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POPULATION STRUCTURE, FEEDING ECOLOGY AND HUMAN-GRIVET MONKEYS CONFLICT AT BAHIR DAR UNIVERSITY MAIN CAMPUS, BAHIR DAR

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ABSTRACT: Studies on population structure, feeding ecology and human - grivet monkeys (*Chlorocebus aethiops*) conflict were carried out at Bahir Dar University (BDU) main campus in 2008 and 2009. A total of 44 individuals were organized in one troop consisting of 11 adult males, 16 adult females, 13 sub-adults/juveniles and 4 infants. The population structure of grivet monkeys showed that there was multi - male multi - female social organization with the ratio of 1:1.45 adult males to adult females. Grivet monkeys spent most of their time (43.30%) foraging on garbage deposited at the campus. In the wild, they spent 39.18% of their time foraging on fruits and 2.06% was spent foraging on flowers. Human-grivet monkey conflict was observed at the campus. Grivets steal food, destroy materials, damage crops, vegetables and fruits. Consequently, people (especially the youngsters) try to kill them. Awareness creation of the residents about wildlife is necessary and people should understand the role of grivet monkeys in the ecosystem at large.

Key words/phrases: Conflict, Grivet monkey, Population structure, Troop.

INTRODUCTION

Vervet monkeys (*Chlorocebus aethiops*) are one of the most successful African primates that occupy a wide variety of habitats (Barrett, 2005). They occur in most parts of the southern and eastern Africa, and are distributed from Senegal to Ethiopia and Somalia up to South Africa. They are habitat generalists and more widely distributed, but absent only from desert, high forest and open grasslands (Cawthon-Lang, 2006; Chris and Stuart, 2006). Vervet monkeys are mostly herbivorous and feed on a wide range of fruits, seeds, flowers, leaves and gum. They also feed on different types of invertebrates and vertebrates (Macdonald, 1985; Dorst and Dandelot, 1987; Kingdon, 2004; Chris and Stuart, 2006). They have also developed tastes for all kinds of human food from hard boiled eggs to beer (Lee, 1979).

Vervet monkeys commonly live in troops and the number of adult males to

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adult females within a troop may vary. This flexibility of numbers, which is possibly related to diet, is one of the most interesting aspects of their social structure (Lee, 1979; Chris and Stuart, 2006). In a troop, it is the females that modify the pecking order and the males usually concert their actions during confrontations with other troops (Kingdon, 2004). Females are normally sexually receptive during the time of ovulation and they can advertise males by distinctive visual, behavioural or phermonal signals (Andelman, 1987).

The taxonomy of vervet monkeys is updated recently, moving all of the species from the genus *Cercopithecus* to a new genus *Chlorocebus* (Grubb *et al*., 2003; Groves 2005; Colin, 2005; Cawthon-Lang, 2006). Taxonomically, there are different groups of vervet monkeys including callitrix (*sabaeus*), tantalus monkeys (*tantalus*), malbrouck (*cynosuros*), Bale Mountains vervet (*djamdjamensis*), vervet (*pygerythrus*) and grivet (*aethiops*) (Grubb *et al*., 2003; Kingdon, 2004). Recently as many as 25 subspecies are included under vervet monkeys (Grubb *et al*., 2003). Of these, grivet (*Ch. aethiops*) comprises four subspecies as *Ch. a*. a*ethiops, Ch. a. hilgerti, Ch. a. matschiei* and *Ch. a. ellenbecki* (Dorst and Dandelot, 1987; Shimada *et al*., 2002). The Bale monkey (*Ch. djamdjamensis*), which was once assigned to *Cercopithecus aethiops,* is shifted to the species level and treated as separate species by its own. Three subspecies occur in tantalus (*Ch. tantalus),* and vervets (*Ch. Pygerythrus)* consist of 15 subspecies.

