area and others nearby is uncertain because their native habitat is surrounded by agricultural farmlands and human settlements that may force them to be eliminated from their natural habitat due to the expansion of agriculture and settlements in the forest.

In most countries within the range of native primates, the major threats to populations remain extensive conversion of primate habitat into areas of human use such as agriculture and settlements (Walsh et al. 2003). Primates living in developing nations may be affected by the economic and human population growth, with increasing extraction of resources from the forest as well as modification or destruction of primates' natural habitat (Serio-Silva et al. 2007).

Local communities around the study area reduced crop damage by guarding their farmland using children and dogs to scare away grivet monkeys, as well as thorny vegetation as fencing. Most communities living around the forest had dogs that hunted grivet monkeys around forest edges to prevent crop damage. The risk of disease transmission to

humans may increase when monkeys and dogs come into physical contact because dogs will come into contact with humans through bodily fluids (Chapman et al. 2005). Moreover, the forest degradation associated with hunting of grivet monkeys by dogs may lead to the disappearance of grivet monkeys from the forest within the coming few years. Therefore, wildlife professionals should incorporate strategies in management plans to benefit wildlife and reduce depredation potential (Conover 1994, Messmer and Schroeder 1996).

Guarding their farmland from wildlife was a popular method in different parts of Africa (Sillero-Zubiri and Swetzer 2001). Guarding was especially common during the harvest season. Farmers guard crops even during the night. Fencing was used near villages and was made of local materials such as thorny bush, wooden poles, and stones, but farmers claimed that animals easily crossed through the fence (Mussa 2009). There could be intensive management in certain high-conflict areas to resolve the damage by wildlife (Elmore and Messmer 2006).

### Management implications

Our study reinforces the belief that sustaining primate populations outside of protected areas will require adaptive management strategies to reduce human–primate conflicts. These strategies must address human needs and wildlife needs to make it effective over the long term. Previous studies suggest that conservation programs and conservation areas lead to crop-raiding conflict rather than benefits to local communities. Therefore, local communities reduce their support for an agreement with conservation policy and practice. Alleviating conflict and reducing damage caused by wildlife would likely increase acceptance of conservation and management actions in the forest (Elmore et al. 2007). Thus, it may be better provide alternative fuel sources for villagers such as biogas technology or solar and wind energy to reduce illegal cutting of trees and wildlife disturbance in the forest area. Planting the 3 most important tree species that contribute most to the diet of the grivet monkey would help reduce the intrusions of the monkeys to neighboring fields. Additionally, communities

could increase crop production of alternative crops that are unpalatable to grivet monkeys.

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