
**Jimma University**

**College of Natural Sciences**

**Department of Biology**

# Feeding ecology, activity pattern and conservation status of Boutourlini's blue monkey (*Cercopithecus mitis boutourlinii*) in the Chato Natural Forest, Horro Guduru Wollega Zone, Western Ethiopia

**By**

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**August, 2014**

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# Feeding ecology, activity pattern and Conservation status of Boutourlini's blue monkey (*Cercopithecus mitis boutourlinii*) in the Chato Natural Forest, Horro Guduru Wollega Zone, Western Ethiopia.

**A thesis Submitted to the Department of Biology, College of Natural Sciences, Jimma University, in partial fulfillment of the requirement for the Degree of Master of Science in Biology (Ecological and Systemic Zoology)**

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**August, 2014**

**Jimma, Ethiopia**

**DECLARATION**

I hereby declare that this thesis entitled Feeding ecology, activity pattern and conservation status of of Boutourilinis blue monkey (*Cercopthecus mitis boutoutlinii*) in Chato Natural forest ,Horro Guduru Wollega Zone, Western Ethiopia is my original work except wherever acknowledged, no part of this thesis has been submitted to any other university.

Name_____

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## List of acronyms

**EFAP**: Ethiopian Forestry Action Plan

**EMA**: Ethiopian Mapping Agency

**GPS:** Geographical Positioning System

**H.W.R.A.D.O:** Horo Wereda rural and agricultural development Office

**IUCN**: International Union for the Conservation of Nature and Natural Resources

**LC**: Least concern

**NBSAP**: National Biodiversity Strategy and Action Plan

**NFPA**: National forest priority area

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***ABSTRACT***

*Boutourlini's blue monkey (Cercopithecus mitis boutourlinii) is a vulnerable sub-species, which is endemic to southwestern parts of Ethiopia. This study was carried out between September 2013 and July, 2014 to provide data on the habitat use, feeding ecology, human-blue monkey conflict, and activity patterns of C. mitis boutourilini in Chato Natural Forest. Chato forest constitutes different habitat types including tree and shrub dominated forests and bushlands with the surrounding farmlands. Study on different selected groups of the blue monkeys was carried out in different habitat types. Activity pattern and feeding ecology were studied by scan sampling within 15 minutes interval. Human blue monkey conflict was assessed by focus group discussion. The overall diet composition of Boutourilinis blue monkeys in group I was dominated by fruits (54.5%), young leaves, (13.2%) and animal preys (12.7%). They also fed on shoot (6.9%), flowers (6.4%), mature leaves (3.3%) and seeds (2.3%). Blue monkeys in group II spent more time feeding on young leaves (26.8%) , fruits, (22%), shoots (19.2%), animal preys (10.7%), flowers (8.2%),seeds(6.5%) ,mature leaves(4.2%) ,barks (1.7%) and other parts(0.7% ) of plants .A total of 26 and 29 plant species were consumed by group I and group II blue monkeys, respectively. Group I spent 49.4% of the time on feeding whereas group II spent (48.7%). Group II monkeys spent 18.8 % of their total time by moving and 20.6% by resting. Group I monkey spent 20.1% of their time by moving and 18.6% by resting. Monkey in group I and group II spent equal time (11.3%) for socialization. Human- blue monkey conflict as well as anthropogenic activities was widely observed as a serious threat to the conservation of the animals.*

**Key words;** Blue monkey, feeding ecology, Chato Forest, activity pattern,

## INTRODUCTON

Across the world, there are 185 known species of primates. There are 175 species and sub-species of primates listed in Africa (Grubb, 2006). Ethiopia harbors different primate species and sub-species and among them are the two subspecies of blue monkey (*Cercopithecus mitis stuhlmanni*) (Fairgrieve and Muhumuza, 2003) and the boutourlini's blue monkey (*Cercopithecus mitis boutourlinii*) (Yalden, *et al.*, 1996; Kingdon, 1997)

Blue monkeys are small (ranging in weight from 4 to 6 kg) and arboreal. The face is nearly naked, usually dark in color (infrequently blue), and has well-developed musculature (Lawlor, 1979). *Cercopithecus mitis* is also known as the diademed monkey because it has a prominent row of forward pointing white fur just above its brow line (Rudran, 1978).White whiskers are well developed in males, males are larger than females canines are slightly larger than the females (Rudran, 1978). These monkeys are catarrhine; the nostrils are close together and they face downward. They have cheek pouches to carry food while foraging (Rudran, 1978).

The blue monkey is a generalist feeder and a forest dwelling guenon (IUCN, 2008). They are frugivorous and folivorous in nature, feeding mainly on fruits and leaves. They also consume seeds and arthropods (Cords, 1987a). Additionally, they tend to concentrate their invertebrate feeding on slow-moving slugs and worms (Rudran, 1978). There are varieties of food components that the blue monkey feed on, ranging from leaves on the canopy trees, fruits to arthropods i.e. insects found crawling on the tree trunks and on the forest ground. (Chapman *et al.*, 2002)

They are more arboreal than some *Cercopithecin*e species, like macaques, vervets and baboons (Estes, 1991; Cords, 1987a, 2000a, 2002). They are also diurnal (Estes, 1991). They differ in

their social organization from other *Cercopithecines*. They live in one-male multi-female groups and have a weakly differentiated dominance hierarchy among females. Their rank may not be related to measures of affiliative behavior or reproductive success (Cords, 1987a, 2000a). Females are permanent members of the natal group whereas young males leave their natal groups as they approach adulthood.

For most of the year, only one adult male is present in the group, though additional males may compete to join the group during the mating season (Cords 1987b; Cords, 2000). They have a polygamous mating system. The genus *Cercopithecus* appeared in the fossil record about 2.9 million years ago (Leakey, 1988). They had a semi-terrestrial frugivorous ancestor, inhabiting woodland habitats. However, once they became rainforest specialists, they started to diversify as a result of repeated isolation and divergence of populations as a consequence of the recurring division of continuous forests into fragments associated with glacial or interglacial cycles (Chapman, 1984; Hamilton, 1988). During isolation, populations of *Cercopithecus* species inhabited different fragments. The divergence of other subspecies from an ancestral *Cercopithecus mitis* occurred during one of these isolations (Twinomugisha *et al.*, 2003).

*Cercopithecus mitis boutourlinii* is a sub-species of *Cercopithecus mitis*, endemic to Ethiopia. Boutourlini's blue monkey received its name from a Russian Count, Augusto Boutourline. He travelled Asia and Africa between1884-1887 and named this sub species during his visit to Shewa, southwestern Ethiopia, where this sub-species is widely distributed (Watkins and Grayson, 2009). Blue monkey as a species are widely distributed and not threatened (Lawes, 1990). However, there are highly localized subspecies, some of which are threatened or

endangered (Oates, 1996). Boutourlini's blue monkey is one of them and is restricted to Ethiopia, occurring from Lake Tana southwards along the western side of the Ethiopian Rift Valley, but does not reach Lake Turkana (Yalden *et al.,* 1977 IUCN, 2008;). Bailey (1977) recorded Boutourlini's blue monkey at the gorge of the Blue Nile River, near Bichena area. It is strictly associated with primary tropical deciduous and riverine forests (Yalden *et al.,* 1977). The taxonomy of Boutourlini's blue monkey remains vague and inconclusive. According to Grubb *et al.* (2003), Boutourlini's blue monkey is classified as a subspecies of *C.mitis,* which contains 16 subspecies. On the other hand, Groves (2005) classified this taxon as one of only seven subspecies of *C. mitis.* According to IUCN (2008), 17 subspecies are recorded in different parts of Africa. Tropical forests and the fauna they support are being threatened by accelerated rates of forest conversion and degradation (Chapman and Lambert, 2000). As a result, conserving the world's primates is becoming a complex endeavour to address the long term conservation of all primate species and their habitats (Wallis and Lonsdorf, 2009). Blue monkeys are classified by IUCN (2008) as a species of Least Concern (LC) or not threatened. Even though, some subspecies of *C. mitis* are locally common, others are threatened (IUCN, 2008).

Boutourlini's blue monkey is listed as Vulnerable (VU) because of the extensive and uncontrolled destruction of its forest habitat for both timber and agriculture. There are different factors at work in the forest reserves, which indicates an uncertain future for the long-term several species of monkeys. These include, intensive exploitation of the forest resources, harassing of monkeys during actual or suspected crop raiding and trapping of monkeys either for sale or for food, or because they are considered to be agricultural pests. The local farmers harass monkeys indiscriminately by throwing stones or using sling shots on them in response to crop raiding (Chism and Cord, 1998). The main reasons for the global decline of primate populations

are hunting, emergent diseases, habitat conversion and fragmentation (Oates, 1996; Cowlishaw a (Nunn and Altizer, 2006). As a result, more than half of the world's primate species are currently threatened by extinction (Chapman and Peres, 2001).In the study area there is no information about diet, habitat use, activity pattern and the level of conflict with human of blue monkey. There for, this study was important to fill this gap by providing an information for the conservation Biologist and government to take conservation measure for blue monkey and Chato forest.

### 1.1 Statement of the problem

The behavior and ecology of blue monkeys is influenced by fragmentation and other forms of human disturbance to their habitat .Blue monkeys *(Cercopithecus mitis)* are among the most widely distributed of Africa's arboreal primate species and inhabit a variety of forest. Blue monkey feeding ecology shows those extremely variable diets, depending on location. Given their wide distribution and flexibility for a forest primate, blue monkeys did not receive conservation attention.

The ecology, behavior and distribution of Boutourlini's blue monkey are not well studied compared to other sub-species of the species C. *mitis*. Indeed, detailed studies on the habitat use, feeding ecology, activity patterns and human blue monkey conflict of Boutourlini's are lacking. The aim of the present study is to provide data on the habitat use, feeding ecology, activity patterns human blue monkey conflict of *C. mitis Boutourilini* in Chato Natural Forest, Ethiopia

## 1.2 OBJECTIVES

1. **2.1General objective**

- The General objective of the present study is to assess the feeding ecology, activity patterns of blue monkey and human blue monkey conflict in Chato Natural Forest, Ethiopia.

### 1.2.2 Specific objective

- To identify the diet of Boutoutirilis blue monkey in different seasons.
- To determine the activity patterns of Boutoutirilis blue monkey in Chato Forest
- To assess the habitat use of Boutoutirilis blue monkey in the Chato Forest.
- To determine human- blue monkey conflict in and around Chato Forest

### 1.2.3 Significance of the study

The present study is intended to address the feeding ecology, habitat use, human blue monkey conflict and activity pattern of Boutourlini's blue monkey in Chato Forest Horro Guduru Wollega Zone, Western Ethiopia. The study provides information on the feeding ecology, activity pattern, the habitat use and determines the level of conflicts with the humans that have emens significances for its conservation. It is highly valuable for other researcher who tries to conduct further research in the study area. It is also important for the government and local community to take conservation measure.

