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Daily Behavioral Activity Pattern of Colobus Monkey in Menagesha-Suba Forest

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Biology

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V. ABSTRACT

The behavioral activity patterns of the black and white Colobus monkey (*Colobus geureza*) were studied in Menagesha-Suba forest reserve in central Ethiopia. The study investigated the activity pattern of feeding, grooming, mating, playing and other forms of behaviors with in selected target guereza groups. Scanning method was used throughout the study to record the overall behavioral activities. The data were collected for six months, between November 2016 and April 2017. A total of 360 scanning periods each with 10 minutes duration were employed during the study. The data were collected based categories (adult males, adult females and young) in the group. The results showed that gurezza spends most of its time resting (38.56%) and feeding (35.04%) while mating (0.27) and aggression (3.17) were the least frequently observed behaviors. More feeding (37.57%), grooming (12.12%) and aggression (3.48%) were observed during the morning, while resting (41.24%) and playing (13.49) were more frequent in the afternoon. Adult females showed the highest proportion of feeding compared to adult males and young. On the other hand, adult males spent more time resting compared to adult females and young. Playing was by far most frequent in the young. The observed variation in activity pattern among the age and sex groups was consistent in the morning and afternoon. The gurezza were observed to feed on seven plant species at the study area with Cypress (36%) and Olive (20%) trees being the most commonly consumed plants. Acacia (5%) and Cape fig (7%) were the least commonly consumed plants. Self-grooming constituted the highest proportion (69%) of the total grooming observed and it was most frequent among males (29%). Females exhibited the highest proportion of non-self grooming. Aggression behavior was observed only among adult males. Aggressions were induced by the presence of hyena and subordinates during mating. It was also displayed when dominant males overtake suitable feeding spots.

Keywords: Behavior, activity pattern, Menagehsa-Suba forest, *Colobus guereza*, scanning method.

1. INTRODUCTION

1.1 Taxonomy

Black and white Colobus monkey belongs to order primate; Sub-order *Haplorrhini;* Infraorder: *Simiiformes;* Family: *Cercopithecidae;* Genus: *Colobus;* and Species: *Colobus guereza.* Grooves (2005) classified the species into seven sub species; *C. g. caudatus*, *C. g. dodingae*, *C. g. guereza*, *C. g. kikuyuensis, C. g. matschiei*, *C. g. occidentalis*, *C. g. percivali*, and *C. g. guereza*.

Quite a number of common names are used for C*olobus guereza* including: Abyssinian black and white Colobus, Abyssinian Colobus, eastern black and white Colobus, guereza Colobus, guereza black and white Colobus, magistrate Colobus, magistrate black Colobus, mantled guereza, and white-mantled Colobus (Jensz and Finley, 2011).

1.2 Distribution

Colobus guereza are reported in the following countries; Cameroon, Central African Republic, Chad, Congo, Ethiopia, Gabon, Kenya, Nigeria, Rwanda, Sudan, Tanzania, Uganda and the Democratic Republic of the Congo (Oates, 1977a; Oates & Trocco, 1983; Napier, 1985; Groves, 2001) (Fig. 1). Regarding the sub-species, their geographic range is; *C. g. guereza* predominantly in Ethiopia, while *C. g. occidentalis* is found from Uganda west of the Nile to southern Sudan, to Cameroon and Gabon. *C. g. dodingae* is only found in the southeastern Sudan. *C. g. percivali* is only found around Mt. Gargues in central Kenya. *C. g. matschiei* is found in western Kenya and south into northern Tanzania. *C. g. kikuyuensis*is is found in central Kenya and *C. g. caudatus* in Tanzania, primarily in the region of Mount Kilimanjaro (Groves 2001). The overall range of occupancy of the species is approximately 268,000 km^2 (Jensz and Finley, 2011). According to de Beaux (1943), the black and white Colobus monkeys in Ethiopian are distributed in the highlands, west of the Rift Valley and extending down into more lowland forests along the Omo River to the south, and the Blue Nile to the west.

Figure 1. The distribution range of *Colobus guereza* (Wiki loves Africa, 2016)

1.3 Studies on the behavior of Colobus monkey

Mohammed Hussen and Dessalegn Ejigu, (2017) had conducted a study on diurnal activity patterns, feeding ecology and conservation status of Colobus monkeys (*Colobus guereza gallarum)*, in Gidabo forest, which is located around Yirgalem town, Sidama Zone. Gidabo forest is found in Southern Nations Nationalities and Peoples Region at about 310km South of Addis Ababa, and 47km from Hawassa in the eastern edge of the Rift Valley. The instantaneous scan sampling method was used to collect data on Colobus monkeys. Diurnal activity patterns of Colobus monkeys including feeding, moving, resting, grooming, social play and others were recorded. For studying the conservation status of Colobus monkeys in the studied area, focus group discussion was conducted to collect information from communities living around the area. Two focus group discussions were conducted. Participants were selected based on their age and duration of residency in the area. Community leaders were approached in advance and requested to organize the focal group discussions. Information was collected based on the presence or absence of conflict between the local people and Colobus monkeys in the area, the causes of conflicts, the attitudes of the local people towards Colobus monkeys, and how both local communities and Colobus monkeys benefited from the forest habitat. The researchers described the result they obtained

about the diurnal activities of Colobus monkey as; the percentage of time spent for different diurnal activity patterns in *C. g. gallarum* indicated that more time (55.77%) was devoted for resting; followed by feeding (22.64%). Moving, grooming and social play activities took relatively less time compared to resting and feeding. The proportion of time spent for feeding on different food items by *C.g.gallarum* indicated that more time was spent for foraging on young leaves than other plant parts. They spent 52.39% of time foraging on young leaves and the least time (5.68%) was spent on barks.

Regarding feeding ecology of *C.g.gallarum* consumed 15 different plant species during the study period. From these plant species that contributed the overall diet of the study species, the top three plant species namely *Prunes africana, Celtis africana* and *Ficus vasta* accounted for more than 50% of their plant diet. According to the total percentage contribution of the plant food items eaten, *Prunes Africana* was the most frequently consumed species which accounted about 26.42%, *Celtis Africana* was 16.98% and *Ficus* vasta was 10.85%.

The response obtained from the focal group discussion revealed that there were no conflicts between *C. g gallarum* and local communities. Therefore, they were not hunted as pests, rather for their skins in early times. This result revealed that the Colobus monkeys in Gidabo forest are not endangered.

Oates &Trocco (1983), studied the loud-call (roaring) vocalizations of Black - and- White Colobus, and divided them into three groups: (1) *C. guereza* and *C. vellerosus*, with low-pitched pulsed calls; (2) *C. satanas*, with higher-pitched, fast-pulsed modulated calls, preceded by an endearing cough; (3) *C. angolensis* and *C. polykomos*, with roars of high or indeterminate pitch and pulse rate.

Abraham Eustace et al, (2015) had conducted a study on black-and-white colobus monkey (*Colobus guereza caudatus*) in Rau Forest Reserve, Moshi, Tanzania investigating overall activities and activity across age and sex groups. The study involved both focal sampling and scan sampling. However, a reconnaissance survey had been conducted in the study area before the implementation of those methods. They collected activity data for 14 days from morning (7:00-8:00h) to evening (15:00-17:00h) in June 2014. Focal observation and recording were done for 5 minutes at 15 minute intervals throughout the day (Fashing ,2001a; Teichroeb et al. 2003), after spotting a monkey, they waited for five seconds before starting recording to avoid over-representing eye-catching activities like moving. The focal adult

individual was selected opportunistically. If the focal adult individual was lost before the end of the day, another adult individual was selected and observation and recording were conducted as long as possible. Upon sighting of individual, the first activity held for 5 seconds was recorded. If the individual was involved in more than one activity for example during social interaction, recording was done into sequence of those behaviors occurred during 5 seconds. Group activity was recorded every 15 minutes by scan sampling to determine activity, which was done by at least 50% of the group members. Five activity categories were recorded: feeding, moving, resting, socialization and others. They described the activities as follow: feeding involved ingestion and masticating of plant or prey; moving referred to the activity which leads to the changing of spatial location either by walking, running or by jumping, resting includes all activities, which the individual was physically inactive either sleeping or sitting, social includes grooming, playing, mating, aggression and greeting. Others include any activity, which did not fit into the above categories, such as drinking, defecating and urinating. For differentiating age categories, they classified adults to include all monkeys that have attained reproductive maturity and full body size. Juveniles included individuals smaller than adults but not carried by their mothers, while infants were carried by their mothers at least occasionally. To differentiate sex was not difficult since the group of black-and-white Colobus monkey is dominated by a single male. Despite to the differences in body morphology and genital organs, only males of black-and-white Colobus monkey possess a large continuous line of white hairs across the perineum.

Regarding the result obtained by the researchers, a total of 3,338 activity observations were collected from both focal animal sampling and scan sampling from one group with 8 to 12 individuals. Other activities, like defecation and urination did occur outside of sampling time; they were recorded but not involved in the analysis. Therefore their results do not have the behavior category named “others”. Back and white Colobus monkeys foraged most heavily on *Ficus sycomorus* (flowers), *Ficus exasperata* (leaves and fruits), *Delonix regia* (leaves) and lianas (leaves) as it were observed when recording feeding activities.