Grivet (*Ch. aethiops*) differs from vervet (*Ch. pygerythrus*) in their external morphology, i.e., in grivet; hands and feet are pale, the base of the tail is with white tuft and the tail tip is whitish in colour, while in vervet, hands and feet are darker than the rest of the body which is grizzled-grey in colour and the tail tip remains darker, and a tuft of reddish hair occurs under the base of the tail (Dorst and Dandelot, 1987; Kingdon, 1997; Chris and Stuart, 2006). Besides, vervet possesses short facial whiskers and forehead band, while in grivet these facial whiskers are more prominent and white in colour (Rochester, 1999; Kingdon, 20004; Chris and Stuart, 2006). From their external morphology, those monkeys which are found at Bahir Dar University (BDU) main campus were identified as *Ch. aethiops*. The main objective of this study was to investigate general information about grivet monkeys with especial emphasis on their population structure, diurnal activity pattern, feeding ecology and their interaction with humans in the BDU main campus.

MATERIALS AND METHODS

The study area

The study was conducted at BDU main campus, which is located 11°57'N latitude and 37°39'E longitude at a distance of about 565 km north-west from Addis Ababa. Topography of the area is relatively flat having mean elevation of 1796 m asl, and with a total area of about 1.5 km^2. It is located southeast of Bahir Dar town close to River Abay in its eastern border. The ten years (1998 to 2007) mean monthly minimum and maximum temperature were 8.4°C and 30.4°C, respectively. It shows distinct dry and wet seasons with the mean annual rainfall of 1497.4 mm. The intensity of annual rainfall increases from May to August, sharply declining from September to October. The mean monthly rainfall which is greater than 400 mm was registered in the months of July and August.

Most areas at the main campus of BDU are covered by indigenous and exotic plants. Previous study by Berhanu Aberha *et al*. (2006) indicated that there are 64 species of woody plants, grouped into 34 families. Faunal diversity has gradually declined in the area. Previously, reptiles including pythons and different mammal species were frequently observed (pers. comm.). However, the habitat is still a home of various species of birds.

Methods

Direct observation, questionnaire, interview and focal group discussion methods were used to collect data on grivet monkeys. Reconnaissance survey of the study area and collection of data were carried out from October 2008 to February 2009. As the study area is relatively small and grivet monkeys live in a group with relatively low density, total count method as adopted by Western and Grimsdell (1979) and Sutherland (1996) was used to estimate their population size. During census, a special place where grivets moved to their overnight roosting site was selected as adopted by Matsuda *et al*. (2008) in other study. Detailed observations of the troop were made to classify individuals into respective age groups as adults, sub-adults/juveniles or infants. Adult individuals were further identified into their sex categories. Clues such as blue scrotum and mostly erected red penis were easy identification means of adult males from sub-adult males. In adult females, a pair of nipples was observed in the chest region. Some adult females were also found with infants sometimes clinging on their belly or on foot at close distance.

Activity pattern of the grivet monkeys group was recorded using

instantaneous scan sampling methods at 15 min intervals (Altman, 1974; Colina and Louis, 1990). At the time of each scan, activity data were collected for different age groups. The group was scanned regularly starting from one direction, i.e., starting from right to left, in order to avoid biases on eye-catching activities (Fashing, 1999; Di Fiore, 2003). As a result of scan sampling method, activities such as foraging, climbing on trees, walking/running on the ground, grooming, chasing/fighting, resting/lying on trees/roofs and other activities (watching, calling, defecating, courtship display and yawning) were recorded.

Diurnal activity pattern involving foraging was assessed early in the morning (06:00 – 10:00h), late morning (10:00 - 12:00h), at noon (12:00 – 13:00h), in the afternoon (13:00 – 17:00h) and late afternoon (17:00 – 18:00h) and their food preference was identified. Observations on foraging were made from focal samples of individuals and the species and food type ingested was recorded every time (Lee and Hauser, 1998). Foraging behaviour was examined by observing during focal watches and all activities related to feeding behaviour including identification of plant species were recorded. Different plant species on which grivet monkeys depend for their forage were collected and identified in collaboration with the local people. Those plants, which could not be identified in the field were collected and identified in the Herbarium of Addis Ababa University. To assess the presence of conflict between people and grivet monkeys, a questionnaire was prepared, evaluated and administered to the residents and students of BDU main campus. Interview and focal group discussions were also conducted to selected individuals.

RESULTS

A total of 44 individuals consisting of 11 adult males, 16 adult females, 13 unidentified sub-adults/juveniles and 4 infants were identified in the troop. The ratio of adult males to adult females was 1:1.45, indicating that the population is female biased. The ratio of infants to adult females was 1: 4.