## 2 .LITERATURE REVIEW

### 2.1 The blue monkey's feeding activity and habitat.

Blue monkeys can cope with a high variety of different habitats, types of forests and weather conditions ( Twinomugisha *et al.*, 2006). They appear in various forest types from rain forests at up to 3000 m, coastal mangrove forests, forest patches on the savannah (Kingdon, 1971 Estes, 1992;) to evergreen semi-deciduous forest (Mnason *et al.*, 2001). As their habitat the natural food sources of guenons also varies greatly (Cords, 1986; Kaplin and Moermond, 2000; Lambert, 2001).

*C. mitis* monkeys are ominivores (Ruduran,1978;Estes,1992). Besides fruits they eat leaves, invertebrates, flowers, seeds, bark and shoots (Fairgrieve and Muhumuza, 2003). They obtain liquid foods or form hole in trees (Rudran, 1978; Estes, 1992). Food is the single most important factor of determining the budjeet of animals time it spends with particular activity(Stock andHofeditz,1996;Adeyemo,1997;Baldellou and Adan,1997;Orams,2000).Most studies in African forest guonmes feeding ecology can come to the conclusion that the genomes spends a lot of time feeding on fruits and fibrous food (Cords,1986;Butaniski,1990;kapplin *et.,al* 1998;Chapmanet *et .,al* 2000;Yasukotashiro,2006) and no invertabrets compred to food from plants (Chapman *et.,al* 2002;Tashiro,2006).

On the contrary, blue monkeys in the Kalinzu forest in Uganda (Tashiro, 2006) spend much more time feeding on invertebrates than shown in any other study. e.g. Butynski (1990), Cords (1986), Kaplin and Moermond (2000) (Tashiro, 2006). The blue monkeys' diet is as varied as their habitat distribution.

### 2.2 Social grouping

An enduring question in behavioral studies of group-living primates is what determines the number of males in a group (Kappeler, 2000). Variation in male number occurs on several

scales: there may be persistent differences among species, among populations or groups of single species, and even within single groups over time. The variables that explain variation on these different scales are not necessarily the same (Henzi, 1988).

Cords (2002) reports variation is observed within single groups over time in forest-dwelling blue monkeys (*Cercopithecus mitis).* Like most other forest guenons, as well as closely related patas monkeys (*Erythrocebus patas*), blue monkey groups include only one adult male most of the time, especially outside the breeding season. During the breeding season, however, the number of males in a group of blue monkeys, and in some other guenon species, is more variable (Cords, 1987a, 1988, 2000; Gonza´lez-Martinez, 1998; Kaplin *et al.*, 1998; Macleod, 2000). Studies of blue monkeys, red-tailed monkeys (*Cercopithecus ascanius*) and patas monkeys have revealed how the one-male group persists during some breeding seasons: the male that has been with the females previously continues to accompany them, and is the only male continuously present. Other males may make occasional, brief visits, but they do not remain in the group. In blue and patas monkeys, most male visitors are known to be non-resident in any heterosexual group, but a few are residents from neighboring groups, which typically make their visits at territorial boundaries or during intergroup encounters. At the other extreme are breeding seasons in which the one-male group structure breaks down completely and several adult males come into the group, often for longer periods, as part of a multimale influx (Cords, 1988). Prior residents may be ousted during an influx, or persist as the sole resident when breeding subsides.

While intermediate cases exist, breeding periods are grouped into influx and non-influx years. According to Cords (1986) in Kakamega blue monkey population, there is no overlap in the values of distinguishing criteria. Specifically, during influx years ,there is a more conspicuous and continuous presence of multiple males (50–94% of days in six influx seasons vs. 4–28% of

days in ten non-influx seasons), and both the average number of males per day (1.6–3.8 in an influx, 1.0–1.3 in a non-influx year) and the maximum number of males per day (11 in an influx, four in a non-influx year) are higher than in non-influx years (Cords, 2000, with additional data from 1998–2001).

The duration of the typical male visit differs, lasting days or weeks in influx years, but only a few hours in non-influx years. According to Cords (2002) variation in the occurrence of multimale influxes is observed. When many females are mating, it should be especially difficult for residents to exclude other males, and more likely that multiple males are present. Female blue monkeys are not necessarily fertile (ovulating, non-pregnant) when they mate (Pazol *et al.*, 2002).

**2.3 Behavior and diet of blue monkey**

The blue monkey, *Cercopithecus mitis boutoutirilinis*, is a subspecies to *Cercopithecus mitis* which is an Old World monkey and a member of the genus Guenons, with species most abundant in the equatorial forests (Cords 1986). *C. mitis* is arboreal, but can occasionally be found foraging on the ground and moving across open areas (Stuart 1997). It occurs in rain forests and montane bamboo forests indifferent country of Africa.

*C. mitis* lives in matriarchal groups of 20-40 individuals, often with one adult male that can stay up to three years in the group. The female becomes sexual mature when she is 5-6 years old and the males when they are somewhat older. The mating season is influenced by nutritional availability, which corresponds to the rain seasons (Swart and Lawes 1996). In the southern range areas the females give birth during the summer months, and reproduction is a seasonal in the equatorial belt (Stuart, 1997).

Hybridizations producing fertile offspring have been observed between *C. mitis* males and females of its smaller relative, the red-tail monkey (*C. ascanius*), in areas where the two species' range overlaps. The mothers of all known hybrid offspring were of the latter species. A male of *C. mitis* weighs 8-10 kg and a female 4-5 kg. The species has a long, dense and silky fur with a mottled grey body colour and a dark face and pale diadem. Cheek pouches extends from the lower jaw down along the neck, in which the monkeys can press down and store food in case of danger or competition. These pouches can hold as much as the stomach and are easily emptied with the hands by pressing the food upwards towards the mouth. *C. mitis* is adapted to a life in the canopy with both thumb and hallox turning away from the other fingers and toes, long muscular back legs and shorter forelegs, and a long tail which improves its balancing. (Lawes *et al.*, 1990).

Tashiro (2006) has reported that the species *C. mitis* uses the strata at around 20 m above ground for foraging. The species is considered to have a very flexible diet, as shown by various studies (Butynski 1990; Lawes *et al.* ,1990;Chapman *et al.* 2002; Twinomugisha *et al.* 2006). *C. mitis* is mainly a frugivore but can also eat larger amounts of leaves, flowers and insects depending on the food supply (Cords 2002; Fairgrieve and Muhumuza 2003). This flexibility is based on its large hindgut and substantial gut surface area as well as a specialized intestine micro flora (Twinomugisha *et al.*, 2006). Large variations in diet between different groups of *C. mitis* have been reported. In Kakamega, Kenya, the monkeys spent 54% of their foraging time on fruit, 16% on leaves and 17% on insects, while for an Ugandian population in Kibale the same numbers were 33% for fruits, 24% for leaves and 30% for insects (Chapman *et al.*, 2002). Data from the

Kalinzu forest in Uganda showed that 50% of the species' foraging time was spent on insectivory with fruit only second in place (Tashiro, 2006), while data from Kenya showed fruit to be the first choice and insects only to be consumed as a last resort (Cords, 2002).

The limiting feature for frugivorous primates in general is considered to be the access of fruit during the lowest seasonal level. This is because fruit often serves as the primary energy source for these populations (Twinomugisha *et al*., 2006).

Seasonality in the consumption of different food items has been observed among *C. mitis* in the Kakamega forests in Kenya, where the highest intake of fruit was in the middle of the rainy and dry seasons. When fruit was less available, the proportion of leaves in the diet increased. Differences in food choice were also observed among lactating and non-lactating females. The lactating first female eat more insects and less fruit, due to their greater need of food of high nutritional value, compared to non-lactating. Smaller juveniles ate more fruit, in expense to leaves, than larger juveniles (Cords, 1986).

The seasonality in food consumption observed in the subspecies can be attributable to the high variation in nutritional quality of fruits over the year. Worman and Chapman (2005) has, found a positive correlation between the lipid content of ripe fruit and the amount of fruit that *C. mitis* included in the diet. Variation in the diet of *C. mitis* has also been observed between logged and unlogged forests in the Budongo Forest Reserve in Uganda. In the logged forest the monkeys consumed a higher proportion of immature fruit than in the unlogged ones who ate more ripe fruit. The ones in the latter habitat included a higher proportion of seeds, young leaves and invertebrates in their diet than the monkeys in logged areas, who also consumed more bark.

These results are an effect of the tree species the presence or abundance tree spices leads to variation in the of food items. It is suggested that the fruit availability is scarcer in unlogged forests, which drives the monkeys to consume more seeds, leaves, and invertebrates as a complement (Fairgrieve and Muhumuza, 2003). Logged areas have been showed to harbour higher primate densities in general (Plumptre and Reynolds 1994), and the group sizes of *C. mitis stuhlmanni* are also smaller in those habitats in comparison to unlogged areas (Fairgrieve and Muhumuza, 2003).

Despite the above mentioned variations in diet, human disturbance seems to have a substantial impact on the foraging behavior of *C. mitis*. Different groups can show dissimilar preferences depending on their habitats' distance to settlements (Tashiro, 2006).

Monkeys that live close to human communities often include trash and crops in their diets and when food is arriving to a place at certain times, such as at disposal sites, the monkeys adjust their visits to these moments. The primary predators of *C. mitis* are eagles, but they are also threatened by other primate species, leopards and snakes. Human activities impose negative effects on the species by decimating and fragmenting its habitat. In some areas it is also hunted as a vermin for destroying crops and debarking trees in plantations while foraging.

### 2.4 Group size, grooming and social cohesion in primates

A number of factors are known to influence social group size in mammals (Pulliam and Caraco, 1984; Hass and Valenzuela, 2002). Among these, food distribution and predation pressure are the two best studied factors (Chapman *et al.*, 1995; Hass and Valenzuela, 2002; Downes and Hoefer, 2004). In addition to these, the social brain hypothesis suggests that, in species that live

in socially bonded groups (such as many primates and carnivores), group size can be constrained by cognitive abilities (Dunbar, 1992a). This hypothesis is based on the finding that group size is strongly correlated with brain size (and specifically neocortex size in relation to the rest of the brain). The size of the neocortex is assumed to limit the number of social relationships an individual can keep track of. If group size becomes too large, it becomes impossible for an individual to maintain close social bonds with all group members. As a consequence, group cohesion will decrease and the group will eventually split (see (Henzi *et al.,* 1997a; Henzi *et al.,* 1997b). In support of this,( Dunbar, 1992a) have shown that social network size in primates is correlated with neocortex ratio, indicating that the number of grooming partners that primates can maintain as a coherent set is also related to the size of their neocortex. The bonding mechanism used in most primate species is grooming – a time consuming activity that can occupy up to 20% of the total day for some of the most social species (Dunbar, 1991). When group size (and the number of available social partners) increases, each individual will have to spend more time grooming.

