

HUMAN-WILDLIFE CONFLICT IN ZEGIE PENINSULA (ETHIOPIA) WITH EMPHASIS ON GRIVET MONKEY (*CERCOPITHECUS AETHIOPS AETHIOPS*)

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ABSTRACT: Data on conflict between human and wildlife in Zegie Peninsula were collected during July, 2008-April, 2009. Face-to-face questionnaire, census of wild animals, direct estimation of crop damage by wild animals and faecal analysis of grivet monkeys were the components of the study. Data were analyzed using descriptive statistics; Chi-square test and one-way ANOVA. Crop loss in 2007/2008 harvest year was 26.78%. Damage estimation of ripened crops in the field by wild animals was equivalent to about 13,000 Ethiopian Birr per day in the study area (1150 ha). There was no significant difference in damage among crops ($F = 0.147$, $df = 3, 16$, $P > 0.05$) and damage in different habitats ($F = 1.41$, $df = 4, 15$, $P > 0.05$). Among the faecal samples of grivet monkeys, 34.28% had the seeds of citrus fruits. Wild animals were killed in response to the damage they cause to crops or for consumption. Trees were cut down and sold to support livelihood. The estimated population of grivets in the study area was 1157, which is about one grivet monkey/ha. Grivet population was not significantly different between the wet and dry seasons ($\chi^2 = 0.44$, $df = 1$, $P > 0.05$). But there was a significant difference in the population of grivets among habitats ($F = 5.36$, $df = 4, 15$, $P < 0.05$). The estimated population of squirrels, duikers and hares in the study area was 428, 37 and 30, respectively. Squirrel population varied significantly between wet and dry seasons ($\chi^2 = 5.6$, $df = 1$, $P < 0.05$). Grivet monkey, squirrel, porcupine and bushpig were the four major pest mammals in the area. Leopard, duiker and hares were minor pests.

Key words/phrases: Conflict, crop damage, grivet monkey, Zegie Peninsula

INTRODUCTION

Human-wildlife conflict is a worldwide problem, both in urban and rural areas (Distefano, 2005). It is intense in developing countries particularly in Africa including Ethiopia, mainly in and around protected areas where human and wildlife live in proximity. Increasing human population in Ethiopia has resulted in overexploitation of natural resources, which in turn led to a variety of human wildlife conflict. In addition to insects and small mammals, elephants, baboons, monkeys, warthogs, and different antelopes cause major crop damage when these animals venture out of the protected areas looking for food (Petersen, 2003). These animals can also cause significant damage to human lives and livestock. These losses can trigger conflict between rural people and wildlife (Begg *et al.*, 2007; Bonham *et al.*, 2007). Most often, children are assigned to look after the farm area resulting in missing of schools, loss of sleep and even restriction to travel (Hoare, 1992).

The major conflict in Zegie Peninsula is between humans and grivet monkeys. Grivet monkey (*Cercopithecus aethiops aethiops*) is a widely distributed and often common species in northern and central Ethiopia (Yalden *et al.*, 1977). It occupies a wide range of habitats from riverine and montane forests to open *Acacia* savanna. Although different mammals occur in Zegie Peninsula, grivet monkeys, squirrels, porcupines and bushpigs are the major known crop pests. In many regions of Africa, primates are the major component in crop damage as a result of their behaviour (Nyamwaro *et al.*, 2007). The increase in human population coupled with more land for crop growing area has led to the decline in the wildlife and their habitats in the peninsula. Warthog has recently been eradicated locally. Studies on human-wildlife conflict in Ethiopia are scarce even though the problem is extensive. Hence, the aim of the present study was to assess the degree of human-wildlife conflict in Zegie Peninsula with special emphasis on grivet monkey, which is a major pest in the region.