The time budget of the grivet monkeys for different activities indicated that on an average the group spent 23.13% for foraging and 16.91 % for resting. Time spent for resting by different age groups indicated that adult males spent 23.34% and adult females 21.44% for resting. However, sub-adults/juveniles and infants took less time (15.23% and 7.63%, respectively) for resting. They rested under the trees and under shades in the forest as well as under the roofs of the buildings during warm weather, especially during noon hours. Adult males spent 18.79% of the time for foraging, while the

time spent by adult females for foraging was 22.52%. The diurnal activity of sub-adults/juveniles showed that they spent 22.34% of the time for foraging and only 6.14% for grooming. They groomed usually with adult females and rarely with adult males or among themselves. Infants spent 28.85 % of their time for foraging and only 5.84% for grooming (Fig.1).

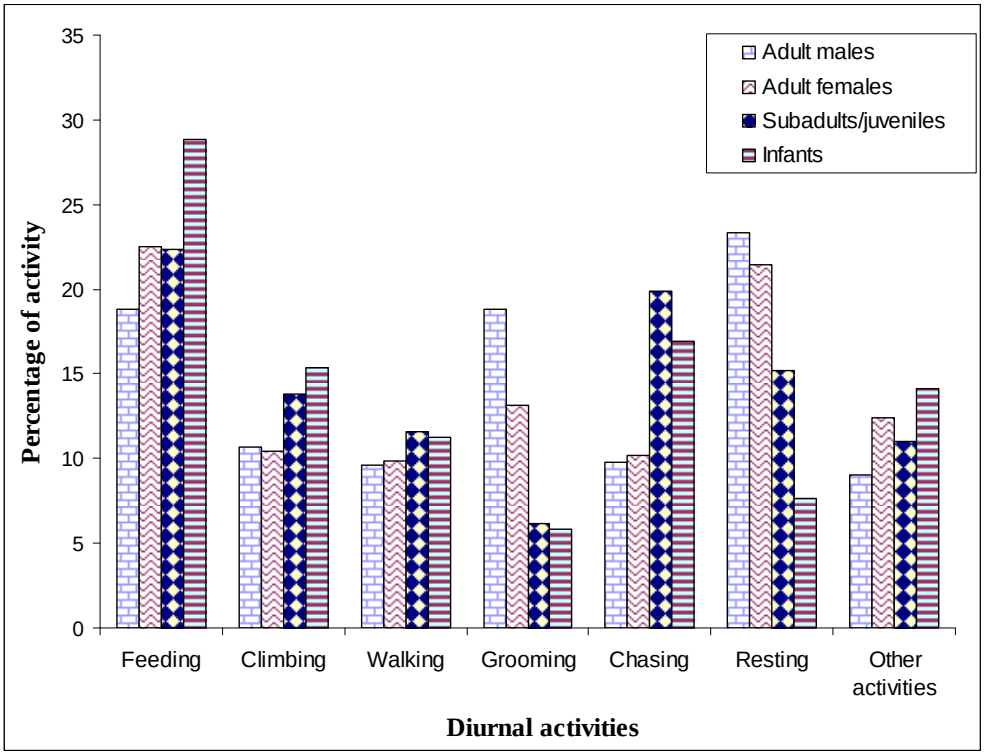

Fig. 1. Diurnal activity patterns of grivet monkeys in different age groups.

The foraging activity of adult males increased from dawn to late morning hours and then sharply declined until late afternoon. Among adult females, the levels of feeding activity increased from early morning up to noon and declined linearly from noon to late afternoon. Even though, adult females spent most of their time foraging (22.52%), time spent for foraging in late afternoon was less than that of adult males. Adult females took their overnight roosting site earlier than other age and sex groups. Sub-adults/juveniles were more active in the morning and less active during late afternoon hours, followed by sharp increase up to early evening hours. Feeding activity of infants increased continuously from dawn till noon and then declined gradually (Fig. 2).