Dunbar (1991) was able to demonstrate that the time primates engage in social activities (i.e. the time spent servicing social relationships) is positively related to group size (at least among anthropoid primates), supporting the idea that when groups are large, individuals have to spend more time servicing their social network than they do when in smaller groups. If groups become too large, individuals cannot afford to spend the necessary time grooming (because of the demands of other essential activities such as foraging) and group cohesion will decrease, leading eventually to group fission.

Thus, group size in primates will be constrained by two independent variables – neocortex size, which sets an upper limit to manageable group sizes, and the amount of time that is available for

grooming. While the former is a species-specific parameter, the latter depends ultimately on environmental variables that determine how much time an individual will need for all other essential activities, such as moving, feeding and resting (e.g. Dunbar, 1992b). According to these researches the investigation of the interactive effects of all three variables (group size, brain size and grooming time) simultaneously in Old World primate's .It is important to note that, this study, draw a distinction between social time and grooming time. Although Dunbar (1991) argued that the difference between these two is minimal, this may not in fact be true: social time includes, in addition to grooming, a wide range of other activities (play, courtship and mating, agonistic interactions, territorial behavior) that are not directly related to social bonding among adults and which might occupy a significant proportion of time in some species.

The researcher therefore limited the data to investget reporting grooming time rather than social time. The study also tested whether the previously reported relationship between grooming and group size is best explained by a linear or by a logarithmic function. This distinction is important because a logarithmic relationship in which grooming time reaches an asymptotic value would indicate that primates are compromising on grooming time when they live in very large groups Because bonding mechanisms may differ between primates with different life history patterns, we included several life history variables (e.g. dispersal patterns) as well as habitus (terrestrial vs arboreal), social system, predation pressure and phylogenetic distance( Martins, 1993) into our analysis.

# 3. MATERIALS AND METHODS

## 3.1 Study area

### 3.1.1 Description of the study area

The study was conducted at Chato Natural Forest which is located in the Horo –GuduruWollega Zone of Oromia National Regional State, Western Ethiopia. This forest is part of National Forest Priority Areas (NFPAs) and has been known by the name Chato-Sangi-Dangab Forest in the country (EFAP, 1994). The forest lies approximately between $9^0$40'- $9^0$42' N latitudes and $36^0$59'-$37^0$ 00'E longitudes (EMA, 1988) in the Horo district at about 314 km west of Addis Ababa (Fig. 1) .This forest is located along altitudinal ranges between 1700 and 2350 m a.s.l and covers an area of about 42,000 hectares. The natural forest covers 18, 000 ha (H.W.R.A.D.O,2013)

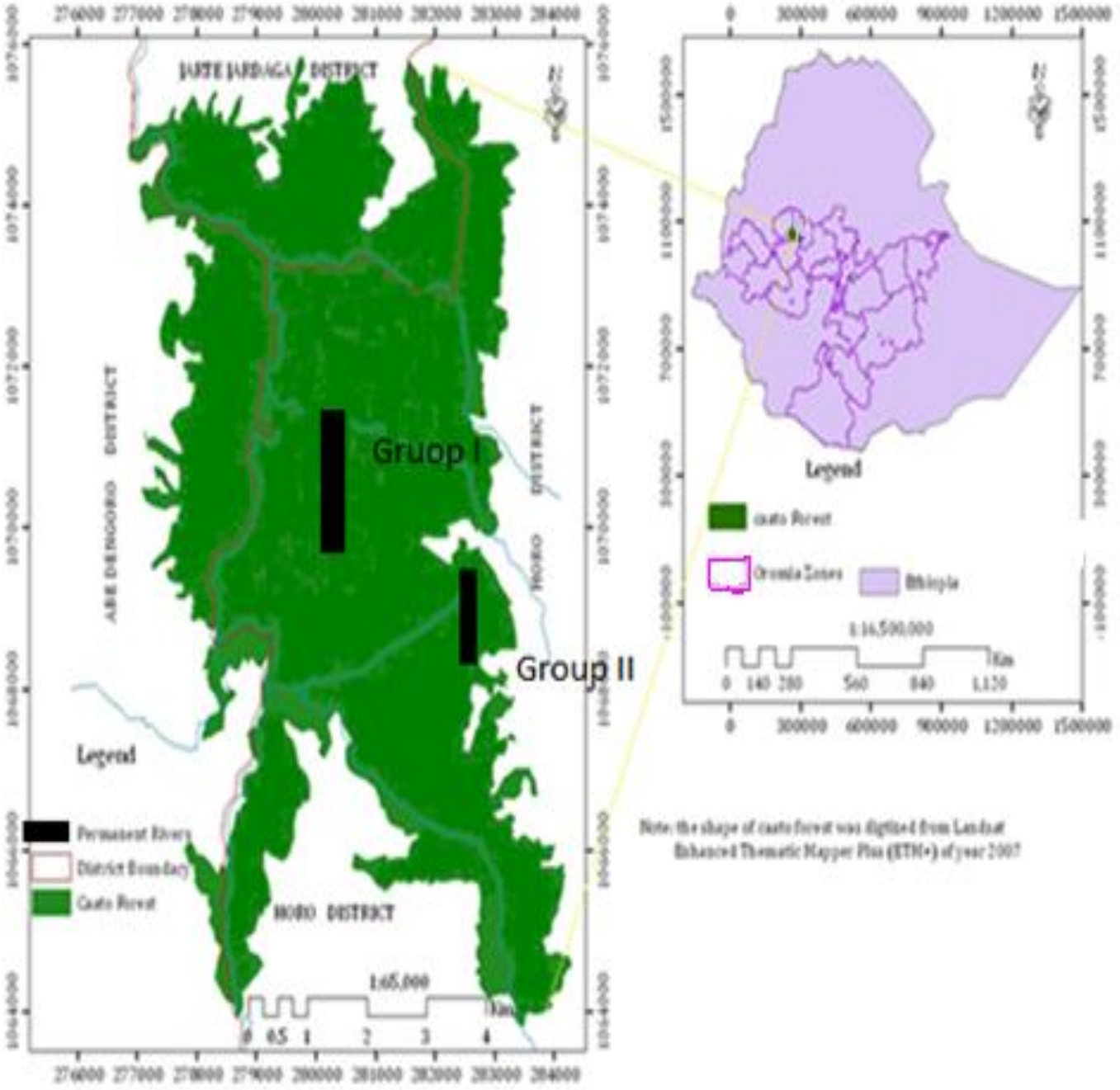


Figure 1 Map of study area, Source (EMA, 1988)

Chato Natural forest is generally characterized by rough with undulating plain, hills, slopes, deep valley, gorges, escarpments and dissected plateaus . Several perennial rivers such as Yamalagi River, Badessa River, Chiracho River, Jaba River and Gabar River are flowing into Garchi River by crossing the forest, all of which emerge from the highlands. It is bounded in the north by Jaba River (Jardega-Jarte Wereda) in the west by Garchi River (Abe Dongoro Wereda), in the southeast by Bafo-Gabar River and in the east direction by plantation (Horo Wereda). Because of topographic nature; the forest area is not easily accessible as it is surrounded by steep hill slope and escarpments. It irrelatively less disturbed by human actions (H.W.R.A.D.O., 2013)

### 3.1.2 Climate

### 3.1.3 Temperature and rainfall

A 15 years rainfall and temperature data obtained from Shambu Meteorological Station from 1999- 2013 was used to describe the climate of the study area .According to 15 years data from the mean annual rainfall in the study area is about 1566 mm . Peak period of rainfall is between May to October, decreasing in November and December with little or no rainfall in January and February. The average annual temperature is about $16.6^0$C .The mean minimum and maximum temperature is $10.78^0$C and $22.32^0$C respectively. There is little temperature variation throughout the year. Horro district has three Agro-Climatic Zones which correspond to the traditional classification systems: 43% Dega (2500-3500 m) 55.56% Woina Dega (1500 -2500 m), and 1.24% Kola (500-1500 m) (EFAP, 1994; HWARDO, 2013).

### 3.1.4 Population and land use

Out of 83,194 total population of Horo district 6,824 were urban dwellers. The society engaged in mixed cultivation of livestock rearing and crop production (HWARDO, 2013). Coffee and honey production is also practiced in the forest area. A according to (H.W.R.A.D.O, 2013) the type of soil in the district is sandy-loam type. However, as visually observed the soils of the forest area are darker-reddish in color with concentrated humus as there is no strong eroding forces along vegetation cover.

The traditional farming systems enforce the population to exploit the forest, particularly at the marginal areas for agricultural expansions and settlements. Based on the data obtained from H.W.R.A.D.O. (2013) the major crops grown in this wereda are cereal crops (tef, wheat, maize, barely), pulses (peas and beans) and oil crops (noug and rape seed). During the 2013/14. Livestock populations in the district were 326257 cattle, 106551 sheep, 26293 goats, 85659 poultry, 34671 horses, 3607 mules and 16691 donkeys as reported by ( H.W.R.A.D.O,2013).

### 3.1.5 Vegetation

The main species of plants found in this forest include broad-leaved and evergreen with important tree species such as *Poutera adolfi-friederici, Mimusops kummel, Millettia ferruginea, Teclea nobilis, Podocarpous falcatus, Celtis africana, Croton macrostachyus,Dracaena steudneri, Allophylus abyssinicum, Albiza gummifera, Prunus africana, Polysciasfulva, Cordia africana, Warburgia ugandensis, Diospyros abyssinica, Macranga capensi, Nuxiacongesta, Ekebrergia capensis, Ficus* subsp., *Syzygium guineense s*subsp. *afromontaum, Oleacapensis subsp macrocarpa* and *Pittosporum viridiflorum* (H.W.R.A.D.O,2013)

### 3.1.6 Wild life

Chato Natural Forest contains a variety of wildlife including Colabus monkey, (*Colabus gureza*), blue monkey (*Cercopthecus mits boutoutirilins*), Olive baboon (*Papio anubis*), warthog (*Phacochoerus africaus*), Africana civet cate (*Civetticits civetta*), Grevet monkey (*chlorocebus aethiops*), Porcupine(*Hystrix cristata*), Leopard (*Ponthera pardus*) and common bushbuck (*Tragelapus scrpitus*) and varieties of birds ( H.W.R.A.D.O,2013).

## 3.2 Method

### 3.2. 1 Preliminary surveys

The present study was conducted from September 2013- Julys 2014. A preliminary survey was conducted for a week in September 2013 to identify the study sites and study groups. Suitable study sites were identified and habitat types were also assessed. Two different Boutourlini's blue monkey troops at two separate sites were selected for the study of their habitat use feeding ecology, activity patterns and human -blue monkey conflict. The first troop (group I) was located in tree dominated forest with low disturbance while the second troop (group II) inhabited a tree and shrubs dominated habitat type (Fig. 1). The two groups of blue monkey are identified by their distinctive natural markings, facial features, skin colors, and sizes of members of each group (Martin and Bateson, 1993). The habitat of group II was partly surrounded by farmland and characterized by relatively high human and livestock disturbances. The study troops were partially habituated to human observers for two weeks by following the group throughout the day to approach the monkeys to within 10-25 meters (Fashing, 2001).