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MATERIALS AND METHODS

The study area

Zegie is the largest peninsula along Lake Tana and is mostly covered with dense forest. It protrudes from the south-western shore of the lake. It is located at coordinates of 11° 41' 57"N, 37° 20' 5"E, 600 km northwest of Addis Ababa, at an altitude ranging from 1770 m along the banks of the lake to 1975 m asl at its summit called Ararat. It can be accessed both by land and water. Zegie Peninsula includes a town called Zegie (Afaf) and two rural *Kebeles*, Ura and Yiganda with an area of 1347 ha (Fig. 1). The study focuses on the two rural *Kebeles* (with an area of 1150 ha), where wildlife and human conflicts are more apparent.

Zegie lies in the moist 'Woina Dega' agro-climatic zone. The mean minimum and maximum temperatures for 12 years (1996–2007) is 11°C and 27.5°C, respectively, with the average annual rainfall 1661.46 mm (ANRSBARD (2007)). Zegie Peninsula possesses one of the very few remaining virgin tropical forests in Ethiopia (CARE Ethiopia,

2001). According to CARE Ethiopia (2001), 90.5% of the whole peninsula was once covered by dense forest trees and shrubs. At present, this has been reduced as a result of over-utilization by the inhabitants.

Livestock rearing and agricultural activity were prohibited in the area since the introduction of coffee five centuries ago (Tilahun Teclehaimanot and Mirutse Giday, 2007). At present, sheep rearing and poultry production are practiced. Charcoal and fuel wood collection are common practices of most of the inhabitants. The economy of Zegie Peninsula revolves around coffee production (CARE Ethiopia, 2001). At present, most families cultivate hop (*Rhamnus pyrnoids*), lemon (*Citrus limon*), citron (*Citrus medica*), orange, bitter orange and sour orange (*Citrus aurantium*), papaya (*Caraca papaya*) and guava (*Psidium guajava*). Few families grow maize (*Zea mays*), mango (*Mangifera indica*), avocado (*Persea americana*) and azamir (*Bersama abyssinica*). Most of the fruit crops in this area were introduced by CARE Ethiopia in the 1990s.

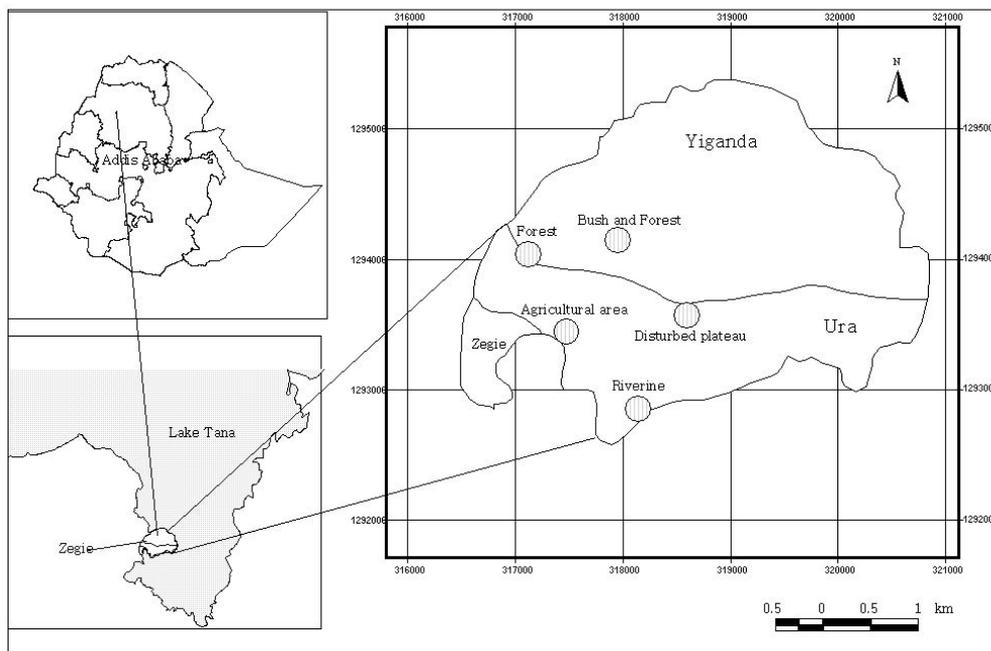


Fig. 1. Map of Zegie Peninsula showing study sites.