Regarding the overall activities the researchers found out that, the black and white Colobus monkeys in Rau Forest Reserve, spent much of their time resting (57.7%) and feeding (27.7%) while less time was spent on moving (10.8%) and social activities (3.8%). The social activities observed were grooming and aggression, which were done by adults, and playing by infants. Socially, grooming was mostly recorded within the group while aggression was

both intra- and inter-group. Social activities were less observed compared to other behaviors i.e. resting and feeding. Resting was high at all times of day while feeding tended to be high in morning and evening; and slightly lower during the afternoon. Movements of the group were higher in the morning and afternoon, becoming lower in the evening. Adults spent about 60% of their time resting while juveniles and infants spent only 50% and 46% respectively. Feeding varied with adults spending 21%, juveniles 27.9% and infants 16.9% of their time taking food. Moving didn't vary across age groups with adults spending 10.5%, juveniles 11.3% and infants 13.1% of their time in this activity. There was a difference in time spent in social activities across age groups with adults spending 7.8%, juveniles 10.8% and infants 23.8% of their time.

Regarding activity across sex groups there was no significant different between sexes in resting in males and females. Feeding (males 19.2% and females 21.1%); and moving (males 14.4% and females 18.1%) were recorded. Social activities mostly recorded in males involved aggression and vocalization while in females was grooming

1.4 OBJECTIVES

1.4.1 General objective:

The general objective was to generate data on the daily behavioral activities of the black and white Colobus monkey (*Colobus guereza*) at Menagesha –Suba forest, in western Showa, Ethiopia.

1.4.2. Specific objectives: To

- record the behavioral activities displayed by adult males, adult females and young in a group of the black and white Colobus monkey,
- identify the most common and frequent daily activity in each category,
- show temporal variation in activity pattern,
- describe mating behavior,
- identify types of playing and grooming interaction

2. **LITERATURE REVIEW**

2.1 General characteristics

The word "Colobus" comes from a Greek word *ekolobose,* meaning " he cut short" or " mutilated", and is so named because its thumb is essentially absent or a thumb that is represented only by a small phalanged tubercle that may at times bear a nail. The lack of a thumb may aid their moving quickly through the trees (Kim, 2002). The colobines differ from other primates in the morphology of their stomachs. The stomach is large and multi-chambered, and the foregut supports a bacterial micro flora with cellulose-digesting abilities. Colobine stomach enables them to digest plant fibers, and many include large quantities of foliage in their diet (Oates & Davies, 1994). Colobine also possess greatly enlarged salivary glands that produce large amounts of saliva. This saliva may help to buffer the acidity of the foregut fluid, and may contain proline-rich proteins that assist with the nullification of tannins in the digestive process (Oates & Davies, 1994). Unlike the other subfamily in the family *Cercopithecidae* (*Cercopithecinae),* colobines do not possess cheek pouches.

According to Abraham Eustace et al. (2015), sexes differed in activity. Resting in males was accompanied with other activities such as vigilance, which is less practiced by females.

Body size also has a positive relationship with resting time in Africa colobines, as males are larger than females and rest more. He further described that, feeding, moving and social activities were mostly observed in females than in males. Regarding feeding habits, Colobus monkeys were observed feeding on leaves, flowers and fruits. According to Jensz and Finley (2011), despite being a diurnal species, the guereza spends over half the day resting, with the remaining hours of daylight devoted mostly to feeding and moving about. When active, this primarily arboreal species can be seen bounding through the canopy, leaping from tree to tree. The guereza sleeps during the night, with a single group generally occupying several adjacent trees nearby a source of food. To communicate, the guereza employs various vocalizations, the most distinctive being impressive loud roar usually made by the dominant adult male and echoed by males in neighboring groups. These roaring bouts, which usually take place during the night or at dawn, are thought to play a role in male-male competition and help maintain spacing between groups. Overall activity of black-and-white Colobus monkey vary, as they spend much time (more than 50% of their time) in resting and feeding while spending less time in social activities like grooming. These variations do occur also

between age and sex groups. Adults rest more than juveniles and infants do while juveniles feed more than adults and infants did. However, infants spend much of the time in social activities especially playing. Regarding activity across sex groups, males rest more than adult females and females socialize (grooming) more than males. The variations in overall activity are due to energy conservation strategies and more time for digesting cellulose food materials hence more resting time. Body size tends to be factor for much resting time across age and sex groups. Availability of social partners was the factor for females to socialize much than males while the involvement of infants into a wide range of social activities was the factor for infants to be involved much in social activities than adults and juveniles. Abraham Eustace (2015).

The social activities observed were grooming and aggression, which were done by adults, and playing by infants. Socially, grooming was mostly observed within the group while aggression was both intra- and inter-group. Shruhsaker and Leland (1987) described grooming that, adjacent groups act aggressively towards each other with the males usually being involved in the fights, but females and younger age classes may also be involved.

Dunham N.T (2013) suggested that differences in forest structure and ecological variables among three areas of the Diani Forest account for variation in overall strata use and support use. Locomotors and postural behaviors are largely consistent across habitat types.

2.2 Body features

The black and white Colobus monkey is described as, a large black monkey with a white mantle, or ornamentation and a tail tuft (Napier 1985). Kim (2002) further specified *C. guereza* as a grey face without fur; a glossy black coated body with a U-shaped white mantle found on the side; the face surrounded by white hair, with bushy cheek hairs (Fig. 2). The tail has a white tuft at its end, which is variable in its extent along the length of the tail. Subspecies are distinguished from one another by color variations in these features (Napier 1985). The main features that set the subspecies apart are the length and coloration of the mantle, which sometimes appears creamy or yellow, the length of the tail, and the extent of the tail tuft (Gron 2009). There is a white stripe on the thigh (Groves 2001).

Figure 2. Physical appearance of *Colobus guereza* (www. Pinterest.com)

At birth, the hair of infant *Guereza* is completely white, in striking contrast with the predominately-black fur of the adult (Groves 2001, also personal observation) (Fig. 3). *Colobus g. guereza* has a tail, which is longer than the head and body combined, with the anterior half being gray and the tuft taking up about half of its length. The mantle is long and extends onto the back, becoming longer further back on the body (Groves 2001). *Colobus g. dodingae* has a tail, which is substantially longer than the head plus the body and is white for only 40% of its distal end. This tail tuft is not particularly bushy. The hair is short and coarse and the mantle is only somewhat creamy in color, and does not expand up onto the dorsum (Groves 2001). *Colobus g. matschiei* has a tail, which is significantly longer than the head and body with the tuft extending over less than half of its length. It has short hair with a yellowish mantle, which does not extend onto the back but extends nearly to the white hairs around the face. The shoulders have some white (Groves 2001). The tail of *Colobus guereza occidentalis* is longer than the head and body combined and the tuft extends only one-third of the tail from the distal end. The mantle is more a cream color than white is and does not extend onto the back. The subspecies has some white on its shoulders (Groves 2001). *Colobus guereza percivali* has very long creamy yellow mantle and very long hair, extending longer than 40 cm (15.7 in) on the lower abdomen. The tail is as long as the head and body combined, with the white tuft extending over about two-thirds of its length (Groves 2001).

Colobus guereza kikuyuensis has a very large tail tuft, covering almost three quarters of its length and the anterior portions of the tail are grayish. The tail is roughly as long as the body and head together. The mantle is long, extends onto the back, and is over 40 cm (15.7 in) long on the lower abdomen (Groves 2001). *Colobus guereza caudatus* has a longer mantle than *C. g. kikuyuensis*, its ventrum is less woolly, and over 80% of the tail is occupied by the tuft (Groves 2001).

Figure 3. A white infant *Colobus guereza* taken care by its mother (www. Pinterest.com)

Colobus guereza is slightly sexually dimorphic, where males are larger and heavier than females (Kingston, 1971). Some researchers describe the body weight and length of *Colobus guereza* as; average weight for males fall between 9.3 and 13.5 kg while for females, the range is between 7.8 and 9.2 kg. (Napier 1985; Oates & Davies. 1994). Head and body length in males averages 61.5 cm. ranging from 54.3 to 69.9 cm. In females, it averages 57.6 cm and ranges between 52.1 and 67.3 cm. Napier, (1985). According to Fashing, (2001a), to differentiate sex was not difficult since the group of black-and-white Colobus monkey is dominated by a single male. Despite to the differences in body morphology and genital materials, only males of black-and-white Colobus monkey possess a large continuous line of white hairs across the perineum

Fashing (2001a) classified the members within a group as; adults, which include all monkeys that have attained reproductive maturity and full body size, and Juveniles, included individuals smaller than adults but not carried by their mothers, while infants were carried by their mothers at least occasionally.