### 3.2.2. Activity pattern

To find out the various daily activities performed by the blue monkeys in the study area, preliminary observation was used in order to be familiar with the study subjects and to determine types of activity patterns of the blue monkeys. To collect the activity pattern of *C.mits* the instantaneous scan sampling methods were used to collect data on selected group members (Altmann, 1974). Activity and dietary data were collected from the study troops for 5 consecutive days per month covering both the wet season (Sep, Oct, Nov, and April) and dry seasons (Dec-Mar). During activity scan sampling, the activities of monkeys were recorded for 5 minutes at 15 minutes intervals during 07:00-17:30 h (Fashing, 2001; Wong and Sicotte, 2007). In addition, the study groups were estimated and recorded every fourth scan (i.e. once/hour) (Adisu Mokonin *et.al.*, 2010).

Following Fashing, (2001) method, at the time of each scan data were collected for the first 3-5 visible individuals of all age structure except infants as they performing one of the behavioral activities. Resting was recorded when the monkey was not involved in change of location, either sitting or lying down on the branches of trees or on the earth. Moving was recorded when the monkey walking, running, jumping, or climbing posture that resulted in change of location. Feeding was recorded when the monkey reaching for and manipulating a food item with hands or mouth, bringing it into the mouth and chewing. Grooming was recorded when the monkey cleaned its body by hands or the body of others, Sexual activity was recorded when the monkey involved in copulatory manner. Playing was recorded including social playing and solitary playing, involving running, climbing or jumping with or without one another. Others was recorded when the monkey performed activities such as vocalization, or defecating.

Activity time budget was calculated by dividing the proportion of the number of behavioral records for each activity category by the total number of activity records each day. Then it was

summed within each month to construct monthly proportions of time budgets. The grand mean proportion of the monthly budgets provided the overall wet and dry season time budgets, as well as the overall time budgets during the entire study period (Di Fiore and Rodman, 2001)

### 3.2.3 Habitat use

The habitat use of blue monkeys in Chato Natural forest was assessed by scan sampling on the selected study groups. The habitat use was recorded during scan sampling for the activity pattern study. This was undertaken every 15 minutes as the group moved from one point to another in their habitats (Vié *et al*., 2001). Habitat use was recorded as the habitat type in which the most members of the group were observed during each scan sample (Tree dominated, Bush land, Shrub forest and farm lands). The proportion of time spent in a particular habitat type was obtained from scan samples collected for each group. The analysis of habitat preferences was determined from the expected number of sightings in each habitat type. The habitat preference of the study groups was analyzed by the proportion of the number of scans where the groups spend in different habitats in the home range during the study period (Vié *et al.,* 2001; Wallace, 2006).

### 3.2.4. Feeding ecology

When an individual was feeding during a scan sample, both the food item was recorded to the species level. The food items were categorized as young leaves, mature leaves, shoots (newly growing aerial parts of a plant including leaf buds), stems (the supporting stalk of plants), flowers, fruits, seeds, bark, unknown plant parts, or animal prey (Dereje Tesfaye, 2010)

Diet composition was determined by calculating the proportions of different food items and species consumed by the monkeys for both groups. The monthly proportion of each food item and species were calculated in the diet as the total number of monthly individual scans for each

food item and species divided by the total number of monthly scan records for all food items and species .The grand means of the monthly proportion of food items and species consumed were used to calculate the overall wet and dry season's diets as well as the overall diet for the entire study period (Fashing, 2001).

### 3.2.5 Human –blue monkey conflict

Focus group discussions were used to collect information from communities living in and around the two selected peasant associations surrounding the forest. The selection was based on the distance from the forest and their impact on the blue monkey. In order to collect information, five pre-designed open-ended questions were used (Appendix 1). Information was collected on the presence or absence of conflict between blue monkey and local people around the forest, the cause of conflicts in between them, their attitude toward blue monkey, how both local communities and wild animals benefited from the protected forest.

Two focus group discussions were conducted. The group size in each discussion varied, in the first discussion 9 individuals and the second 11 individuals were participated. Participants were selected based on their age and duration of residency in the area and the type of crop they cultivate. Participants were invited to discuss issues according to their convenience using Afaan Oromo language. Most often, community leaders were approached in advance and requested to organize meetings two days ahead to hold discussion with the researcher by involving communities on the issue.

### 3.2.6. Data analysis

Data were analyzed using the SPSS software. The habitat use, activity pattern and feeding ecology of Boutourlini's blue monkeys were analyzed using Chi-square test.

# 4. RESULTS

## 4.1. Feeding ecology

The result indicates that blue monkeys fed more on the fruits (54.5%) than leaves in group I but group II fed more on leaves than other types of food (Fig. 3).Group I and group II inhabited partly different habitat types (Fig. 1). The home range of group I was natural tree dominated forest with small patches of bush lands (Fig. 1). Individuals in group II had four habitat types: tree dominated forest, bush land, shrubs forest and cultivated areas including human settlements, agricultural fields, grazing lands, and land being prepared for planting coffee.

Members of group I used more time on feeding fruits, which accounted for 54.5% of the overall diet (n=1920 feeding records). Young leaves (13.2%) and animal preys (12.7%) made the second and third largest parts of blue monkey diet in the study area (Fig. 3).shoot (6.9%) and flowers (6.4%) were also consumed by blue monkey. Members of group I consumed other food items such as mature leaves (3.3%) seeds and bark both constituted 1.3 % (Fig. 3).

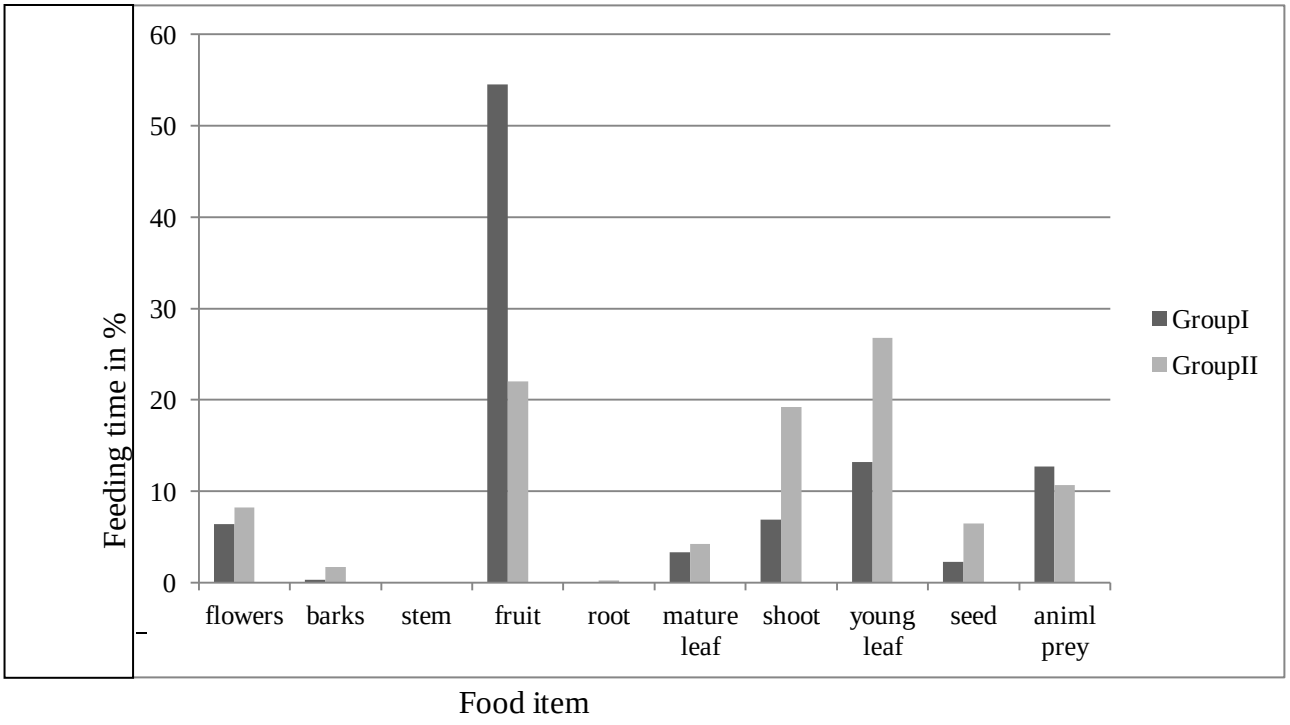


Fig. 2. Feeding times devoted to different food items by Boutourlini's blue monkey for group I and group II in percent

Young leaves were the most frequently consumed food items by group II, which accounted for 26.8% of the overall diet (n=1920 feeding records) during the study period (Fig. 3). Fruits, shoot and animal prey were the next most often consumed food items, accounting for 22 %, 19.2 %, and 10.7% of the diet, respectively (Fig. 3).

There were significant differences in time spent feeding on fruit, young leaves and shoot($x^2$ =202.7, 8 $p$<0.05) between individuals of the two groups (Fig. 3). However, there were no significant difference between the two groups in time spent feeding on seeds mature leaves, bark, flowers, animal prey ($p$>0.05)

Boutourlini's blue monkeys in group I consumed a total of 26 plant species which accounted for more than 89% of their diet during the study period (Table 1). Blue monkey found in group II consumed 29 plant species, which accounted for more than 87% of their diet (Table 2).

Plant species that contributed for the overall diet of group I, the top three species accounted for more than 70% of their plant diet. According to total percentage contribution of plant food items in group I *Mimusops kummel* was the most consumed species accounting for 38.67%, *Syzygium guineense* subsp.*afromontanum 22.4*%, *Ficus vasta* 9.55 % ( Table 1)

In the case of group II, the following five highly consumed plant species accounted for 53% of their total plant diet. *Ficus vasta* contributed 23.6%, *Ficus sur* 11.5%, *Syzygium guineense* subsp.*afromontanum 8.15%*, *Mimusops kummel* 5.05% and *Syzygium guineense* subsp. *guineensis* 4.43 % (Table 2).