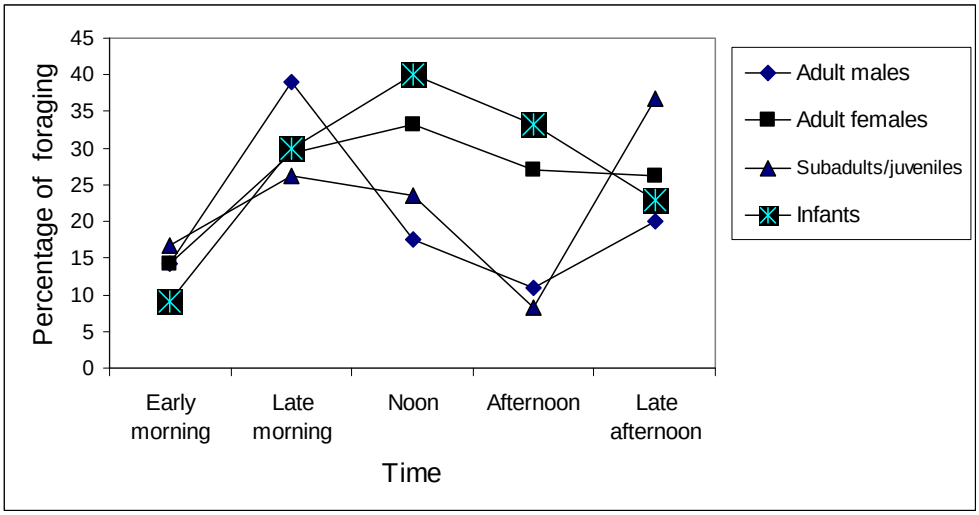

Fig. 2. Foraging activity in different age groups of grivet monkeys.

Grivet monkeys were observed most of the time foraging on different types of left over food items available within the garbage, especially fruits (banana, orange and mango). They also foraged on onion, bread and other food items available in the garbage. They spent 43.3% of their time foraging at the garbage site, 39.18% foraging on different types of wild fruits/seeds and 9.28% foraging on wild leaves. They spent least time (2.06%) foraging on flowers. They were occasionally observed gnawing on *Acacia* bark and licking the juice. Grivets also fed on gum that oozed out from the bark (Fig. 3).

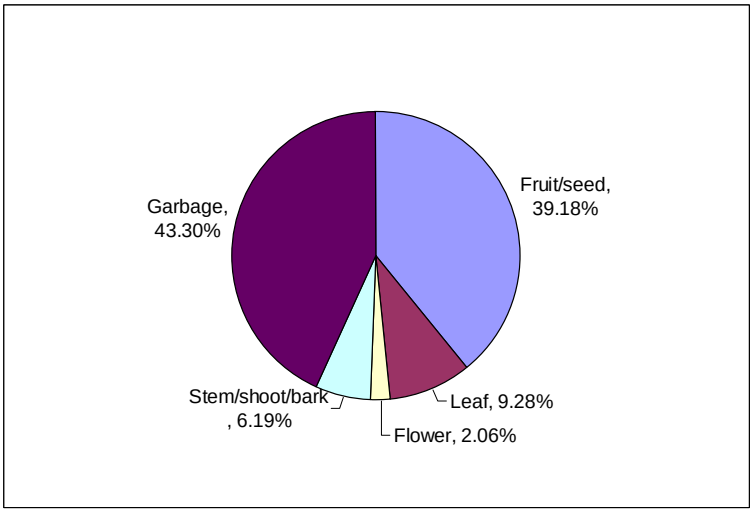

Fig.3. Percentage of daily time budget spent foraging by grivet monkeys.

The most important plant species commonly foraged by grivet monkeys in the study area were *Ficus vasta*, *Cordia africana*, *Psidium guajava*, *Mangifera indica*, *Rubus apetalus*, *Dovialis abyssinica*, *Acacia siberana*, *Coffea arabica* and *Leucaena leucocephala*. Fruits of Ficus, and Cordia supported most of the foraging demand among fruit bearing plants in the wild. They also fed on leaves, flowers and stem/bud/bark of 14 plant species (Table 1).

Table 1. Plant species commonly foraged by grivet monkeys.