Methods

A pilot survey was conducted to gather information about the inhabitants; weather condition, accessibility, fauna, flora, and topography of the study area. A questionnaire was prepared and a total of 54 local residents were randomly interviewed initially. Out of the 1382 households, 20% (n = 276) were selected using systematic random sampling method, of which 168 were male and 108 female heads. The questionnaire consisted of both open-ended and fixed-response questions with the following three main categories: personal information, household economy, crop damage and conflict with wildlife. Census was conducted in five randomly selected sites with different characteristic habitats (Fig. 1). Coffee plantation shaded by large trees occurred in all habitats. Hop (*Rhamnus pyrinoids*) and fruit crops also occurred in all selected habitats but with different densities and distribution; more in riverine and agricultural areas. Riverine and agricultural areas had relatively more settlements than the rest.

Line transect method was employed to carry out the census following Whitesides *et al.* (1988) and Plumptre (2006). GPS (GARMIN GPS 72) and compass were used in locating the sites. The sites had an area of 50 x 500 m (2.5 ha) each. When trees and houses were encountered, the path of least resistance was taken (Jones, 2006). Each site was partitioned into 20 parts, each having a width of about 25 m. Out of the total extent of the study area, 10.87% was covered in the five study sites. The number of grivet monkeys counted in the 125 ha was used to extrapolate the total number in Zegie Peninsula.

Grivet monkeys and other wild mammals encountered on the way were counted. The number of grivet monkeys was recorded in 125 ha both during wet and dry seasons. Then, the mean number was used to estimate the total number in the whole area. Physical features were used for sex identification of grivets. The blue scrotum of adult males was visible from a distance. A pair of nipples in adult females on the chest region and infants sometimes clinging on the belly or on foot helped to identify females. Females without infants that had a similar body size were also classified as adult females (Mori *et al.*, 1999).

Direct observation was conducted to identify the magnitude of crop damage by wild animals. The estimate was carried out using the method of Nau-

ghton-Treves (1997). Five sites were selected randomly. One grid for each site with an area of 2.5 ha was marked. Each grid was further divided into five cells, each of 0.5 ha. Damage estimation on ripened crops was carried out five times during the month of February. The mean damage of each crop was calculated in kg/day. The cost of each crop in kg (about 2 Birr/kg) was obtained from the market and was used to calculate the loss of each type of crop or fruit crop for the study sites (12.5 ha). Based on this estimate, total loss was calculated for the whole area

A total of 35 fresh faecal samples of grivet monkeys were collected by identifying their resting or roosting places and analyzed following Putman (1984); Scalet *et al.* (1998) and Remis *et al.* (2001). The faecal samples were sun dried, washed with hot water, filtered with filter paper and analyzed macroscopically. The components in each faecal sample were identified and the percentage of each was calculated. The types of plant species consumed and used by grivet monkeys were directly observed and identified. Data were analyzed using version 15.0 SPSS computer programme and Excel software. Descriptive statistics, one way ANOVA and Chi-square tests were employed in the analysis of data.

RESULTS

Among the households, 88.4% had poultry and 73.3% had sheep, while 8.9% did not possess domestic animals. The majority of the respondents (87.9%) possessed 0.5–2.00 ha of land, 11.7% had 2.5–4.00 and 0.4% had 10 ha of land. The ratio of land (ha) to household in the study area was 0.83:1.00, while the population density of the rural Zegie was 7.13/ha. Trees were cut for sale to supplement livelihood.

Fifteen types of crops are grown in the peninsula. Coffee, lemon, hop and bitter orange were cultivated by 99.6%, 97.1%, 93.5% and 90.5% of respondents, respectively, while maize and banana were cultivated by 3.6% of the respondents. Guava, papaya, mango and bitter orange are the four crops most vulnerable to damage by wild animals. The highest loss of crops during the 2007/2008 harvest year (in Birr) was coffee followed by lemon, orange and sour orange, while the least were avocado and peach (Fig. 2).