Table 1. List of plant, food item consumed and percentage contribution in plant diet of Boutourilinis blue monkey (group I)

| Scientific name | Family | Type | Local name | Plant parts consumed | % contribution |
|---|---|---|---|---|---|
| *Mimusops kummel* | Sapotaceae | T | Qoladi | SH YL FR SD | 38.67 |
| *Syzygium guineense* subsp.*afromontanum* | Myrtaceae | T | Badeessaa | FL FR YL SD | 22.14 |
| *Ficus vasta* | Moraceae | T | Qilxuu | SH FL FR | 9.55 |
| *Prunus africana* | Rosaceae | T | Homii | ML FL FR | 3.32 |
| *Syzygium guineense* subsp.*guineensis* | Myrtaceae | T | Goosuu | FR FL SH | 2.21 |
| *Sparmannia ricinocarpa* | Tiliaceae | TS | Burkutuu | YL SH | 2.11 |
| *Allophylus abyssinicus* | Sapindaceae | T | Malqaqqoo | SD FR FL SH | 2.01 |
| *Croton macrostachyus* | Euphorbiaceae | T | Bakanisaa | SH SD YL | 1.82 |
| *Phoenix reclinata* Jacq. | Arecaceae | T | Meexxii | SD FR FL | 1.70 |
| *Podocarpus falcatus* | *P0docarpaceae* | T | Birbisa | FR SD | 1.50 |
| *Ficus sur* | Moraceae | T | Harbuu | SH FR ML YL | 1.06 |
| *Gardenia ternifolia* | *Gardenia ternifolia* | T | Gambello | YLSH | 0.84 |
| *Olea welwitschii* | Oleaceae | T | Bahaa | YL SH | 0.76 |
| *Hippocratea goetezi* | Celastraceae | S | H/qolalafesa | MLYL SH | 0.60 |
| *Olinia rochetiana* | Oliniaceae | T | Noolee | SH YL | 0.52 |
| *Ehretia cymosa* | Boraginaceae | T | Ulaagaa | SH FR | 0.48 |
| *Bersama abyssinica* | Melianthaceae | F | Ararsaa | SH BA | 0.35 |
| *Clutia abyssinica* | Euphorbiaceae | S | Ulee foon | SH FR | 0.26 |
| *Albiza gummifera* | *Albiza gummifera* | T | Bribiraa | YL SH | 0.23 |
| *Celtis africana* | Ulmaceae | T | Cayyii | YL SH | o.18 |
| *Argomuelera macrophylla* | Euphorbiaceae | S | Hanbubbu | FR SD | 0.16 |
| *Carissa spinarum* | Apocyanceae | S | Hagamsaa | FR SD | 0.15 |
| *Acaccia abyssinica* | Fabaceae | T | Laftoo | FR SD | 0.09 |
| *Hibiscus macranthus* | Malvaceae | S | Hincinnii | SH SD FR | 0.02 |
| *Justicia schimperiana* | Acanthaceae | S | Dhumugga | FL FR SD | 0.02 |

T-trees , S –shrub, H – herbs, F- ferns , L-liana SH-shoot, YL-young leave, FR- fruit, SD- seed ML- mature leaves, FL-flowers.

Table 2. List of plant, food items consumed and percentage contribution in plant diet of Boutourilini blue monkey (group II**)**

| Scientific name | Family | Type | Local name | Plant parts consumed | % contribution |
|---|---|---|---|---|---|
| *Ficus vasta* | Moraceae | T | Qilxuu | FR, YL,SD,SH | 23.6 |
| *Ficus sur* | Moraceae | T | Harbuu | SH FR ML YL | 15.12 |
| *Syzygium guineense* subsp.*guineensis* | Myrtaceae | T | Goosuu | FR FL SH BR | 8.15 |
| *Mimusops kummel* | Sapotaceae | T | Qoladi | SH YL FR | 5.05 |
| *Syzygium guineense* subsp.*afromontanum* | Myrtaceae | T | Badeessaa | SH,YL | 4.43 |
| *Coffee arabica* | Rubiaceae | S | Bunaa | FR,SD | 3.68 |
| *Phoenix reclinata* Jacq. | Arecaceae | T | Meexxii | FR,SD | 3.5 |
| *Podocarpus falcatus* | *Podocarpus falcatus* | T | Birbisa | FR,SD | 2.75 |
| *Prunus africana* | Rosaceae | T | Homii | SH,YL | 2.45 |
| *Lagenaria abyssinica* | Cucurbitaceae | C | Buq/ sexanaa | SH,YL | 2.38 |
| *Rubus steudneri* | Rosaceae | S | Goraa | FR,SD | 2.29 |
| *Embelia schimperi* | Myrsinaceae | T | Hanquu | FL,FR | 2.24 |
| *Allophylus abyssinicus* | Sapindaceae | T | Malqaqqoo | FR,YL | 2.21 |
| *Pittosporum viridiflorum* | Pittosporaceae | T | Qasamee | SH,YL | 1.85 |
| *Ficus thonningii* | Moraceae | T | Dambii | SH,YL | 1.73 |
| *Cyathula cylindrica* | Amaranthaceae | H | Kobboo | YL,SD | 1.53 |
| *Grewia ferruginea* | Tiliaceae | L | Dhoqonuu | ML,YL | 1.13 |
| *Dovyalis abyssinica* | Flacourtaceae | S | Koshommii | FR,ML | 1.12 |
| *Gardenia ternifolia* | *Gardenia ternifolia* | T | Gambello | ML | 0.93 |
| *Schefflera abyssinica* | Araliaceae | T | Getema | ML | 0.84 |
| *Acanthus eminens* | Acanthaceae | S | Kosoruu | FL | 0.78 |
| *Urera hypselodedron* | Urticaceae | L | Laanqisaa | YL,SH | 0.76 |
| *Sparmannia ricinocarpa* | Tiliaceae | TS | Burkutuu | ML | 0.68 |
| *Achyrospermum schimperi* | Lamiaceae | H | Kussayyee | ML,YL | 0.53 |

| | | | | | |
|---|---|---|---|---|---|
| *Carissa spinarum* | Apocyanceae | S | Hagamsaa | FR,SD | 0.35 |
| *Arisaema schimperiana* | Araceae | H | Nitii bofaa | RO | 0.32 |
| *Dombeya torrida* | Sterculiaceae | S | Danisaa | SH,YL | 0.25 |
| *Dracaena steudner* | Dracaenaceae | T | Marqoo/warqe | SH | 0.18 |
| *Ekebergia capensis* | Meliaceae | T | Somboo | SH | 0.14 |

T-trees ,S –shrub, H – herbs, F- ferns C- climber, L-liana SH-shoot, YL-young leave, FR- fruit, SD- seed ML- mature leaves, FL- flowers

From the monthly percentage contribution of different food items of different plants to the diet of group I blue monkey, fruits were the top food item for most months (ranges 20.3–72.7%) whereas young leaves (3.9–25.3%) and animal prey (10 -16.5%) were the second and the third most consumed food items in most months (Table 3).

Table 3. Percentage contribution of different food items to the diet of Boutourlini's blue monkeys Group I during the study period

| Month | Flower | Barks | Stems | Fruits | Root | Mature Leaves | Shoot | Young leaves | Seeds | Animal prey |
|---|---|---|---|---|---|---|---|---|---|---|
| Sep | 5.3 | - | - | 43.0 | - | - | 8.0 | 25.3 | 5.38 | 13.09 |
| Oct | 14.6 | - | - | 41.48 | - | 4.0 | 8.08 | 20.3 | - | 11.54 |
| Nov | 27.8 | - | - | 31.1 | | 7.8 | 15.8 | 5.8 | 1.7 | 10 |
| Dec | 6.7 | 0.57 | - | 56.5 | | 1.1 | 3.83 | 14.6 | 3.2 | 13.6 |
| Jan | - | - | - | 59.2 | - | 6.5 | 4.6 | 14.5 | 3.2 | 11.5 |
| Feb | 0.7 | - | - | 72.7 | - | - | 3.2 | 9.1 | 2.6 | 11.7 |
| Mar | 0.7 | - | - | 66.8- | - | 2.1 | 7.3 | 3.9 | 2.7 | 16.5 |
| Apr | - | - | - | 67.4 | - | 5.0 | 2.1 | 13.3 | - | 12.2 |

The monthly percentage contribution of different food items from different plants to the diet of group II is also shown in Table 4. Unlike group I, this group spent much of the time predominantly foraging on young leaves (ranges 13.6-38.2%). They also consumed fruits (14.4-30.4%), shoot (12.4-28.2%) and animal prey (14.4-19.4%) during almost all months of the study period.

Table 4 . Percentage contribution of different food items to the diet of Boutourlini's blue Monkeys Group II during the study period

| Month | Flower | Barks | Stems | Fruits | Root | Mature Leaves | Shoot | Young leaves | Seeds | Animal prey | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sep | 7.8 | 2.1 | 0.1 | 18.4 | - | 9.1 | 15.2 | 35.3 | 2.4 | 9.6 | |
| Oct | 11.4 | 0.6 | - | 18.9 | 2.3 | 0.16 | 15.9 | 38.2 | 0.3 | 10.88 | |
| Nov | 19.9 | - | 3.5 | 23.0 | | - | 24.7 | 23.6 | - | 5.3 | |
| Dec | 1.8 | - | 1.8 | 24.6 | - | 7.2 | 23,5 | 27.6 | - | 12.8 | |
| Jan | 10.0 | - | - | 14.4 | - | 9.0 | 13.2 | 24.5 | 20.3 | 8.6 | |
| Feb | 8.0 | - | 4 | 24.7 | - | - | 28.2 | 23.3 | 7.4 | 4.4 | |
| Mar | 2.6 | - | - | 21.6 | - | 2.5 | 15.8 | 29.5 | 8.6 | 19.4 | |
| Apr | 3.7 | 7.0 | - | 30.4 | - | 4.9 | 12.4 | 13.6 | 10.7 | 17.3 | - |

Blue monkey of group I spent more time feeding on fruits during the dry season which accounted 56.5% compared to the wet season (49.5%) (Table 5). Whereas they spent more time on feeding on young leaves (17.5%), flowers (7.9%), shoots (7.4%) and mature leaves (4.2%) during the wet season. During the dry season, blue monkey of group I spent feeding on young leaves (14.7%), flowers (3.4%) and shoots (4.9%) (Table 5).