Vernacular Name (Amharic)	Scientific Name	Parts eaten
Warka (Shola)	*Ficus vasta*	Fruit
Bamba	*Ficus gnaphalocarpa*	Fruit
Wanza	*Cordia africana*	flower, fruit
Zeyitun	*Psidium guajava*	Fruit
Yedega- injori	*Rubus apetalus*	Fruit
Koshim	*Dovyalis abyssinica*	Fruit
Dewani-girar	*Acacia seiberiana*	gum, leaf, fruit, flower
Buna	*Coffea arabica*	Fruit
Digita	*Calpurnia subdecanra*	Leaf
Bisana	*Croton macrostachys*	Fruit
'Avocado'	*Presea americana*	Fruit
Mango	*Mangifera indica*	fruit
'Safani'	*Leucaena leucocephala*	leaf
'Elephant grass'	*Pennisetum species*	bud, fleshy stem/shoot

A total of 60 individuals were available for questionnaire survey. Most of these respondents (96.67%) have observed different wildlife species in the campus such as grivet monkeys, various avian species, snakes, bat, fox, porcupine, mongoose and hare. Among these respondents, 75% agreed that there is conflict between people and grivet monkeys in the campus. They complained that grivets steal food and other valuables. They also defecate on cars, spoil their clothes after being washed and left for drying in the open air. Grivets forage on cereals or crops left outside. Their noise was also nuisance especially early in the morning while they were running over the roofs of the houses. Students also complained about grivet monkeys as they are disturbed by them while studying in the surroundings. However, 25% of the respondents confirmed that although grivets interfered with people, their impact is not significant compared to their ecological values. They also added that grivet monkeys are symbols to the area; they are charismatic to the campus as they are the only wild animal species frequently observed. They give aesthetic beauty to the area and contribute for research and education in the campus. Some of the respondents (40%) described that grivet monkeys are the causes for disturbance and destruction of valuable materials, and hence their habitat should be isolated from the residential

areas. However, 28.33% of them advocated that grivet has the right to live in its natural habitat and disturbance to this animal should be minimized, while 23.33% of the respondents suggested evacuating grivets from the area or that they should be killed without any alterative options. Thus, the opinion of most of the respondents (63.33%) about grivet monkeys at BDU main campus was negative.

DISCUSSION

Historically, grivet monkeys of BDU main campus emigrated from the nearby Abay River in 1974 and the founders to the area were only two individuals (pers. comm.). They gradually adapted to the area and isolated themselves from their original habitat. Though the majority of the residents complained that grivet's population increased at alarming rate, only a single troop having 44 individuals was encountered during the study period. This is probably due to various anthropogenic and natural factors imposed on grivet monkeys in the area. Interview results indicated that some monkeys were trapped alive and took to the town by city dwellers, and many of them were killed by the residents. There were also accidental deaths. For example, three grivets were killed by accidents from electric power lines in a single incidence during the study period. These indicated that different anthropogenic factors hinder the population growth of grivet in the campus.

In grivet monkeys, the diurnal activity pattern varied according to their respective age groups. Adult male grivet monkeys become active feeding in the morning and inactive from late morning to late afternoon. As the temperature increased, adult males preferred resting to other activities. They isolated themselves from the group and lay down on trees or roofs of buildings and sometimes they were observed in deep sleep. On the contrary, the activity of adult females was different and become active in foraging continuously compared to adult males. However, their feeding activity was interrupted by other activities such as resting, grooming or chasing. This is in line with other research findings conducted in rhesus monkeys in which the higher ranking females had greater access to foraging sites and total food intake (Deutsch and Lee, 1991). This might be the reason in which adult females required more food to satisfy their high energy demand for various physiological activities. As a result, adult females were forced to feed for longer time to get sufficient diet especially when food quality in the area is poor.

In sub-adults/juveniles, more time was spent for foraging and chasing than grooming. They become inactive for feeding before noon and try to chase

each other. Even though they spent least time for grooming, this type of activity in sub-adults/juveniles with different age groups might help to reinforce social bonds between group members as it was observed in other primates such as in Arunachal macaque (Kumar *et al*., 2007). In the afternoon, sub-adults predominantly spend most of their time foraging sometimes continuously up to their overnight roosting time in the early evening. The diurnal activity pattern for infants was different from other groups and they spent most of their time for foraging. They actively fed while other groups took rest at noon.