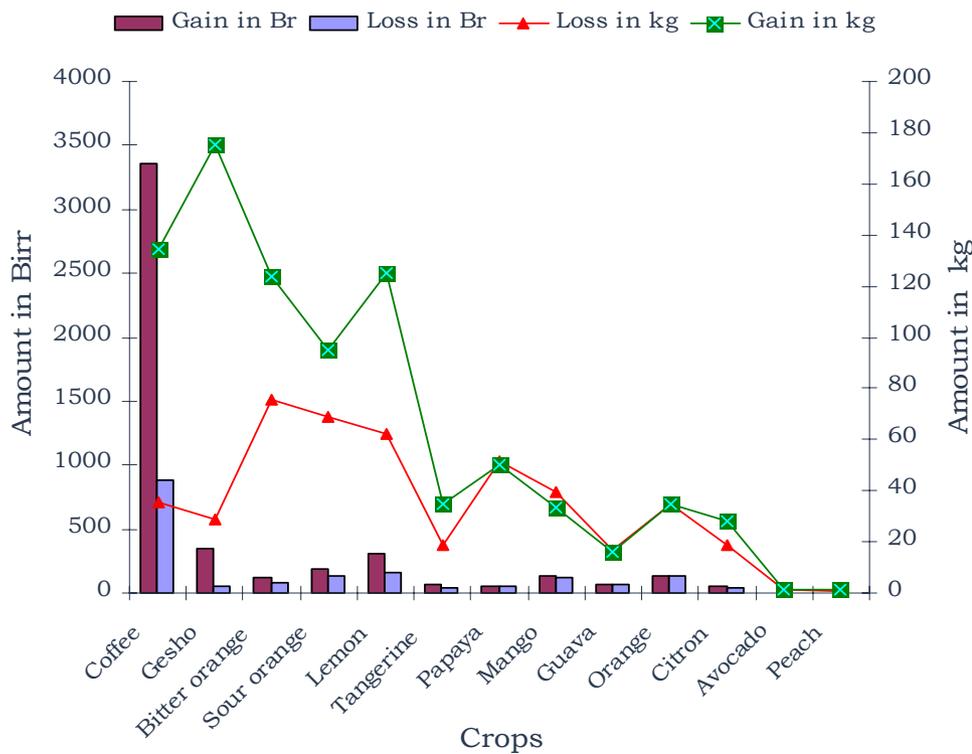


Fig. 2. Crop yield and loss in kg and in Eth. Birr during 2007/2008 harvest year.

Among the mammals, grivet monkey, squirrel, duiker, hare, bushpig, porcupine, leopard, spotted hyaena, mongoose, common bushbuck, serval, African civet, golden jackal, honey badger, armadillo and hyrax occur in the area. From the responses made, leopard, grivet monkey, bushpig, duiker and common bushbuck are the most illegally hunted wild animals in the area. Warthog has been eradicated from the study area as a result of illegal hunting. Grivet monkeys and squirrels are the most commonly observed wild animals in the peninsula. Depredation of sheep and domestic dogs by leopard is frequent in the area. Crop damage by wildlife is apparent throughout the

year. From the results of the questionnaire and personal discussion with the inhabitants, coffee damage was intensified since 1990 when CARE Zegie project introduced fruit crops that are not indigenous to the area.

Most respondents (90.2%) considered grivet monkey as the most problematic wild animal in the area and 44.6% of the respondents described squirrel as the second followed by porcupine (29.0%) and bushpig (28.3%). On the other hand, 14.85% and 23.9% of the respondents have placed hares, leopard and duiker altogether in the third and fourth rank, respectively (Table 1).

Table 1. Percent of respondents in the ranking order of pest wild mammals in the study area.