2.3 Habitat

Guereza are arboreal and tied to habitats that have trees and are present in both deciduous and evergreen forests (Fig. 4). They are found in forests and savanna woodlands within and to the north of the moist forests of central Africa, often extending into highland or montane forests (Oates 1977a; Oates & Davies, 1994; Lwanga, 2006). However, they are found in a variety of habitat types, including primary, secondary, riparian, gallery, and upland forests, especially those near rivers, lakes and with higher elevations (Dunbar & Dunbar 1974; Oates 1977a; Dunbar 1987). The species often prefers disturbed, secondary, or colonizing forests, and prefers degraded forests to old growth when both are available (Thomas 1991; Lwanga 2006). This preference is likely attributable to high species diversity of food trees in some secondary growth forests and may be explainable in terms of milder chemical defenses in secondary growth species (Oates 1977b; Lwanga 2006). Other habitat types include moist lowland, medium-altitude and highland forests, rainforests, gallery forests, swamp forests and wooded grasslands (Oates 1977a; Dunbar 1987; Oates 1994; Fashing 2001b; Harris & Chapman 2007). Guereza will also occasionally visit swamps (Oates 1978). In addition, they can be found in high forests in mountainous areas, including altitudes up to 3300 m as well as areas under human use, such as eucalyptus plantations (Dunbar & Dunbar 1974; Fashing et al. 2007; Harris & Chapman 2007) (Fig.4).

Figure 4. The arboreal *Colobus guereza* in trees (www.alamy.com**)**

2.4 Behavior

2.4.1 Feeding

Leaves and fruit are the main foods of the guereza but the diet is quite variable (Oates 1994; Fashing 2001b) (Fig. 5). Odwyer (2011) specified that the proportion of time spent foraging for different food items was dominated by foraging for leaves; foraging for mature leaves in particular accounted for the highest proportion of time spent at this activity. The next most foraged for food item was unripe fruits. Other food items were foraged for to a much lesser extent. While the species has been believed to be exclusively leaf-eater, it is not obligate folivorous (Oates 1994; Fashing 2001b). The proportions of these types of food relative to one another varies by study site and time of year, often with leaves making up more than half to most of the diet, but with fruit sometimes predominating (Dunbar & Dunbar 1974; Oates 1994; Bocian 1997; Fashing 1999; 2001a; Harris & Chapman 2007). The guereza possess large and multi-chambered stomachs, which allows them better digest plant fibers, including foliage. This ability to digest plant material is also assisted by stomach bacteria. Together, these and other morphological adaptations allow the species to feed on large quantities of leaves (Gron 2009, Arkive 2011). Fleshy fruits are usually consumed when unripe, with consumption being reduced as they fully ripen, likely to avoid competition with other primate species that prefer ripe fruit (Fashing 1999; Chapman et al. 2006; Harris & Chapman 2007).

The usual guereza preference is to eat and select for young leaves, but in times of scarcity, to rely on mature leaves and fruits. However, the use of mature leaves can vary widely across forests and between groups within the same forest (Oates 1977b; 1994; Chapman et al. 2006; Harris & Chapman 2007). In addition, the possibility exists that fruit might be a preferred food item in some habitats (Fashing 2001b). Other foods consumed include bark and wood, seeds, flowers, petioles, lianas, arthropods, water-plants, concrete from buildings and soil (Oates 1978; Bocian 1997; Fashing 2001b; Chapman et al. 2006; Plumptre 2006; Fashing et al. 2007; Harris & Chapman 2007). Guerezas tend to eat foods with high protein-to-fiber ratios, and the availability of such foods is correlated with guereza biomass in a given habitat (Chapman et al. 2004). Figure 5 shows a guereza feeding leaves on a tree.

Figure 5 *Colobus guereza* feeding on leaves (www. Pinterest.com)

2.4.2 Movement

Guereza primarily use quadrupedal locomotion and leaping to move through their environment, followed in frequency by climbing and other locomotor patterns (Mittermeier & Fleagle 1976; Morbeck 1977; Gebo & Chapman 1995). The species' quadrupedal movement usually consists of bounds and gallops up and across large supports and when not moving,

they will usually sit or recline (Mittermeier & Fleagle 1976; Gebo & Chapman 1995). Leaps are usually short and contribute to a generally horizontal or downward pattern of movement (Morbeck 1977; Gebo & Chapman 1995) (Fig. 6). The species rarely is seen suspending and usually feeds above a support (Mittermeier & Fleagle 1976). While primarily arboreal, the species will descend to the ground to feed and to travel in cases where there are not suitable arboreal pathways (Oates 1977a).

Figure 6. Black and white Colobus monkey leaping from a tree (www.elelure.com)

2.4.3 Mating and reproduction

Harris & Monfort, (2006) described that female black and white Colobus show no external sign of estrus and have an ovarian cycle of 24 days. Copulation may be solicited by both sexes (Harris & Montfort, 2006). Females elicit copulation by presenting their ano-genital region to males (Estes, 1991), while males present an erect penis to a female and/or touch the female ano-genital region or rump area (Harris & Montfort, 2006). Copulation may occur at any time in the year, although in the wild, most births occur in the rainy season (Oates, 1977c). A female may give birth every 19-24 months (Harris & Monfort, 2006). A single white offspring is produced after about gestation of 6months (Harris & Monfort, 2006) (Fig 3). They gradually take on the adult coloration at about three months. The newborn infants are handled by the mother and other members of the group, mainly females and rarely by males (Horwich & Wurman, 1978). Handling of very young infants in this manner is an unusual feature among primates (Oates, 1977c; Horwich & Wurman, 1978). When the infant acquires its adult colorings, attention from other members of the troop dramatically diminishes, or completely ceases. Infants as young as two to four months old start eating

leaves in small amounts, and play and explore away from their mother. By the time, they reach six months old, infant Colobus monkeys become largely independent from their mother, although they will still suckle and associate with their mother during rest or while travelling, until they reach 10 months old. Young Colobus over a year old are classified as juveniles and only associate with their mother during rest (Oates, 1977c). Juvenile males mature at six years old, while females mature younger, at four years old (Oates, 1977c). The number of males in a Colobus group has been shown to be a function of the number of females in it, and multi-male groups were shown to have lower reproductive rates than one-male groups (Dunbar, 1987).

2.4.4 Playing

Playing is the most common activity in the young *C. guereza* and infants spend much of the time in social activities, probably due to their involvement in a wide range of activities including playing, which is common at other ages (Fashing, 2001a). Infants spent time in playing while adults are resting (Grimes, 2000).

2.4.5 Aggression

Geureza is a territorial species, which defends its relatively small core territory in an aggressive manner towards neighbors. Aggressive encounters between groups usually involve chases, displays and vocalizations rather than physical contact. Adult male black and white Colobus monkeys produce loud calls, known as roars, during daily, contagious night and morning choruses, and in response to predators (Marler 1972; Oates 1977c). Physical aggression within the group is usually not harmful and rarely escalates into a conflict (Grunau and Kuester J. 2001). within multi-male groups, one male is dominant to the others and interactions between the adult males are aggressive, with some males eventually being forced out. There are definite indications of infanticide in consequence of the threat of male replacements within mixed groups (Kim 2002). The guereza is often found living in sympatry with a number of other primate species (Gron 2009). Infant guerezas have been observed playing with infant vervets (*Chlorocebus aethiops*) (Chapman & Chapman 1996). However, as a rule, one of the males would be dominant over the other males, with exclusive access to females (Oates, 1977c; Harris & Montfort, 2003).

2.4.6 Social behavior and groupings

Guereza generally live in small, cohesive groups, typically ranging in size from 3 to 15 individuals, but occasionally up to as many as 23 (Fig. 7). These social groups sometimes support several adult males, but normally comprise one adult male, accompanied by several reproducing females, adolescents and infants (Arkive 2011). The core of the mixed group consists of the females, who remain in the group of their birth for life. These females are thought to be close relatives that display their friendly intergroup relationships, marked by mutual grooming and well-developed "infant transfer." This latter phenomenon consists of an infant being handled by several females soon after birth and carried as far as 25 m from its mother. A mother may even suckle the infant of another female and her own simultaneously (Kim 2002). Unlike females, young males leave the group of their birth before they are fully mature. The adolescent guereza males leave their birth group either voluntarily or due to pressure from the adult male of the birth group. Upon leaving their natal group, young males lead a solitary life or temporarily associate with other solitary males. They may eventually take over their own harem and create a new group (Kim 2002). Within multi-male groups, one male is dominant to the others and interactions between the adult males are aggressive, with some males eventually being forced out.

Figure 7. A group of *Colobus geureza* handling two newborns (www.google.com)

2.4.7 Communication

Male guereza roar loud nocturnal and dawn choruses as a means of spacing groups. Six vocal sounds have been recorded: roars, snorts, purrs, honks, screams and tongue clicks (Gron 2009). In addition to vocal communication, visual signals, such as flapping of fringe fur, facial expression, and body posture are used in aggressive communication between groups. Tactile communication in this species includes grooming, playing, and fighting (Kim 2002). Despite being a diurnal species, the guereza spends over half the day resting, with the remaining hours of daylight devoted mostly to feeding and moving about. When active, this primarily arboreal species can be seen bounding through the canopy, leaping from tree to tree. The guereza sleeps during the night, with a single group generally occupying several adjacent trees nearby a source of food. To communicate, the guereza employs various vocalizations, the most distinctive being impressive loud roar usually made by the dominant adult male and echoed by males in neighboring groups. These roaring bouts, which usually take place during the night or at dawn, are thought to play a role in male-male competition and help maintain spacing between groups (Arkive 2011, Gron 2009, Hippel 1998).