Table 5. Percent of time spent by blue monkey (Group I) feeding on different food items at different season s

| Diet | Time spent in percent | |
|---|---|---|
| | Wet season | Dry seasons |
| Flowers | 7.9 | 3.4 |
| Barks | 0.1 | 0.5 |
| Stem | 0.0 | 0.0 |
| Fruits | 49.5 | 56.5 |
| Roots | 0.0 | 0.6 |
| Mature leaves | 4.2 | 2.4 |
| Shoot | 7.4 | 4.9 |
| Young leaves | 17.5 | 14.7 |
| Seeds | 1.1 | 3.7 |
| Animal prey | 10.4 | 12.8 |
| Others | 0.1 | 0.5 |

Individuals of group II spent more time feeding on young leaves (30.1%) during the dry season than during the wet season (22%) (Table 6). This group also spent more time feeding on fruits (24.5%) during the dry season than during the wet season (20.3%) (Table 6). They spent more time feeding on seeds (7.4%) and young leaves (30.1%) during the dry season than during wet season. Individuals of this group spent more time feeding on shoots (23%) during the wet season than during the dry season (15.4%). More time was spent to feed on animal prey (11.4%) during dry season than during wet season (10.8%). This group spent more time to feed on flowers 8.5% and mature leaves 6.4% during the wet seasons than during the dry seasons

Table 6. Percent of time spent by blue monkey (Group II) feeding on different food item at different seasons

| Diet | Time spent in percent | |
|---|---|---|
| | Dry season | Wet season |
| Flowers | 7.9 | 8.5 |
| Barks | 1.6 | 2.2 |
| Stems | 0.0 | 0.0 |
| Fruits | 24.5 | 20.3 |
| Roots | 0.0 | 0.0 |
| Mature leaves | 1.5 | 6.4 |
| Shoots | 15.4 | 23 |
| Young leaves | 30.1 | 22 |
| Seeds | 7.4 | 5.8 |
| Animal prey | 11.4 | 10.8 |
| Others | 0.2 | 0.6 |
| Total | 100 | 100 |

The major food items in the diets of group I were fruits of *Mimusops kummel* and fruits of *Syzygium guineense* subsp.*afromontanum* which accounted 27.92% and 16.14% respectively of their diets. Animal prey (12.7%) was the third most often consumed food item (Table7). Young leaves of *Mimusops kumml* (6.2%), fruits of *Ficus vasta (*6.16%), seeds of *Mimusops kummel* (3.02%), young leaves of *Syzygium guineense* subsp *guineensis (*3.0%) were some of the diets consumed by group members

Table 7. Percent of time spent feeding on specific food items (n=1680) by group I

| Scientific name | Family | Type | Flower | Barks | Stem | Fruits | Root | Mature leave | Shoot | Young leaves | Seeds | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Mimusops kummel* | Sapotaceae | T | | - | - | 27.92 | - | - | - | 6.2 | 3.02 | 38.67 |
| *Syzygium Guineense (.afromontanum* | Myrtaceae | T | 2.94 | - | - | 16.14 | - | - | - | 3.0 | 0.06 | 22.14 |
| *Ficus vasta* | Moraceae | T | 1.25 | - | - | 6.16 | - | - | 2.14 | - | - | 9.55 |
| *Prunus Africana* | Rosaceae | T | 0.8 | - | - | 0.05 | - | 0.48 | - | - | - | 3.32 |
| *Syzygium guineense (guineensis)* | Myrtaceae | T | 0.04 | - | - | 1.20 | - | - | 0.97 | - | - | 2.21 |
| *Sparmannia ricinocarpa* | Tiliaceae | TS | - | - | - | - | - | - | 0.65 | 1.46 | - | 2.11 |
| *Allophylus abyssinicus* | Sapindaceae | T | 0.41 | - | - | 0.32 | - | - | 0.83 | - | 0.45 | 2.01 |
| *Croton macrostachyus* | Euphorbiaceae | T | - | - | - | - | - | - | 1.47 | 0.32 | 0.03 | 1.82 |
| *Phoenix reclinata* Jacq. | Arecaceae | T | 0.21 | - | - | 1.02 | - | - | - | - | 0.28 | 1.70 |
| *Podocarpus falcatus* | Podocarpaceae | T | - | - | - | 1.04 | - | | - | - | 0.46 | 1.50 |
| *Ficus sur* | Moraceae | T | 0.23 | - | - | 0.63 | - | - | 0.1 | 0.1 | - | 1.06 |
| *Gardenia ternifolia* | Rubiaceae | T | - | - | - | - | - | - | 0.16 | 0.68 | - | 0.84 |
| *Olea welwitschii* | Oleaceae | T | - | - | - | - | - | - | 0.19 | 0.57 | - | 0.76 |
| *Hippocratea goetezi* | Celastraceae | S | - | - | - | - | - | 0.47 | 0.02 | 0.11 | - | 0.60 |
| *Olinia* | Oliniaceae | T | - | - | - | - | - | - | 0.1 | 0.42 | - | 0.52 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *rochetiana* | | | | | | | | | | | | |
| *Ehretia cymosa* | Boraginaceae | T | 0.34 | - | - | - | - | - | 0.14 | - | - | 0.48 |
| *Bersama abyssinica* | Melianthaceae | F | - | 0.30 | - | - | - | - | 0.05 | - | - | 0.35 |
| *Clutia abyssinica* | Euphorbiaceae | S | 0.21 | - | - | - | - | - | 0.05 | - | - | 0.26 |
| *Albiza gummifera* | *Albiza gummifera* | T | - | - | - | - | - | 0.23 | - | - | - | 0.23 |
| *Celtis Africana* | Ulmaceaee | T | - | - | - | - | - | - | 0.01 | 0.22 | - | 0.23 |
| *Argomuelera macrophylla* | Euphorbiacae | S | - | - | - | - | - | 0.12 | 0.12 | 0.12 | - | 0.18 |
| *Carissa spinarum* | Apocyanceae | S | 0.12 | - | - | | - | | - | - | 0.04 | 0.16 |
| *Acaccia abyssinica* | Fabaceae | T | 0.02 | - | - | - | - | - | | - | 0.07 | 0.09 |
| *Hibiscus macranthus* | Malvaceae | S | - | - | - | - | - | - | - | - | 0.01 | 0.01 |
| *Justicia schimperiana* | Acanthaceae | S | 0.01 | - | - | - | - | - | - | - | - | 0.01 |
| Animal prey | | - | - | - | - | - | - | - | - | - | - | 12.7 |

T-trees,S –shrub, H – herbs, F- ferns.

The major food items in the diets of group II were young leaves of *Ficus vasta* which accounted for 13.37% (Table 8). Animal prey accounted for 10.7% of their diets. Fruits of *Ficus sur* (5.26%) ,shoots of *Ficus vasta (*5.16%), young leaves of *Ficus sur (*4.23%) were some of the plant parts consumed by group II (Table 8).

Table 8.Percent of time spent feeding on specific food items (n= 2320) by group II.

| Scientific name | Family | Type | Flowers | Barks | Stems | Fruits | Roots | Mature leaves | Shoots | Young leaves | Seeds | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ficus vasta* | Moraceae | T | - | - | - | 3.84 | - | - | 5.16 | 13.17 | 1.2 | 23.6 |
| *Ficus sur* | Moraceae | T | - | - | - | 5.26 | - | - | 2.02 | 4.23 | 0.11 | 11.52 |
| *Syzygium guineense(.afromontanum* | Myrtaceae | T | 3.48 | 1.29 | - | 2.35 | - | - | | - | - | 8.15 |
| *Mimusops kummel* | Sapotaceae | T | 1.25 | - | - | 1.74 | - | - | 2.06 | - | - | 5.05 |
| *Syzygium guineense(.guineensis)* | Myrtaceae | T | - | - | - | - | - | - | 2.79 | 1.64 | - | 4.43 |
| *Coffee Arabica* | Rubiaceae | S | - | - | - | 2.24 | - | - | - | | 1.44 | 3.68 |
| *Phoenix reclinata* Jacq. | Arecaceae | T | - | - | - | 2.64 | - | - | - | - | 0.86 | 3.50 |
| *Podocarpus falcatus* | *Podocarpus falcatus* | T | - | - | - | 2.03 | - | - | - | - | 0.72 | 2.75 |
| *Prunus Africana* | Rosaceae | T | - | - | - | - | - | - | 2.05 | 0.4 | - | 2.45 |
| *Lagenaria abyssinica* | Cucurbitaceae | C | - | - | - | - | - | - | 0.3 | 2.08 | - | 2.38 |
| *Rubus steudneri* | Rosaceae | S | - | - | - | 2.1 | - | - | - | - | 0.19 | 2.29 |
| *Embelia schimperi* | Myrsinaceae | T | 2.06 | - | - | 0.18 | - | - | - | - | - | 2.24 |
| *Allophylus abyssinicus* | Sapindaceae | T | | - | - | 0.12 | - | - | - | 2.01 | - | 2.21 |
| *Pittosporum viridiflorum* | Pittosporaceae | T | | - | - | - | - | - | 1.04 | 0.81 | - | 1.85 |
| *Ficus thonningii* | Moraceaec | T | - | - | - | - | - | - | 1.02 | 0.71 | - | 1.73 |
| *Cyathula* | Amaranth | H | - | - | - | - | - | - | - | 0.87 | 0.66 | 1.53 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *cylindrical* | aceae | | | | | | | | | | | |
| *Grewia ferruginea* | Tiliaceae | L | - | - | - | - | - | 0.24 | - | 0.89 | - | 1.13 |
| *Dovyalis abyssinica* | Flacourtaceae | S | - | - | - | 0.1 | - | 1.02 | - | - | - | 1.12 |
| *Schefflera abyssinica* | Araliaceae | T | - | - | - | - | - | 0.92 | - | - | - | 0.92 |
| *Acanthus eminens* | Acanthaceae | S | - | - | - | - | - | 0.84 | - | - | - | 0.84 |
| *Urera hypselodedron* | Urticaceae | L | 0.78 | - | - | - | - | - | - | - | - | 0.78 |
| *Sparmannia ricinocarpa* | Tiliaceae | T | - | - | - | - | - | - | - | 0.76 | - | 0.76 |
| *Achyrospermum schimperi* | Lamiaceae | H | - | - | - | - | - | 0.68 | - | - | - | 0.68 |
| *Ocimum lamiifolium* | Lamiaceae | H | - | - | - | - | - | 0.50 | - | 0.03 | - | 0.53 |
| *Carissa spinarum* | Apocyanceae | S | - | - | - | 0.05 | - | - | - | - | 0.03 | 0.35 |
| *Arisaema schimperiana* | Araceae | H | - | - | - | - | 0.32 | - | - | - | - | 0.32 |
| *Dombeya torrid* | Sterculiaceae | S | - | - | - | - | - | - | 0.20 | 0.05 | - | 0.25 |
| *Dracaena steudner* | Dracaenaceae | T | | - | - | - | - | - | 0.18 | -= | - | 0.18 |
| *Ekebergia capensis* | Meliaceae | T | - | - | - | - | - | - | 0.14 | - | - | 0.14 |
| Animal prey | - | - | - | - | - | - | - | - | - | - | - | 10.7 |

T-trees ,S –shrub, H – herbs, F- ferns C- climber, L-liana.

### 4.2. Activity patterns

Blue monkey conduct their daily activities within a social group on the average ranging from 7-13 individuals in group I and 12-15 individuals in group II. The greatest proportion of activity time budget of blue monkeys

was devoted to feeding (53.6%) followed by resting (19.3%), moving (18.3%) during the dry seasons for group I. This group also spent time for social behaviors such as grooming (3.7%), playing (3.0%) and other such as sexual activities (1.0) , aggression (0.9%) , drinking (0.4%) during the dry season. The time spent by members of group I monkey during wet seasons was feeding (48.3%) followed by moving (22%), resting (18%), grooming (3.5 %), playing and aggression (2.4%), sexual activities (1.4%) and drinking (0.9%) (Fig. 4).