Mammals	Ranking order and % of respondents					Cumulative (%)
	First	Second	Third	Fourth	Missing	
Grivet	90.2	4.7	3.3	1.1	0.7	100
Squirrel	1.4	44.6	24.3	19.9	9.8	100
Porcupine	2.2	22.0	29.0	25.4	21.4	100
Bushpig	3.6	16.3	23.6	28.3	28.2	100
Others	0.4	4.7	14.85	23.9	56.15	100

Most respondents (70%) acknowledged the increasing tendency of crop damage by wildlife from time to time. Among the respondents, 77% described wild animals as disadvantageous because of the nature of crop and property damage. Most (75%) of the respondents noted that there was a decline in forest coverage of the area. Among the respondents, 77% is of the view that wild animals should be eradicated to settle the conflict. Chasing and killing of wild animals were the common practices in the area. Support provided by concerned agencies regarding wildlife issues was not adequate.

The estimated mean number of grivet monkeys in the whole study area (1150 ha) was 1157. The estimated numbers of grivets during the wet and dry seasons in the study sites were 120.5 and 131.0, respectively. The grivet population was not significantly different between the wet and dry season counts ($\chi^2 = 0.44$, $df = 1$, $P > 0.05$). But there was a significant difference in the number of grivets among habitats ($F = 5.36$, $df = 4, 15$, $P < 0.05$) (Fig. 3).

The number of adults, juveniles and infants of grivets in the whole study area was 565.8, 462.3 and 128.8, respectively. Adults comprised 48.91%, juveniles 39.96% and infants 11.13% (Table 2). There were significant differences between the

number of adults and infants ($\chi^2 = 29.88$, $df = 1$, $P < 0.05$) and between juveniles and infants ($\chi^2 = 20.46$, $df = 1$, $P < 0.05$).

Table 2. Number of different age and sex groups of grivets in the study sites.

Habitat	Sex and age groups	
Riverine	Adult male	4.0±0.913
	Adult female	8.0±1.291
	Juvenile	12.25±2.839
	Infant	3.75±0.479
Disturbed plateau	Adult male	2.25±0.250
	Adult female	3.75±1.111
	Juvenile	4.75±0.854
	Infant	0.5±0.500
Bush-forest	Adult male	3.25±0.479
	Adult female	7.0±0.707
	Juvenile	11.75±1.887
	Infant	3.0±0.707
Forest	Adult male	5.25±0.629
	Adult female	11.0±2.041
	Juvenile	9.0±2.888
	Infant	2.25±0.250
Agricultural area	Adult male	5.75±1.111
	Adult female	11.25±1.377
	Juvenile	12.50±3.069
	Infant	4.5±0.866

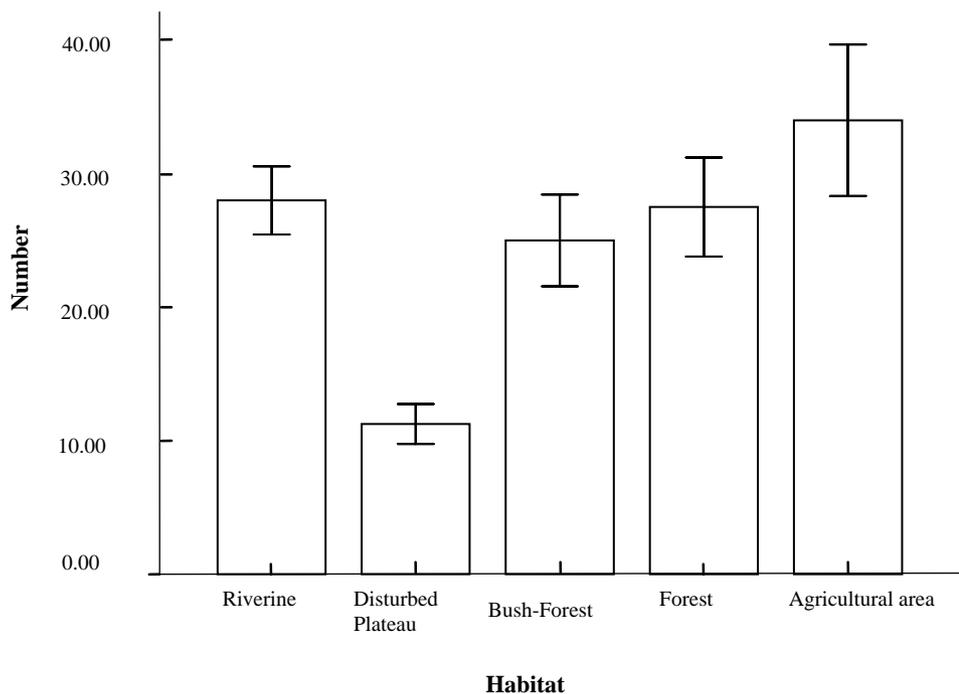


Fig. 3. Population of grivet monkeys recorded in each habitat.