2.5 Home range

Home range for *C. guereza* is variable with location. With full home range estimates ranging from just over 0.01 km² to 1 km², with most estimates at the lower end of this range, usually under around 0.2 km². Home ranges can overlap, often sharing home range area with several other groups (Hippel 1996; Krüger et al. 1998; Fashing 2001c; Harris & Chapman 2007). In addition, there are core areas within the home range, which are significantly smaller than the overall home range (Krüger et al. 1998; Fashing 2001c; Harris & Chapman 2007). When compared between study sites, groups are typically between 6 and 10 individuals and usually average under 12 individuals (Oates 1994; Krüger et al. 1998; Fashing et al.2007). In long-term studies, single-group day range averages were between 252 and 734 m ranging as small as 62 m to over 1360 m in a day (Oates 1977b; Bocian 1997; Grimes 2000; Fashing 2001a).

2.6 Conservation status and threats

According to Jensz and Finley (2011), *Colobus guereza* is not globally threatened and is listed as least concern by the IUCN. Although this species is locally threatened in parts of its range, the guereza remains relatively widespread and abundant, and, owing to its tolerance of

forest degradation, is considered one of the least threatened species of Colobus monkey. The species as a whole is a low priority for conservation. Clearance of forests for agriculture is a major concern for some guereza populations, particularly those belonging to the subspecies *C. g. gallarum* and *C. g. matschiei*, both of which have a relatively small range in East Africa (Kingdon et al 2008, EOL 2011). According to Arkive (2011), the persecution of guereza for meat and pelts is an additional threat in parts of its range. In particular, commercial trade in guereza skins is believed to be putting *C. g. percivali*, the only subspecies classified as Endangered, at considerable risk of extinction.

According to Struhsaker et al. (2008), unlike most other primate species, the mantled guereza can survive habitat degradation and can even thrive in degraded forests. Sometimes, logging may increase the number of preferred food trees for the mantled guereza and it is more abundant in logged areas than unlogged ones Oates, J. F. (1994). However, complete forest clearance causes dramatic declines in numbers. In Uganda, complete forest clearings caused a decline of 50% over eight years Chapman et al. (2000). The mantled guereza is also threatened by hunting for meat and its skin. Mantled guereza meat sells as bush meat for $4–9 US. Chapman, et al.,(2007). The skins have been sold for fashion or in the tourist trade, Eves and Ruggiero, (2000).

According to Kim (2002) and Arkive (2011), the guereza has several predators. The main predator of the guereza is the crowned hawk-eagle (*Stephanoaetus coronatus*). The chimpanzee (*Pan troglodytes*), has also been observed hunting the species, and remains have also been found in the scats of leopards (*Panthera pardus*). Other potential predators include other raptors such as Verreaux's eagles (*Aquila verreauxii*) (Gron 2009).

Certain diseases are also threats to Colobus geureza. According to Rabineau (2009) and MAF Biosecurity N.Z (2011), the guereza appears to be susceptible to some parasites such as the intestinal nematode parasite or whipworm, *Trichuris trichiura* and the protozoa *Cyclospora colobi.* The whipworm parasite has been recorded in high levels in many primates including the guereza (Gillespie et al. 2005). Levels of infection (determined by eggs in faecal samples) may be an indicator of the health of the individuals (Rabineau 2009).

3 ATERIALS AND METHODS

3.1 Study area

Menagesha – Suba forest is located 40 km southwest of Addis Ababa. It lies within coordinates of 38° 31' – 39' E and 08° 54' N – 09° 04' N, the altitude ranges between 2330 – 3300 m (Ababayehu Dessalegn and Tilaye Wube, 2012). According to Ministry of Agriculture (2002), and Breitenbach (1962), King Yacob (1597-1603) commissioned Menagesha-Suba as a crown forest and ordered its reforestation, which led to the use of *Juniperus procera* seeds from Wof-Washa by the year 1600. Currently, the forest covers an area of about 2500 ha of which 800 ha is plantation forest and the remaining is natural. According to Feyera et al. (2001), the forest cover is confined to the northwestern and southwestern half of the Wochecha Mountain, whereas the eastern slope has been converted into farmland.

The climate at Menagesha area has a bimodal rainfall pattern with main rainy season from mid June to end of September and a short rainy season between mid - April to mid - May (Lalisa et al., 2009). The annual rainfall in the area is around 1100 mm and the mean monthly temperature ranges from 9.5°C to 22.5°C

The vegetation is described as undifferentiated evergreen montane forest dominated by *Hypericum revolutum, Hagenia abyssinica, Juniperus procera* and *Podocarpus falcatus.* (Breintenbach et al.1962, Feyera et al., 2001). Abate Zewdie (2007) classified the vegetation in Menagesha – Suba forest into six clusters of: 1. *Cupressus lucitanica, 2. Myrsine Africana - Erica arboria, 3. Myrsine africana - Oleaeuropa, 4.Oleaeuropa – Sideroxy longilletti, 5.Dovialis abyssinica – Allophylus abyssinicus, and 6.Lantana trifolia – Juniperus procera.* Figure 8 shows a section of the forest.

Figure 8. The section view of the forest

According to the information obtained from tourist guides and workers at the MSF forest; and personal observations the Menagesha-Suba forest harbors various species of wild animals, including Anubis baboon (*Papio anubis*), colobus monkey (*Colobus geureza*), Menelik's bushbuck (*Tragelaphus scriptus*), wild hogs (*Sus scrofa*), caracals (*Caracal caracal*), spotted hyena (*Crocuta crocuta*), wildcat (*Felis silvestris*) and a variety of bird species.

3.2 Methods

Behavioral data were collected by observing target family groups. The family groups were selected based on accessibility and chance of encounter. The group size recorded was between seven and thirteen members, (on average ten members). The categories in the group were selected based on morphological difference and genital of the adults as described in Abraham Eustace et al, (2015). That is, morphological difference to differentiate the adults from the young, because the adults are bigger than the young. It was difficult to determine the sexes of the young; therefore, they are included in a single category. Genitals and aggression were used to differentiate the adult males from adult females. Two observation sessions were used in one day. These were equally divided in morning (7:00 – 10:00) and afternoon (14:00 – 17:00) sessions. Different family groups were studied in each session. Data were collected for six consecutive months (November 2016 – April 2017). Two days of data collection were

employed for each month. Behavioral records were made for 10 consecutive minutes with two minutes of pause, which were repeated until the end of each hour of observation. Thus, there were five observation periods in each hour. Behavioral records on the frequency of activities on feeding, grooming, playing, mating, aggression and resting were recorded using a data sheet. An attempt was also made to determine type of food which were most selected by members of the target group and the direction of aggressive behavior.

The location of the target family groups was recorded using GPS handset (Garmin GPS 72H). Binocular field glass was used to observe animals which were far high on the trees.

3.3 Data analysis

Data were statistically analyzed using one sample and paired samples t-test at the 95% significance level. SPSS software ver. 17 was used for the analysis.

4. RESULTS

4.1. Overall frequency of behavioral activities

A total of 1481 activity bouts were recorded within the 360 scanning periods and it revealed that feeding (35.04%) and resting (38.56%) constituted the highest ratio. On the other hand mating (0.27%) and aggression (3.17%) constituted the least ratio. Others grooming (11.14%) and playing (11.75%) were moderately performed. The result obtained for each behavioral activities are given on Figure 9.

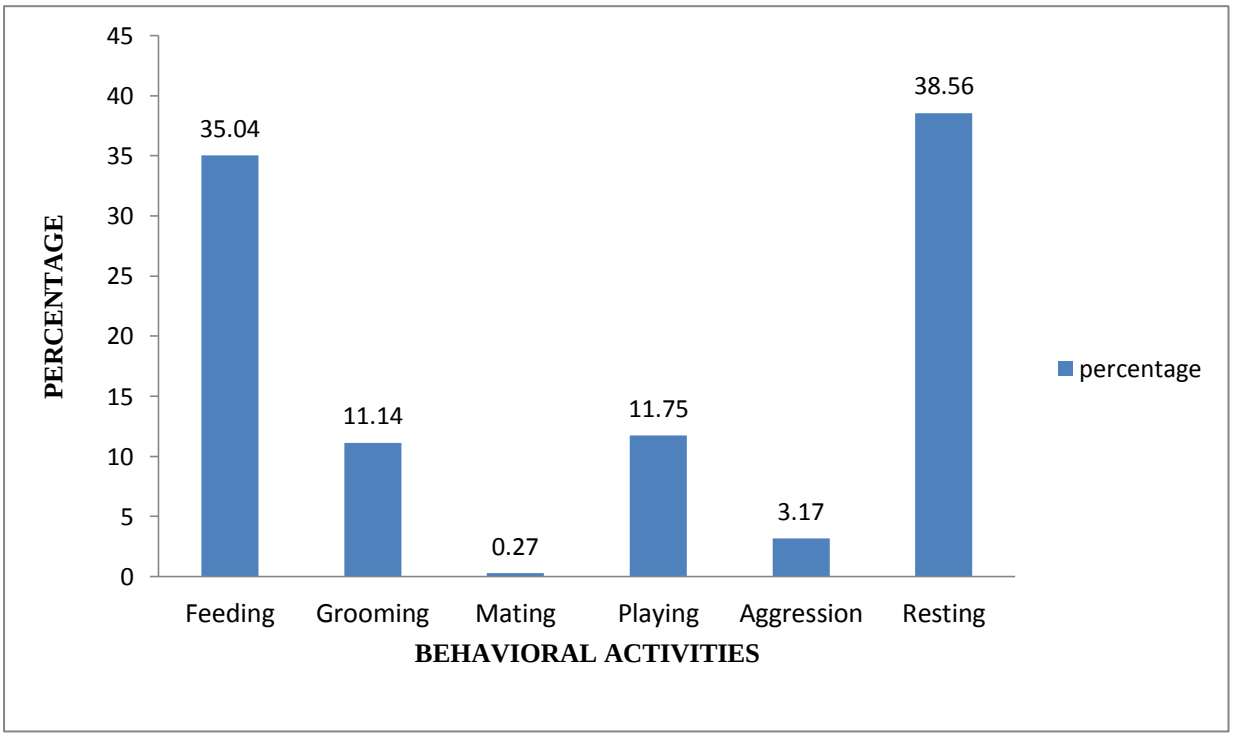


Figure 9. The overall activity records of black and white Colobus monkey

4.2 Temporal variation of activity pattern

Feeding (37.57%), grooming (12.12%) and aggression (3.48%) behaviors were more frequent in the morning than the afternoon. While resting (41.24%) and playing (13.49%) were more frequent in the afternoon. Mating (0.62%) was observed during the afternoon session only. The temporal variation in percentage frequency of activities was not statistically significant ($p=0.998$) (Fig. 10).