Experience and competence allow older individuals to solve unique problems more effectively than younger individuals (Kendal *et al*., 2005). The positive relationship between age and task success suggests that long experience of individuals may enable them to outperform younger individuals. Generally, it is possible to suggest that within primates, older individuals are more innovative in exploiting resources than younger ones. This is probably because of their increased manipulative competence. This improvement in foraging efficiency in adult grivets might enable them to spend relatively less time for foraging than sub-adults or infants in the same group.

In the wild, grivet monkeys mainly forage on fig fruits, Acacia seeds, flowers, foliage and gum (Kingdon, 1997, 2004). If there is sufficient amount of food from wild plants such as fruits, flowers and leaves, primates become dependent on natural food. Since the study area is a modified habitat, limited food is available for grivet monkeys. As a result, grivets are forced to develop adaptations of feeding by exploiting the available food in the garbage. Consequently, they spend most of their time feeding on garbage sites. They also steal food from the residents, and even the residents complained that they tried to snatch food from their kids. Generally, grivet monkeys show opportunistic feeding behaviour and the diet varies depending upon where they live. In the absence of naturally available food like the case in the main campus of BDU, they try to scavenge food from the garbage or steal human food. When sufficient food is available, these animals become very active and engage themselves in playing. This shows the importance of food availability in affecting the quality and timing of social interactions (Lee, 1979). Grivet monkeys were not observed feeding on meat of any sort regardless of the possibilities (Macdonald, 1985; Dorst and Dandelot, 1987).

Because of conflict with grivet monkeys at BDU main campus, there was a

campaign practiced by the campus community to evacuate them from the area. Even the residents hired a guard to kill or evacuate grivet monkeys from the area using domestic dogs. They attempted to kill and their corpses were displayed on a tree to frighten others not to get closer to the residences. However, because of their highly adaptive behaviour, such attempts were unsuccessful. The questionnaire result indicated that even one man alone killed three grivet monkeys. Young people also tried to trap the animals using traditional traps and this was confirmed during observation and focal group discussions. Three monkeys that escaped from the trap possessed ropes attached on their necks. Previous study in eastern and central Eritrea also indicated conflict between humans and vervet monkeys since both use common habitats extensively (Dietmar, *et al.,* 2002).

Grivet at the main campus of BDU destructs vegetables and fruits grown in the backyards. Different studies indicated that the kinds of crop grown and the types of direct preventive measures used are the main factors that might influence susceptibility of crop raiding by primates (Saj *et al.*, 2008; Marchal and Hill, 2009). The location and distance of a property from their habitat is an important factor influencing vervet crop-raiding (Saj *et al.*, 2008). Most respondents in the present study feared that grivet monkeys might transmit some communicable diseases to human beings either directly or indirectly. This might be true as different parasites which are common for human beings are also found in non-human primates. Different gastrointestinal parasites such as pinworms, trichurids and schistosoma were detected from faeces of Kenyan baboons (Halin *et al.*, 2003).

Conflict with grivet monkeys is not limited only to the residents. Students in the campus also raised the same complaint. These monkeys in the campus have become notorious in destructing various materials including their stationery materials during their study in the field. As their frequent movements interrupt attention, some students complained that they were highly disturbed by grivets. Moreover, grivets defecate on some students while studying under the tree. Therefore, the fate of grivet monkeys could be influenced by different groups of people living at the campus. This was also observed in other areas where the status of other primates such as red-tall monkeys in Kampala forests was highly influenced by the intensity of human activities (Baranga, 2008).

Regardless of complaints by the majority of people about grivet monkeys at the campus, some respondents argued that these animals are not harmful. They are very important ecologically as they involve themselves in various

activities like in seed dispersal, in checking the populations of certain insects, birds and small mammals, and they are likely to check predator population by preying on other animals (Rochester, 1999). Their aesthetic values should not also be ignored. Moreover, they are also used as experimental animals in scientific research and vaccine production. As a result, they are widely used in research involving immunology and infectious diseases (Colin, 2005). From this study, it is possible to conclude that the majority of the residents' attitude about grivet monkeys was negative. Hence, the University Administration should develop rules and regulations in order to conserve the biota of the campus.

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