In addition to grivets, other wild mammals encountered were squirrels, duikers and hares with the estimated mean number of 427.8, 36.8 and 29.9, respectively in the area. The mean number of squirrels in the study sites (125 ha) was 58 and 35 during the wet and dry seasons, respectively. The squirrel population was significantly different between the wet and dry seasons ($\chi^2 = 5.6$, $df = 1$, $P < 0.05$).

The average crop loss from 12.5 ha on five counts was 71.4 kg or 142.8 Birr. Estimated loss of fruits in five habitat types is given in Table 3. Estimated damage on ripened crops was equivalent to Birr 13,000 per day in the whole study area. There was no significant difference in damage among crops ($F = 0.147$, $df = 3, 16$, $P > 0.05$) (Fig. 4) and damage in different habitats ($F = 1.41$, $df = 4, 15$, $P > 0.05$) (Fig. 5).

Table 3. Estimated loss of fruits (kg) in the five main habitat types each 2.5 ha by considering the average cost of each fruit/kg as 2 Birr.

Habitat type	Crop type consumed in kg				Total cost in Birr
	Bitter orange	Sour orange	Papaya	Others	
Riverine	4.4	4.0	3.4	5.0	33.6
Disturbed plateau	2.8	2.6	3.2	3.4	24.0
Bush-forest	3.2	3.6	3.2	3.6	27.2
Forest	2.2	2.6	3.2	3.2	22.4
Farm	4.6	5.2	4.2	3.8	35.6
Total	17.2	18.0	17.2	19.0	142.8

Others include guava, citron and orange

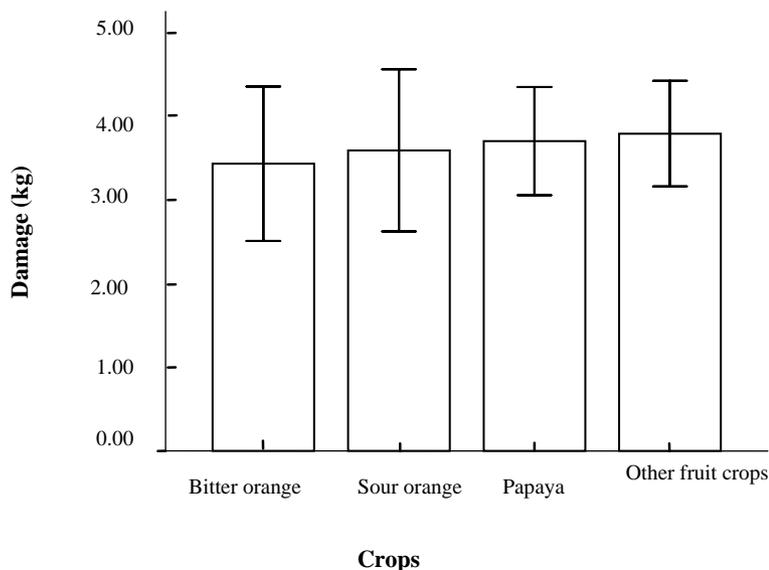


Fig. 4. Amount of each crop type (kg) damaged by wild animals per day in the study sites.