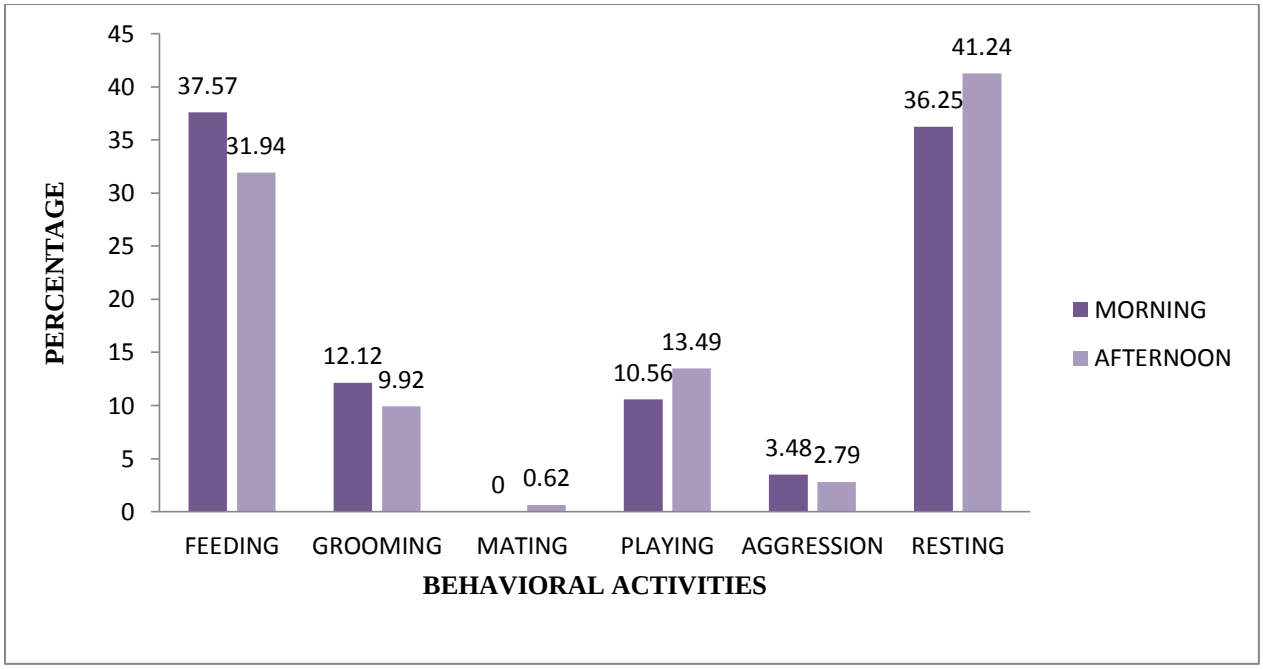
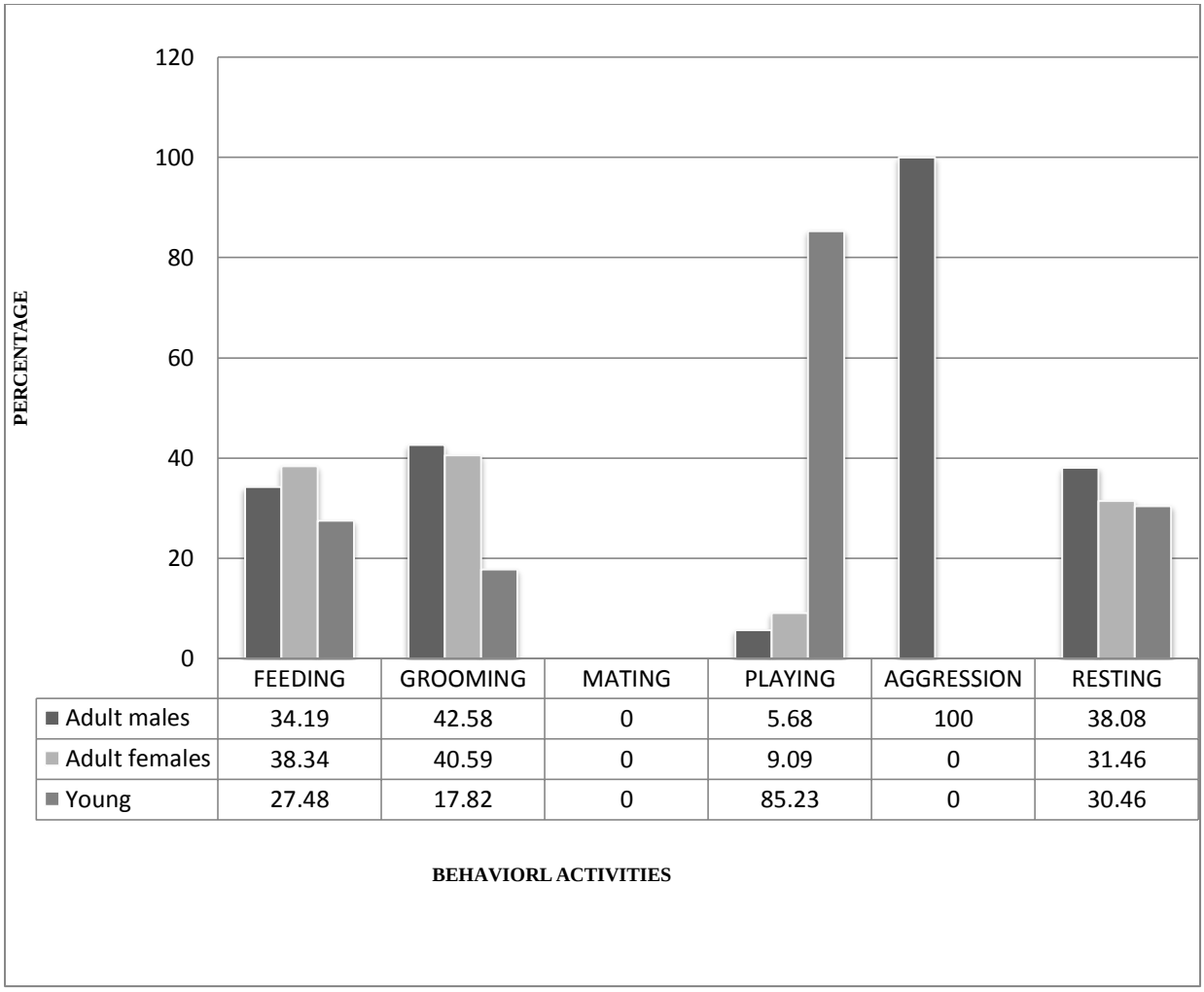


Figure 10. Percentage frequency of activities in the morning and afternoon sessions

4.3 Category variation in activity pattern

I. Morning session

Adult females spend more time feeding (38.34%) than adult males and young while the young spent the slightest time on feeding (27.48%), but they perform playing more frequently (85.23%) than the rest group members. On the other hand, aggression (100%) and resting (38.08%) were more common in adult males than adult females and young (Fig.11).



	FEEDING	GROOMING	MATING	PLAYING	AGGRESSION	RESTING
Adult males	34.19	42.58	0	5.68	100	38.08
Adult females	38.34	40.59	0	9.09	0	31.46
Young	27.48	17.82	0	85.23	0	30.46

Figure11. Comparison of each activity between each category for the morning session

I. Afternoon session

Adult females constituted the largest percentage of feeding (35.92%) in the afternoon as well. On the other hand, adult males showed the highest proportion of resting (37.22%), and they were the only group members that showed aggression during this session. The young, still constituted the least share in resting (28.2%), however, they took the largest portion in playing (81.61%). All of the mating records were in the afternoon session (Fig. 12).