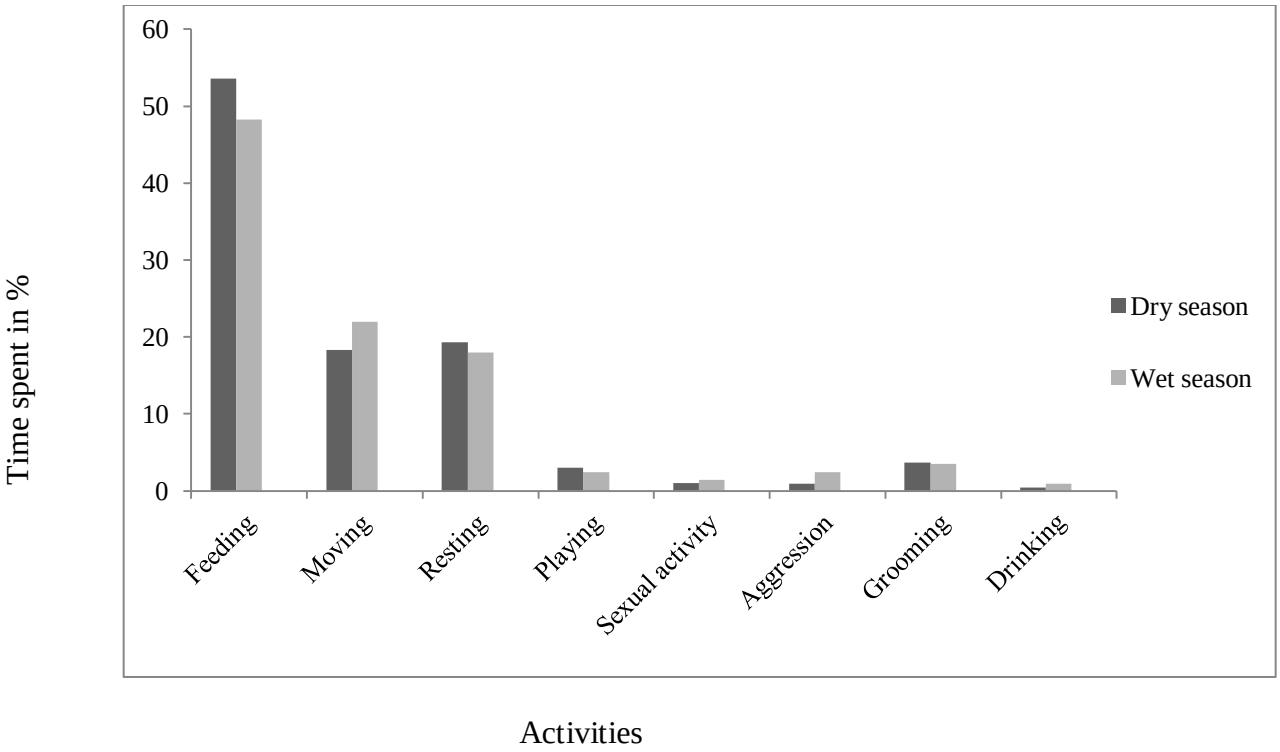


Fig. 3. Wet and dry season activity time budgets of blue monkey (Group I) in Chato Forest

Individuals in group II on average spent more time in feeding (49.4%) and moving (20.5%) during the dry season compared to wet seasons in which they spent feeding (48.3%) on feeding and (16.9%) moving (Fig. 5). This group spent more time on resting (23.5%) during the wet season than during the dry season (17.6%). Members of group II also spent more time on playing (4.8%) during the dry season than during the wet season (3.1%). This group also spent

more time in social activities such as grooming (4.2%) aggression (1.9%), and sexual activities (1.8%) during wet season but the major activities during the dry season were grooming (3.8%) aggression (1.7%), and sexual activities (1.2%) (Fig. 5). There was no significant difference in time spent between the two seasons in any of the major activities ($p>0.05$) for both groups

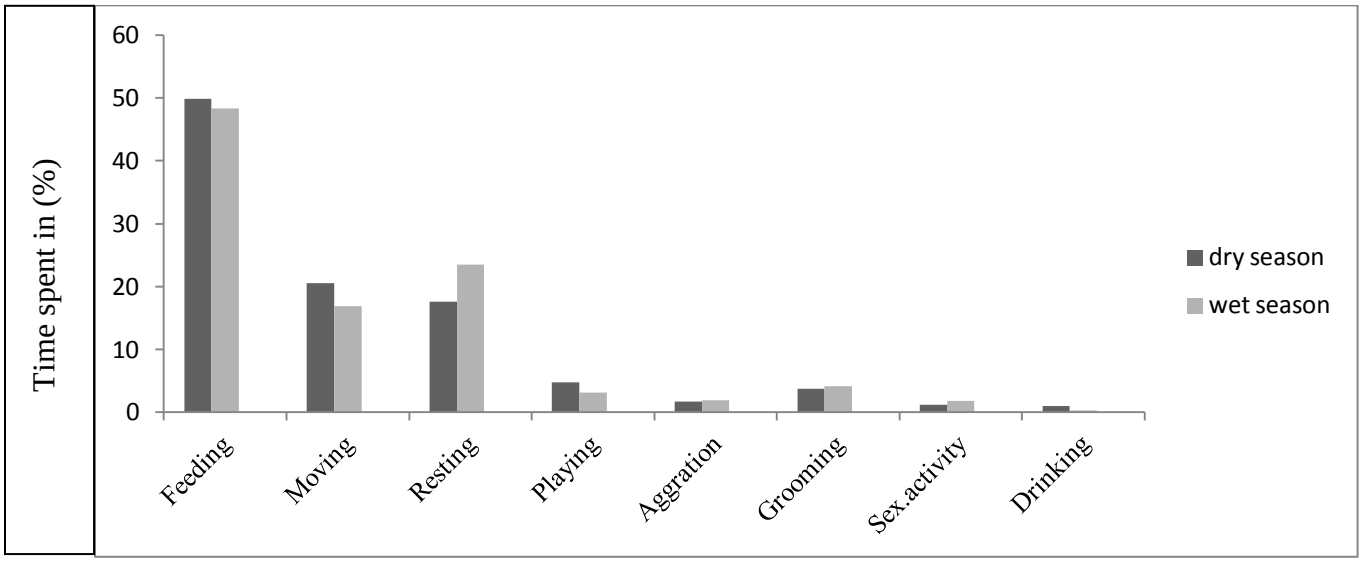


Fig. 4 Wet and dry season activity time budgets of blue monkey (Group II) in the Chato Forest

### 4.3. Habitat Use

Tree-dominated forest was the most important habitat for group I blue monkey which account 78.5% out of 3860 of scans (Table 9). Bush land dominated by *Rubus apetalus* (Rosaceae) provided as blue monkey habitat about 11.5 % whereas shrub forest 10.0% of scans (Table 9). Monkeys in group II used a more diverse array of habitat types including tree-dominated forest (33.3 %, N=4690 scans), shrub forest (26.5 %), bush land (28.9 %), and farmland (10.0%) (Table 9)

Table 9. Percent scan sample of blue monkeys in different habitat types

| Groups | Percent time spent and habitats | | | |
|---|---|---|---|---|
| | Tree dominated | Bush land forest | Shrub forest | Forest boundary |
| I | (78.5) | (11.5) | (10.0) | - |
| II | (33.6) | (28.9) | (26.5) | (10.0) |

**4.4 Focus group discussion (FGD)**

The result presented here summarizes the views and interest of discussants within each study area. The result of discussions held with FGD showed that there were conflicts between local communities and blue monkey around the forest. Hence blue monkey which live in the forest were involved in crop damage and pose loss of crops. According to the discussants most of the primate such as olive baboon, grivet monkey and blue monkey were involved in crop damage. Olive baboons and grivet monkeys were the most crop raiders and involved in damaging of all crops in the area but blue monkey was involved in damaging coffee plantation. Local people in an area kill blue monkeys, distracting their habitats, to protect crop pests. According to the participants' idea, the main cause of the conflict was the damaged caused by blue monkeys to their crops.

Discussants who live far away from the forest strongly blamed many wild animals such as olive baboon and grivet monkey but they did not consider blue monkeys as agricultural pest since these participants do not involve in coffee planting and blue monkeys cannot move out of fragmented forest to agricultural land where there is no forest .Only blue monkeys which live in

fragmented area were involved in damage of coffee around the forests. The groups which live inside the tree dominated area (group I) was not involved in crop damage and local people do not consider them as their agricultural pest. Only a few discussants wanted the existence of wild animals and support to protect their habitats.

There is lack of community based wildlife management in the area. Even though, the current rehabilitation of forest is encouraging but still without alternative livelihood for the farmers around the forest it cannot be sustainable. To make clearer one of the discussant gave his idea as follows:"Before many years ago we develop a negative attitude toward the conservation of primate including blue monkey because blue monkey raids coffee during coffee growing season. In my view if the government supports us, we understand that the endemicity of blue monkey and the use of forest in keeping the balance of nature. Thus, we are ready to protect and conserve the forest and blue monkeys. The discussant stressed that the government expands the forest by minimizing agricultural land and by plantation of trees such as junipers around the forest. If the government wants to conserve the forest and blue monkey, our problems should be considered and solved first." The major threats for blue monkeys were the current expansion of coffee plantation, which can affect its main habitat and increase human-blue monkey's conflict.

# 5. DISCUSSION

## 5.1 Feeding ecology

Forest dwelling guenons exhibit a diverse dietary preference such as fruits, leaves, flowers, vertebrates and invertebrates to varying degrees. However, they are distinguished from leaf-eating monkeys (Colobinae) by morphological adaptations to frugivorous diets (e.g. low and rounded molar cusps, simple stomach and pouches in their cheeks for storing food) (Fleagle, 1999). In the present study fruit were the top food item, i., e had the highest percent monthly contribution to the diet of any food item, during 8 months for Group I (range: 31.1-72.7).These goes in the line with the finding of Dereje Tesfaye, (2010) which indicate that blue monkey found in tree dominated forest spent most of their time feeding on fruit in Jibat Forests, Ethiopia.

Boutourlini's blue monkey consumes fruits as primary choice when present. They even partly shift their home ranges after 2-3 months to a nearby range in order to search and feed on fruiting plants. Boutourilinis blue monkeys that inhabit relatively in tree dominated forest (group I) at Chato were able to meet their needs almost inside tree dominated habitats .This pattern is different to that for Stuhlmann's blue monkeys (*Cercopithecus mitis stuhlmanni*) in Kakamega Forest, Kenya where an otherwise forest-dwelling group occasionally ventured out of the forest to access trees of *Bischofia javanica* planted in the surrounding human-dominated landscape to feed on fruit (Cords 1987*;* Pazol and Cords 2005).