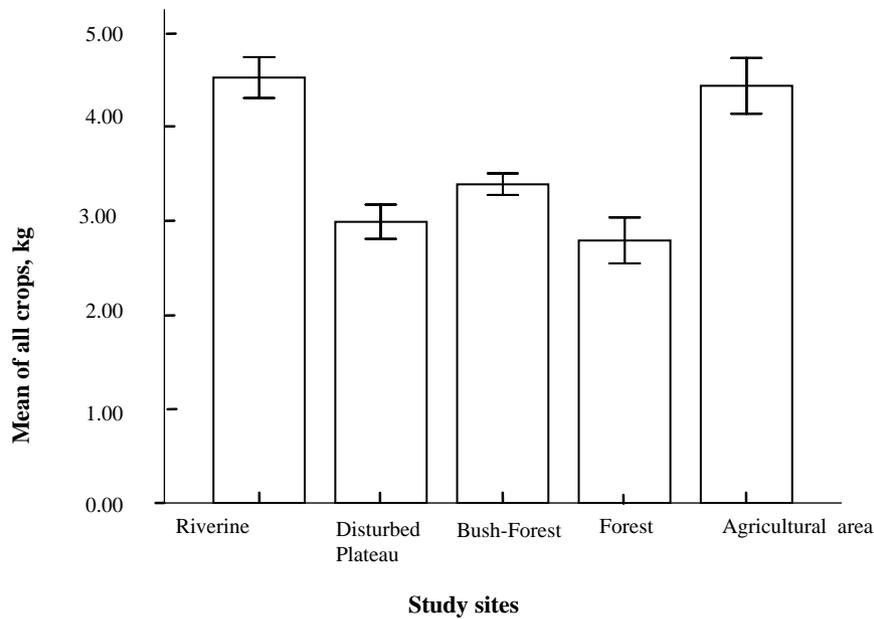


Fig. 5. Amount of all crops (kg) damaged by wild animals per day in the different habitats.

All faecal samples collected from five different sites had seeds of fig trees (*Ficus*), 77.14%, 34.28%, 22.85% and 22.85% of the samples had the seeds of *Rothmannia urcelliformis*, citrus seeds, Sudan teak (*Cordia africana*) and *Ehretia cymosa*, respectively. Important food items of grivets other than fruit crops commonly observed during the study period are given in Table 4.

Some of the wild trees, including those that were used for food were also used as a resting site. These include, East African yellow wood (*Podocarpus falcatus*), wild elder (*Nuxia congesta*), Sudan teak (*Cordia africana*), *Mimusops kummel*, large poded albizia (*Albizia*) and fig trees (*Ficus spp.*).

Table 4. The most favoured food plants of grivets other than fruit crops.

Plant species	Parts consumed
Broad-leaved croton (<i>Croton macrostachyus</i>)	Fruit
Sudan teak (<i>Cordia africana</i>)	Fruit
<i>Ehretia cymosa</i>	Fruit
"Birbira" (<i>Millettia ferruginea</i>)	Young shoots
Water berry (<i>Syzygium guineense</i>)	Fruit
Fig trees (<i>Ficus</i>)	Fruit
Large poded <i>Albezia</i> (<i>Albezia</i>)	Young shoots
<i>Mimusops kummel</i>	Fruit
<i>Rothmannia urcelliformis</i>	Fruit
<i>Vangueria volkensi</i>	Fruit

DISCUSSION AND CONCLUSIONS

The majority of residents on Zegie Peninsula have developed negative attitudes towards wild animals, particularly to grivet monkeys, squirrels, porcupines and bushpigs in response to the order of the problem they caused. These wild animals have been known to cause crop damage in the study area and elsewhere (Andeberhan Kidane, 1982; Dorst and Dandelot, 1995; Sillero-Zubiri and Switzer, 2001; ANRSEPRD, 2004, Kingdon, 2004, ANRSBARD, 2006, 2007; Mesele Admasu, 2007). Leopards and duikers were also nuisance animals as viewed by the respondents. Leopards hunt dogs and sheep in the area. When natural preys are scarce, carnivores including leopards are known to seek domestic animals (Petersen, 2003; Mudingu, 2007; Kittle, 2009). A partly consumed dog was observed hanging on a tree during the survey, which was a victim of leopard hunt. At times, leopards were observed to show a preference for canids, even attempting to snatch dogs right from their masters (Bies, 2002; Kittle, 2009). Illegal hunting has resulted in the decline of many wild animals in the peninsula. Wildlife perceived as 'problem animals' are killed by local people (Mudingu, 2007). As described by Petersen (2003), all wild animals encountered are shot on sight, either for food or in retaliation to the damaged crops or domestic animals. Duikers and hares are also known to damage crops in the study area. Many species of wild herbivores such as duikers and hares are blamed for crop raiding and cause damage in the field in different regions (Sillero-Zubiri and Switzer, 2001; Distefano, 2005).