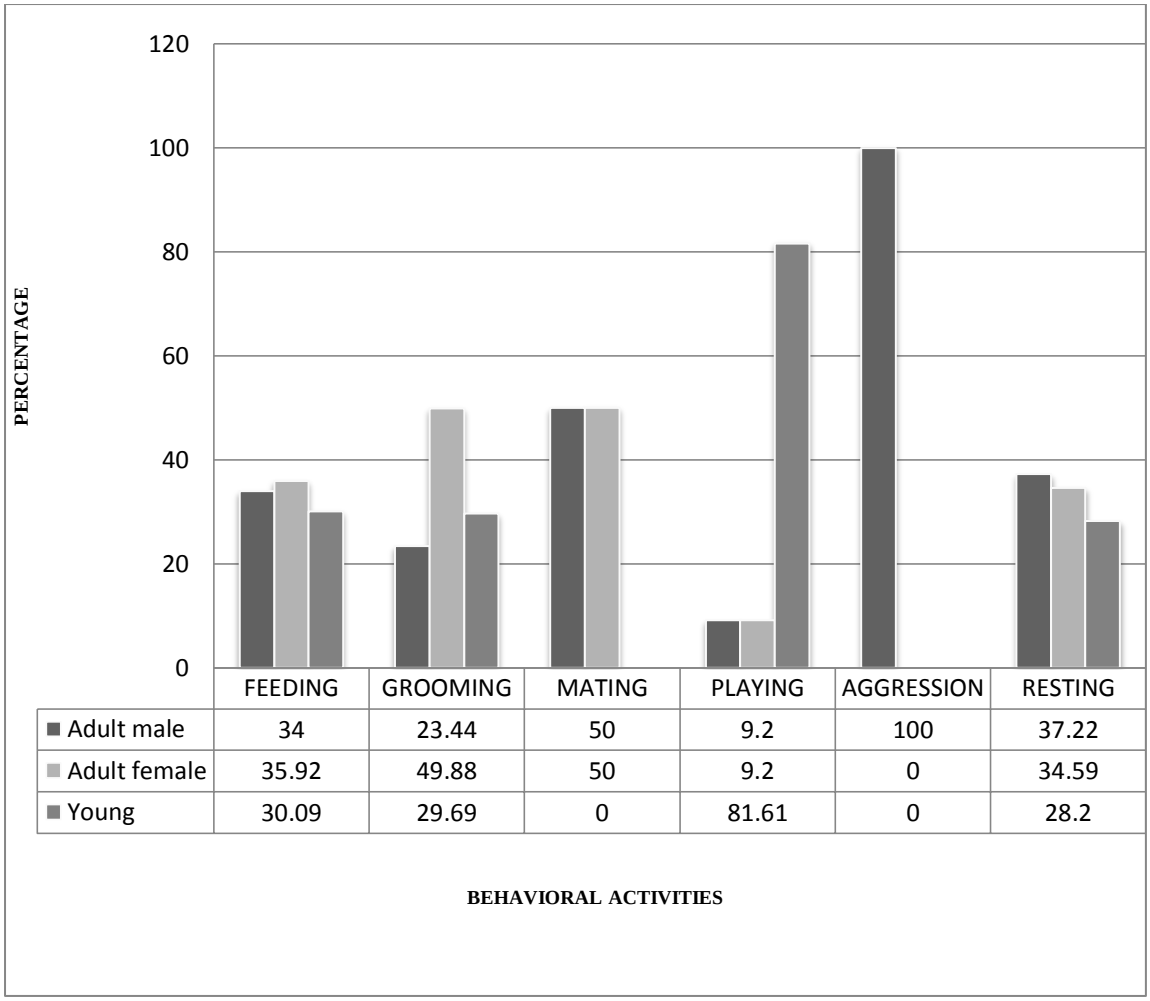


Figure 12. Comparison of each activity between each category for the afternoon session

4.4. Description of observed behavioral activities

I. Grooming

Self-grooming had taken the largest ratio for grooming between the sex and age groups (69%), out of which the adult males had accounted for 29 %, followed by the adult females (17.58%). Regarding the directional grooming, it was the adult females to young grooming which constituted the largest portion (17.58%), followed by adult female -to-adult female grooming (6.67%), whereas, no adult male to adult male, adult male to young, young to adult male, young to adult female and young to young grooming was recorded (Table 1).

Table 1 Direction of grooming and percentage frequencies

No	**Direction of grooming**	**Freq.**	**%**
1	Adult male self grooming	48	29.1
2	Adult female self grooming	29	17.58
3	Young self grooming	37	22.42
4	Adult male to Adult male	0	0
5	Adult male to Adult female	9	5.45
6	Adult male to Young	0	0
7	Adult female to Adult male	2	1.21
8	Adult female to Adult female	11	6.67
9	Adult female to Young	29	17.58
10	Young to Adult male	0	0
11	Young to Adult female	0	0
12	Young to Young	0	0

II. Mating

The tallness of the trees and the thickness of the forest had made recording the mating activity much difficult. Therefore, it was found to be the least observed behavioral activity in this study. Within two scanning periods only 0.27% mating activities were observed during the entire study period in a single afternoon in December.

III. Playing

Only the young ones displayed solo playing (24.57%). The highest frequency of playing was young to young (62.88%). The adult males and adult females did not perform solo playing throughout the study. The adult male with adult female, and adult male with young playing activities had constituted 2.88% and 1.71%, respectively while adult female-to-adult female playing was not recorded (Table 2).

Table 2. Direction of playing activities and percentage frequencies

No	Direction of playing activities	Frequency	%
1	Solo playing , Adult male	0	0
2	Solo playing , Adult female	0	0
3	Solo playing , Young	43	24.57
4	Adult male with Adult male	2	1.14
5	Adult male with Adult female	5	2.88
6	Adult male with Young	3	1.71
7	Adult female with Adult female	0	0
8	Adult female with Young	12	6.88
9	Young with Young	110	62.88

IV. Aggression

A total of 47 aggression behavior instances were recorded by the adult males. Of these, 29 (61.70%) were in the morning and 18 (38.30%) were in the afternoon. Aggression behavior was induced in response to the presence of a predator, in this case hyena, chasing away subordinate males during mating and overtaking suitable feeding spots.

4.5. Supplementary data on diet composition

A total of seven plant species were used as food by the black and white Colobus monkey at MSF. Of these, *Cupressus lustanica* (Cypress) was the most preferred (36.75%) followed by *Olea europa* (olive) which had constituted 24.17%. Three of the seven tree species; that is, *Prunus africana* (Tiqur enchet) 13.58%, *Pinus radiata* (Pinus) 11.26% and *Ficus sur* (Shola) 7.28% were moderately consumed. *Acacia abyssinica* (Umbrella thorn) 4.97% and *Mellitia ferruginea* ('Birbira') 1.99%, on the other hand were the least consumed plant species (4.97% and 1.99%), respectively. The dietary contribution of the seven plant species showed statistically significant difference ($p=0.021$). (Table 3).

Table 3. The types and percentage of trees (foods) consumed by *Colobus guereza*

No.	Scientific name	Common name	Amharic name	Percentage (%)
1	*Cupressus lusitanica*	Cypress	Yeferenj tid	36.75
2	*Olea europa*	Olive	Weyira	24.17
3	*Prunus africana*	Red stink wood	Tiqur enchet	13.58
4	*Pinus radiata*	Monterey pine	Pinus	11.26
5	*Ficus sur*	Cape fig (Horn cluster fig)	Shola	7.28
6	*Acacia abyssinica*	Umbrella thorn	Girar	4.97
7	*Milletia ferruginea*	Baker	Birbira	1.99

5. DISCUSSION

Regarding feeding preference, Oates (1994) and Fashing (2001b) described that the leaves and fruits are the main foods of guereza. This had been true for the guereza in the Menagesha-Suba forest, meaning throughout the study time they were feeding on laves mostly. Gron (2009) and Arkive (2011) stated that the guereza possess large and multi chambered stomach, which allow them to digest plant fibers including foliage. In this study, the guereza were not confined on feeding on certain trees only. They were observed feeding on seven different kinds of plant species (Table - 1). This implies that the guereza stomach is adapted to digesting a diverse group of plant species. Fashing, (2001b) also described dietary flexibility in guereza. He had stated that because of energy conservation, Colobus monkeys tend to move short distances and spend much time resting while feeding on the abundant food available. This is consistent with results of the present study.

In *Colobus guerezza,* female and juveniles are main grooming performers; where as the dominant male rarely grooms others and receives little in return (Oates. 1994). This was also observed in the present study, although, the males contained the largest portion in self-grooming, it was the females that were observed grooming more frequently than the other sex and age group members. That is, female self-grooming (17.58%), female to young (17.58%), and female-to-female (6.67%). This had constituted 41.81%) of the grooming in the Menagesha-Suba forest during the entire study period (Table-1).

Mating was the least frequently observed activity during this study. Only twenty minutes (two periods) mating activity was observed. More males were involved in moving along with the female, but a single male had the chance to mate. This was recorded twice during the entire scanning session. A female was observed soliciting mating by showing her genital area to the male. This was also described by Estes (1991) and Harris & Monfort (2006) where the females elicit copulation by presenting their ano-genital region to males, while males present an erect penis to a female and/or touch the female ano-genital region.

According to Fashing (2001a), playing is the most common behavioral activity in the young than the adults. Grimes (2000) also stated that infants spent time in playing while adults are resting. The present study strengthened finding of these previous studies. From the total recorded playing activities in the Menagesha – Suba forest, the young spent much more time in playing than the other age and sex group members did (87.45 %).

In the present study *Colobus guereza* were observed displaying aggressive behavior, which included roaring followed by powerful shaking of tree branches towards the hyena passing by during one of the morning scanning sessions. Other incidents were observed when male guereza jumped into their own group, the females and the young had been producing a crying sound, but no significant physical fights had occurred. This was also consistent with Grunau, and Kuester, J (2001), who stated that physical aggression within the group is usually not harmful and rarely escalates into conflict.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The *Colobus guereza* in the forest are foraging and living in the tall trees where they easily found abundant food and hence, they rarely come down. Furthermore, there is no hunting in the forest. This implies that, they are not endangered. Feeding and resting were the most frequent behavioral activities. They had been consuming seven tree species that accounted for 100% of their diet over the course of the study. Among trees they consumed, *Cupressos lusitanica* was the most consumed species, which had accounted for 36.75% of the overall diet during the study. *Colobus guereza* did not show rigidity and restriction that makes them depend on few plant species. During the study, they were observed feeding on the leaves of all trees they were climbing, except, *Juniperus procera,* which they mostly used to escape up, sunbathing and sleep.

In this study, regarding the overall behavioral activities the adults spent much time in feeding and resting whereas, the young spent more time in playing than the adults. Within the age and sex group females are the main grooming performers, they also spend much time in feeding than the males and the young. On the other hand the males spend most of their time in resting. During the study the guereza in Menagesha-Suba forest were observed engaged in mating only ones during the study. This implies that mating is the least most frequent activity in black and white colobus monkeys.

6.2 Recommendations

- In this study the *Colobus guereza* were not observed feeding anything from *Juniperous procera.* Therefore, further researches are recommended.
- Since the trees in MSF are much taller the mating activity was not thoroughly studied, therefore, more studies with high quality materials are recommended.

7. REFERENCES

Abate Zewdie (2007). Comparative floristic study on Menagesha Suba State Forest on years 1980 and 2006.MSc. Thesis, Addis Ababa University, Ethiopia.

Abebayehu Dessalegn and Tilaye Wube (2012). Population density, structure and grouping pattern of Menilik's bush buck in the Menagesha - Suba state forest, Ethiopia. SINET; Ethiopia Journal of Science, 35(2): 129 – 134.

Abraham Eustas, Alex W Kisingo, Ladislaus W Kahana, Emmanuel H Lyimo, (2015), activity patterns of black and white Colobus monkey (*Colobus guereza caudatus*)in Rau Forest Reserve, Serengeti Zone Anti poaching unit, wild life division, Ministry of Natural Resources and Tourism, Tanzania.

Arkive (2011), Guereza (*Colobus guereza*) Downloaded from http://www.arkive.org/guereza/colobus-guereza/#src=portletV3api

Accessed 14 August 2017.

Bocian, C. M. (1997). Niche Separation of Black-and-White Colobus Monkeys (*Colobus angolensis* and *Colobus guereza*) in the Ituri Forest.Ph.D. Thesis, City University of New York, New York.

Breitenbach von F. (1962). National Forestry Development Planning: A Feasibility and Priority Study on the examples of Ethiopia. *Ethiopian Forest Review* 3/4**):** 41-68.

Breitenbach von F. & J. Koukol (1962). Menagesha state forest: A description of the forest, its management and its future development including the National Park Project. Ethiopian Forestry Review 3/4**:** 17-37.

Chapman C.A, Chapman L.J. (1996). Mixed-species primate groups in the Kibale Forest: ecological constraints on association. International Journal of Primatology 17(1):31-50.

Chapman, C.A.; Balcomb, S.R.; Gillespie, T. R.; Skorupa, J. P.; Struhsaker, T. T. (2000). "Long-term effects of logging on African primate communities: A 28 year comparison from Kibale National Park, Uganda" (PDF). Conservation Biology.14: 207 Doi 10.1046/j.1523-1739.2000.98592.x

Chapman C.A, Chapman L.J, Naughton-Treves L, Lawes M.J, McDowell L.R , (2004) Predicting folivorous primate abundance: validation of a nutritional model. American Journal of Primatology 62:55–69

Chapman, C.A., Lawes, M. J., & Eeley, H. A. C. (2006). What hope for African primate diversity? African Journal of Ecology, 44: 116–133.

Chapman, C. A.; Naughton-Treves, L.; Lawes, M. J.; Wasserman, M. D.; Gillespie, T. R. (2007). "Population declines of Colobus in western Uganda and conservation value of forest fragments" (PDF). International Journal of Primatology. 28 (3): 513. IDO:10.1007/s10764-007-9142-8

de Beaux O. 1943. Mammalia. In E. Zavattari (ed.): Missione Biologica Sagan-Omo, vol. 7, pp. 15-57. Reale Accademia d'Italia, Rome.

Dunbar, R.I. and Dunbar, E.P. (1974).Ecology and population dynamics of *Colobus guereza* in Ethiopia. Folia Primatology 21:188-208.

Dunbar, R.I.M. (1987). Habitat quality, population dynamics, and group composition in colobus monkeys (*Colobus guereza*). International Journal of Primatology 8(4):299-329.

Dunham N.T. (2013). Positional behavior and habitat use of Peters' Angola black-and-white Colobus monkey (*Colobus angolensis palliatus*) in structurally distinct areas of the Diani Forest, Kenya. PhD. Thesis, the Ohio State University.

Encyclopedia of Life (EOL). (2011). Fact sheet: *Colobus guereza*. Downloaded from http://www.eol.org/pages/915945. Accessed September 18 2017

Estes R.D. (1991). The behavior guide to African mammals, including hoofed mammals, carnivores, primates. London: University of California Press, Ltd

Eves, H. E.; Ruggiero, R. G. (2000). "Socioeconomics and the sustainability of hunting in the forests of northern Congo (Brazzaville)". In Robinson, J. G.; Bennett, E. L. Hunting for Sustainability in Tropical Forests. New York: Columbia University Press. pp. 427–454. ISBN 978-0-231-50492-8

Fashing P.J. (1999). The behavioral ecology of an African Colobine monkey: diet, range use, and patterns of intergroup aggression in eastern black and white Colobus monkeys (*Colobus guereza*).PhD dissertation, Columbia University.

Fashing, P.J. (2001a). Male and female strategies during intergroup encounters in guerezas (*Colobus guereza*): evidence for resource defense mediated through males and a comparison with other primates. Behavioral Ecology Sociobiology 50, 219—230

Fashing, P.J. (2001b). Feeding ecology of guereza in the Kakamega Forest, Kenya: The importance of Moraceae fruit in their diet. International Journal of Primatology **22**: 579-609.

Fashing, P.J. (2001c). Activity and ranging patterns of guereza in the Kakamega Forest:

Inter group variation and implications for intra group feeding competition. International Journal of Primatology **22**: 549-577.

Fashing P.J. , Mulindahabi F., Gakima J. B, Masozera M. , Mununura I., Plumptre A.J., and Nguyen N., (2007), Activity and ranging of *Colobus angolensis ruwenzorii* in Nyungwe Forest, Rwanda: Possible Costs of Large Group Size. International Journal of Primatology; 28:529–550

Feyera Senbeta, Demel Teketay & Näslund, B.A (2001). Native woody species regeneration in exotic tree plantations at Munessa-Shashemene Forest, Ethiopia. New Forests.

Gebo D.L, and Chapman C.A. (1995). Positional Behavior in Five Sympatric Old World Monkeys. American Journal of Physical Anthropology 97: 49–76.

Gillespie, T.R., Chapman, C.A and Greiner, E.C. (2005). Effects of logging on gastrointestinal parasite infections and infection risk in African primates. Journal of Applied Ecology 42, 699–707

Grimes K.H. 2000, Guereza dietary and behavioral patterns at the Entebbe Botanical Gardens. PhD. Thesis, the University of Calgary.

Gron K.J. (2009). May 12. Primate Factsheets: Guereza (*Colobus guereza*) Taxonomy, Morphology, &Ecology .<http://pin.primate.wisc.edu/factsheets/entry/guereza> Accessed 14 August 2017.

Groves C.P. (2001). Primate Taxonomy. Washington DC: Smithsonian Institutional Press.

Groves, C. P. (2005). Order primates. In D. E. Wilson & D. M. Reeder (Eds.), Mammal species of the world. A taxonomic and geographic reference (3rd ed., pp. 111–184). Baltimore: Johns Hopkins University Press.

Grunau, T. and Kuester, J. (2001)."Dominance style in female guereza (*Colobus guereza, Rüppell* 1835)".Primates.42 (4): 301. Doi:10.1007/BF02629621.

Harris, T. R. & Monfort, S. L. (2003). Behavioral and endocrine dynamics associated with infanticide in a black and white Colobus monkey (*Colobus guereza*). *American Journal of Primatology* 61: 135-142.

Harris, T. R. & Monfort, S. L. (2006). Mating behavior and endocrine profiles of wild black and white Colobus monkeys (*Colobus guereza*): Toward an understanding of their life history and mating system. American Journal of Primatology 68: 383-396.

Harris, T.R. and Chapman, C.A. (2007).Variation in diet and ranging of black and white Colobus monkeys in Kibale National Park, Uganda. Primates 48(3):208-21

HippeL F. A (1996). Interactions between overlapping multimale groups of black and white colobus monkeys (Colobus guereza) in the Kakamega Forest, Kenya. American Journal of Primatology. 38(3): 193-209.