In the absence of viable alternative economic activities, many residents of Zegie Peninsula have resorted to cut trees for sale and firewood. An estimated 90% of the firewood entering Bahir Dar town is from Zegie Peninsula (CARE Ethiopia, 2001). It was common to see papyrus boats carrying wood for sale to Bahir Dar city every day during the present study period.

By considering the price of each crop (harvested during 2007/2008 in the whole study area) at the time when the response was forwarded, the loss was 26.78%. Direct observation of crop damage by wild animals was equal to 13,000 Birr per day. This was extrapolated from the loss of crops/day in five different habitats. However, this figure can be variable because of the different ripening season of the crops. Among the faecal samples of grivet

monkeys analyzed, 34.28% had fruit crops. People especially with subsistence economy are likely to develop negative attitude towards wild animals even with smaller losses (Oli *et al.*, 1994).

Inhabitants claim that it is after the introduction of different fruiting plants to the area by CARE Zegie in the 1990s that wild animals became an issue in the area. Earlier studies show that only 8% of the respondents confirmed coffee damage to wildlife compared to 93.8% of the respondents in the present study. Grivet monkey and squirrels are the most attributed by the respondents as major pests on fruit crops. To minimize the conflict, plant species that are not palatable by the pest species should be introduced.

There was about one grivet monkey per hectare in the study area. The age structure of grivets showed that adults are more in number, followed by juveniles, while infants are the least. The size of a population and its age and sex composition may indicate its viability (Harris, 1998). Female biased sex ratio and fairly high proportion of juveniles indicate a healthy population (Yisehak Doku *et al.*, 2007). However, the population of grivets is declining. The number was estimated to be over 4000 few years ago compared to the present study (ANRSEPRD, 2004). There was no significant difference in the number of grivets between wet and dry seasons. As most of the area is surrounded by water and the remaining area has discontinuous forest, immigration or emigration of grivets that could influence the number is unlikely. However, there was a significant difference among habitats in the number of grivets. Relatively, the highest number was observed in the agricultural area, followed by intact forest and riverine habitats, while the least was in the disturbed plateau. The difference in abundance within the study sites may be related to the difference in food and shelter availability. Crops in agricultural area and fruits and young shoots of plants in intact forest may be preferred by grivets for food and shelter, which is not the case in disturbed plateau where plant cover is much less. There can be free movement of grivets to preferred areas for feeding and resting within the study area. Kingdon (2004) stated that vervets and grivets may disperse into fruiting zones during fruiting seasons.

People carry out various activities within the area to satisfy their daily needs, causing major disturbance to wild animals and their habitats (Yisehak Doku *et al.*, 2006). Distefano (2005)

described that overlapping of the home ranges of wild animals with human settlements as the root cause of human-wild animal conflict. When settlements and resources are intermingled, a large proportion of the wildlife population becomes pests increasing the risk of revenge (Sprague and Iwasaki, 2006). Both humans and wild animals are subjected to harm from the conflict in Zegie as it is elsewhere.

The present study shows that the human-wild animal conflict in Zegie Peninsula is substantial and urgent measure should be taken to alleviate the problem. Proper wildlife management programmes should be implemented in the area. People may avoid their dependence on fruit crops that are introduced by CARE that attracted more wild animals and cultivate others that are not attractive instead. Trees, particularly perennials, that are the food choice of grivets and other wild animals, should not be cut down. Awareness should be created among the inhabitants about the importance of wildlife and the negative consequences of illegal hunting and deforestation. Making tourism a part of the livelihood of inhabitants may be crucial as the area is a centre of tourist attraction.

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