Hippel F. A. (1998).Use of sleeping tree by black and white colobus monkeys (*Colobus guereza*) in the Kakamega Forest, Kenya. *American Journal of Primatology* 45: 281-290.

Horwich R. H. & Wurman, C. (1978). Socio-maternal behaviors in response to an infant birth in *Colobus guereza*. Primates 19(4): 693-713.

Jensz K. and L. Finley, 2011. Species profile for *Colobus guereza*. Environmental Consultants Pty Ltd. Hobart, Tasmania.

Kim K. (2002). "*Colobus guereza*" (On-line), Animal Diversity Web. 2011 http://animaldiversity.ummz.umich.edu/site/accounts/information/Colobus_guereza.html, [Accessed 14 August 2017]

Kingdon J., Struhsaker, T., Oates, J.F., Hart, J. & Groves, C.P. (2008). *Colobus guereza*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.1. <www.iucnredlist.org>.

Kingston T. J. (1971). Notes on the black and white Colobus monkey in Kenya. East African Wildlife Journal 9: 172-175.

Kruger O., Affeldt, E., Brackmann, M. & Milhahn, K. (1998). Group size and composition of *Colobus guereza* in Kyambura Gorge, southwest Uganda, in relation to chimpanzee activity. International Journal of Primatology 19: 287–297.

Lalisa Alemayehu, Hager H, and Gruber, M. (2009).The community-state forest interaction in Menagesha Suba area, Ethiopia: the challenges and possible solutions for Trees Livelihoods 19:111–128.

Lwanga J.S. (2006).Spatial distribution of primates in a mosaic of colonizing and old growth forest at Ngogo, Kibale National Park, Uganda. Primates 47(3):230-8.

Ministry of Agriculture and Forestry Biosecurity New Zealand (MAF). (2011). Import risk analysis: Primates from Australia, Canada, the EU, the USA, and Singapore. Draft for public consultation. Downloaded from http://www.biosecurity.govt.nz/files/regs/imports/risk/pangasius-risk-analysis.pdf. Accessed September 2017.

Marler, P. (1972). Vocalizations of East African monkeys II: black and white colobus. Behavior 42, 175—197.

Ministry of Agriculture. (2002). Menagesha Suba State forest. Addis Ababa, Ethiopia.

Mittermeier, R.A. & J.G. Fleagle. (1976). The Locomotor and postural repertoires of *Ateles geoffroyi* and *Colobus guereza*, and a reevaluation of the locomotor category semi-brachiation. American Journal of Physical Anthropology 45(2): 235–256.

Mohammed Hussen and Dessalegn Ejigu, (2017). Diurnal activity patterns, feeding ecology and Conservation status of Colobus monkeys in Gidabo forest, Sidama zone, Ethiopia. Palgo Journal of Agriculture 4 (3): 238-245.

Morbeck M.E. (1977). Positional Behavior, Selective Use of Habitat Substrate and

Associated Non-positional Behavior in Free-ranging *Colobus guereza*. Primates 18: 35–58.

Napier, P. H. (1985). Catalogue of Primates in the British Museum (Natural History) and Elsewhere in the British Isles. Part III: Family *Cercopithecidae*, Subfamily Colobinae, British Museum (Natural History), London.

Oates J.F. (1977a). The guereza and man. In: Rainier III (Grimaldi) Prince of Monaco, Bourne GH, editors. Primate conservation. New York: Academic Press 419-67

Oates J.F. (1977b). The guereza and its food .In: Clutton-Brock T. H, editor. Primate ecology: studies of feeding and ranging behavior in lemurs, monkeys and apes. London: Academic press p 275-321.

Oates J. F. (1977c). The social life of a black and white Colobus monkey, *Colobus guereza*. Zeitschrift fur Tierpsychologie 45: 1-60.

Oates J. F. (1978). Water-plant and soil consumption by Guereza monkeys (*Colobus guereza*): a relationship with mineral and toxins in the diet? *Biotropica* 10(4): 241-253.

Oates J. F., and Trocco, T. F. (1983).Taxonomy and phylogeny of black-and-white Colobus monkeys. Inferences from an analysis of loud call variation. Folia Primatology.40: 83–113.

Oates J.F. (1994). The natural history of African colobines. In: Davies AG, Oates JF, editors. Colobine monkeys: their ecology, behavior and evolution. Cambridge (UK): Cambridge University Press p. 75-128.

Oates J. F., Davies A. G. (1994). What are the Colobines? In: Oates JF, Davies AG (editors). Colobine Monkeys: their ecology, behavior and evolution. 1-9. Cambridge University Press, UK.

O'Dwyer R. (2011). The black-and-white colobus monkeys (*Colobus angolensis palliatus*) of Diani Forest, Kenya. Behavioural responses to habitat fragmentation.

Plumptre A. J. (2006). The diets, preferences, and overlap of the primate community in the Budongo Forest Reserve, Uganda: effects of logging on primate diets. In N. E. Newton-Fisher, H. Notman, J. D. Paterson & V. Reynolds (Editors.), Primates of Western Uganda (pp. 345–371). New York: Springer.

Rabineau J. (2009). Integrated non-invasive investigations of captive Abyssinian Colobus monkeys (*Colobus guereza*): behavior, stress and parasitism. PhD thesis submitted September 2009, University of Exeter. Downloaded from https://eric.exeter.ac.uk/repository/bitstream/handle/10036/106776/RabineauJ_fm.pdf?sequence=1 Accessed September 2017.

Shruhsaker T. T., Leland L. (1987). Colobines: Infanticide by adult males. In: Smuts BB, Cheney D. L., Seyfarth R. M., Wrangham R. W., Struhsaker T. T. (editors). Primate Societies. 83-97. the University of Chicago Press, Chicago.

Struhsaker T., Oates, J. F.; Hart, J.; Butynski, T. M.; Groves, C. P. (2008). "*Colobus guereza* species. *Matschiei"*. IUCN Red List of Threatened Species. Version 2008. International Union for Conservation of Nature. Retrieved 4 Sep 2017.

Teichroeb J.A, Tania L. Saj, James D. Peterson and Pascale Sicotte, (2003). The Effect of Group Size on Activity Budgets of *Colobus vellerosus* in Ghana. International Journal of Primatology; 24: 743–758.

Thomas, S.C. (1991). Population densities and patterns of habitat use among anthropoid primates of the Ituri Forest, Zaïre. Biotropica 12(1):68-83.

8. PLATES

The tall trees where *C. guereza* feed and sheltered (Photo Bayesa Yemane, 2017)

A Colobus guereza in a tree at MSF

9. APENDICES

No.	ACTIVITY		MORNING-Hours				AFTERNOON-Hours					
1	FEEDING		7-8	8-9	9-10	Total		14-15	15-16	16-17	total	
		M	43	37	27	107		17	28	25	70	
		F	48	42	30	120		21	28	25	74	
		Y	37	26	23	86	313	16	22	24	62	206
2	GROOMING	M	10	21	12	42		2	4	9	15	
		F	9	17	15	41		5	17	8	30	
		Y	1	13	4	18	101	3	9	7	19	64
3	MATING	M	0	0	0	0		0	0	2	2	
		F	0	0	0	0		0	0	2	2	
		Y	0	0	0	0	0	0	0	0	0	4
4	PLAYING	M	1	4	0	5		1	4	0	8	
		F	3	5	0	8		2	6	0	8	
		Y	14	33	28	75	88	21	27	23	71	87
5	AGGRESSION	M	11	9	9	29		8	7	3	18	
		F	0	0	0	0		0	0	0	0	
		Y	0	0	0	0	29	0	0	0	0	18
6	RESTING	M	34	40	41	115		27	40	32	99	
		F	26	34	35	95		21	36	35	92	
		Y	25	29	38	92	302	19	30	26	75	266
7	TOTAL						**833**					**645**
8	%											

The overall behavioral activiry record of the C. monkeys in Menagesha-Suba forest

Sca. Per.	Feeding			Grooming			Mating			Playing			Aggression			Resting		
	M	**F**	**Y**	**M**	**F**	**Y**	**M**	**F**	**Y**	**M**	**F**	**Y**	**M**	**F**	**Y**	**M**	**F**	**Y**
S1																		
S2																		
S3																		
S4																		
S5																		
S6																		
S7																		
S8																		
S9																		
S10																		
S11																		
S12																		
S13																		
S14																		
S15																		

The Colobus guereza behavioral activity data recording table

Spot No.	Elevation	Accuracy	Coordination	
			N	E
1	2423m	7.9m	08° 57.949’	038° 32.418’
2	2399m	7.5m	08° 57.978’	038° 32.412’
3	2373m	6.3m	08° 58.014’	038° 32.406’
4	2383m	7.4m	08° 58.005’	038° 32.499’
5	2373m	5.6m	08° 58.038’	038° 32.337’
6	2367m	4.5m	08° 58.008’	038° 32.384’
7	2363m	6.3m	08° 57.959’	038° 32.384’
8	2402m	6.8m	08° 57.948’	038° 32.413’
9	2422m	6.4m	08° 57.921’	038° 32.527’
10	2444m	6.6m	08° 57.876’	038° 32.503’
11	2456m	6.1m	08° 57.797’	038° 32.650’
12	2475m	6.5m	08° 57.876’	038° 32.691’

Spot area coordination of the study area in Menagesha-Suba forest