Members of group II most of the time live near the farmland area where the habitats are fragmented. These inhabitants showed variation in the food items consumed in dietary composition between the two groups. This could be correlated with the high levels of dietary

flexibility in *C. mitis* (Chapman *et al.*, 2002) and their ability to occupy diverse habitat types (Jaffe and Isbell, 2007). Young leaves are the favorite food of the blue monkey in group II and spend most of their time feeding on it. Young leaves possess lower cellulose level and lower levels of toxic secondary compounds than mature leaves (Rechar, 1985; Strier, 2003). These makes digestion easier for blue monkeys. Study by Cords (1987) on *C. mitis* and *C. ascanius* in Kakamega Forest, Kenya showed that leaves comprised almost 23% and 10% of the plant diet, respectively.

Group II blue monkeys that live around forest boundary were mostly depended on young leaves of herbs, trees and lianas because there were only very few fruiting trees. In the present study, generally leaves contributed almost 16.4% and 32% of their overall diet for group I and group II, respectively. For most guenons seeds can be difficult to digest because of secondary compounds they contain, but they feed on them during shortage of fruits (Brugiere *et al.*, 2002). Boutourlini's blue monkeys consumed seeds of *Mimusops kummel* and *Coffee arabica* from wild plant. Seeds of *Syzygium guineense* and *Phoenix reclinata* contributed for only less than 1% of their diet composition. This shows that their seed consumption is very low. They also feed on flowers of different plants when available. Blue monkey feeds on animal prey during all the months of the study period and these may be to fulfill their protein requirement. Most of the forest guenons have been observed feeding on arthropods and other invertebrates. Insects make up a large proportion of the diets of *C.mitis* at Kibale, Uganda (35.1-45.4%) (Butynski, 1982).In the present study, animal diet was the 3$^{rd}$ important components of group I next to fruits and young leaves. They were observed chasing flying insects and nematodes. They were also observed searching for eggs in the nest of birds.

The results of present study show that Boutourlini's blue monkeys do indeed consume very different diets in group I and group II. Most of the young leave in group II diet came from, (*Ficus vista*) a species that was so abundant in their range. This dietary difference might be related to the availability of food resources in their home range.

**5.2 Activity pattern**

Blue monkey are social animals .They live in a group on average 7-13 for group I and 12-15 for group II. Compared to these, the average size of blue monkey group *Cercopthecus mits stuhlmnanni* in Kimbale National Park was 24 individuals (Chapman, 2000).This suggests that blue monkeys have different group size living in close relatives in neighboring Chato Forest. There was an increase in the average group size in home range area of which is highly disturbed by humans and livestock in group II than less disturbed area of group I. These is different compared to study by Jiang *et., al.* (1992) who suggests that when primate group receives protection, the size of group initially increases subsequently new groups may forms.

The amount of time spent for different activities in animals is an indication of balancing energy budgets for various activities. A monkey that can easily obtain food can spend more time for resting and grooming than feeding and moving (Pombo *et al.,* 2004). In the present study, Boutourlini's blue monkey spent more time feeding than moving and resting in both group I and group II. They spend less time for social activities such as grooming, playing, aggression and sexual activities. The result of the present study suggests that they spend more time feeding on fruit for group I and feeding on leaves for group II. In most cases, the activity time budget has

direct correlation with the availability of specific resources and dietary diversity. Blue monkeys showed high movement pattern to encounter fruit when there is fruit scarcity (Kaplin, 2001).

Dry season is the time for most fruiting plants to bear fruits. The feeding time budget for group I showed little variation between the two seasons. This variation might suggest that the availability of fruits during the dry season allowed them to take more time when foraging as it is their primary choice. The presence of ample resource would reduce the time spent for searching it. The time budget for social activity, especially for playing, aggression and sexual activity for group I blue monkey take greater time during wet season's than during dry seasons. This might be related to very attractive and ever green area during wet seasons.

However, the feeding time budget for group II was almost the same in both seasons. Members of this group spent most of their time feeding on young leaves of *Ficus vasta,* leaves of different herbs, shrubs, lianas and trees during the study period. This is because of minimal availability of fruiting trees in their habitats.

**5.3 Habitat use**

Boutourlini's blue monkeys in Chato Forest were observed in all of four types of habitats. Members of group I mostly spent their time inside tree dominated forests but sometimes seen in bush lands and shrubs habitats during foraging. Individuals of group II also spent more of the time in tree dominated forest over (33.6%) than in any other habitat type. However, considerable amount of time was also spent by group II in the bush land over (28.9%) and shrubs habitats over (26.5%) but they were rarely seen in farmland (10.0%). Group I even though they inhibited near the forest boundary they spent most of their time in tree dominated area than in forest boundary. The probable reason could be due to the presence of ample resource for feeding and no

disturbance by human action. According to Jaffe and Isbell (2007), guenons living in open habitats become more vulnerable to predators. In the present study, the limited ranging in open habitats of group I blue monkey might be related to the avoidance of predators.

Most types of Old World monkeys of the genus *Cercopithecus* occupy variable forest habitats, from primary, secondary and gallery rain forest to bamboo forest, flooded and swamp forest (Jaffe and Isbell, 2007). The blue monkeys (*C. mitis*) in particular are mostly distributed in tropical montane forests (Kaplin, 2001), moist, semi deciduous forest and evergreen rainforest (Cords, 1986; Butynski, 1990). *C. mitis boutourlinii* is strictly associated with primary tropical deciduous and reverien forest (IUCN, 2008). However, the present study area is classified as hills, slops, deep valley gorges escarpment and dissected plateaus (H.W.R.A.D, 2013) These goes in line with the information Kaplin,( 2001) and IUCN,(2008) which was associated with deciduous and evergreen rainforest and reverien forest.

The habitat preference of blue monkey is different from other guenons such as grivet and vervate monkey that inhabits wide range of habitats including Savannah, woodland and grassland forests. In general understanding the habitat preference of animals is important for planning future conservation and management of species (Chapman *et. al* 2006).Therefore recognizing the tree dominated forest and fragmented area near farmland habitats of blue monkey is a basic to plan for future scientific conservation and management of Chato Natural Forest. Habitat loss through deforestation is the primary threat for primates (Chapman *et al*., 2006). As forest size and quality decrease, reduction of food sources for forest-dwelling primates and local extinction might result (Lee and Hauser, 1998).

## 5.4 Focus group discussion (FGD)

The relative impact of wildlife damage on farm production and household income varies greatly according to the amount of land owned and peoples economic dependence on rural activities (Messmer, 2000). Crop raiding is a cause of much conflict between farmers and wildlife throughout the world (Hill *et al.,* 2002). In the present study, the cause of conflict between blue monkey and local people around Chato Forest were a tendency of the monkey to raid the surrounding coffee beans during the ripping seasons. At present, crop damage and livestock depredation by wildlife are major sources of economic losses. As a result, local communities have in turn threatened protected areas by poaching and by causing habitat loss through encroachment of farms into protected areas (Weladji and Tchamba, 2003). In the present study traditional farming systems enforce the population to exploit Chato Forest, particularly at the marginal areas for agricultural expansions and settlements. Conservation attitude of communities living adjacent to protected area is highly influenced by the problem associated with wildlife (Balakrishnan and Ndlhovu, 1992).In the present study the negative attitude of local community toward blue monkey was because of the expansion of coffee plantation, which can affect the habitat of blue monkey and increase human-blue monkey's conflict .Human wildlife conflict has far reaching environmental impacts over the long term because these farmers tend to attempt to eradicate crop raiding primates (Hill 1997; Lee and Priston 2005).

Boutourlini's blue monkeys are raid crops. Mitigation strategies need to be developed to ensure that the needs of both the local people and the blue monkeys are met ( Hill 2000; Strum 2010).

### 5.5 Conservation

In order to conserve blue monkey and prevent future decline, conservation practice involving local people is a must (Wallis and Lonsdorf, 2009). Chato Natural Forest was severely threatened by agricultural land expansion and commercial timber production. Grazing has a significant impact in the area in accelerating habitat degradation and competition with wildlife.

The present study indicates that the long-term conservation prospects of Boutourlini's blue monkeys are promising. Boutoutirilins blue monkeys found in group I and group II in Chato Forest occupy different habitat that contain different vegetation compositions. Despite the markedly different vegetation compositions of these two groups of home range and the groups inhabiting these different home ranges are able to survive on different diets, with the blue monkeys in group I relying much more heavily on fruit and those in group II subsisting more on young leaves, particularly from *Ficus vista.* Despite the encouraging evidence of habitat and dietary flexibility in presented in this study, however, there are reasons to suggest that the long-term conservation of Boutourlini's blue monkeys is far from assured. Their limited distribution in the forests of western Ethiopia, and the growing human population and related high rate of forest clearance in the region, highlight the need for protection of the remaining forests where Boutourlini's blue monkeys occur. (Chapman *et al.* 2007; Chatelain *et al,.* 1996). Ultimately, given the high density and rapid growth of the human population in western Ethiopia, the ability to withstand fragmentation and other disturbance to their habitat will likely be the key factor in determining the long term conservation prospects of blue monkey.

Blue monkeys exhibited a tendency to spend more time in tree dominated area , which may be linked to both fruit resource availability and structural characteristics such as larger fruit patches (Leighton, 1993) or a closed canopy for arboreal travel (Kaplin,2001).This pattern is different from that for *Stuhlmann's* blue monkeys (*Cercopithecus mitis stuhlmanni*) in Kakamega Forest, Kenya where otherwise forest-dwelling group occasionally ventured out of the forest to access trees of *Bischofia javanica* planted in the surrounding human-dominated landscape to feed on fruit. Hence their primary tendency to use tree dominated forests in this study may be correlated with the availability of these resources especially potential fruiting trees in the tree dominated forest than in other habitat types.

Awareness creation among the local community is very important for conservation of blue monkey and wildlife as whole in the Chato Forest. Currently there are several activities going on to protect Chato Forest. These are the promising implications for proper conservation and management of the habitat. The survival of the species is determined by the long-term plans in conserving and managing their immediate habitats and the surrounding environment.

# 6 CONCLUSION AND RECOMMENDATIONS

## 6.1 Conclusion

- ❖ Blue monkeys in a group I showed preference for tree dominated forest habitat than any other habitats in Chato forest where as that of group II inhibits in all four habitat type.
- ➢ Blue monkeys spend much of their activity time budget for feeding and moving than socializing and resting in both group I and group II.
- ✓ Blue monkeys consumed a total of 26 plant species for group I and 29 plant species for group I and group II throughout the study period.
- ❖ Blue monkey in a group I spent most of their time feeding on fruit of *Mimusops kummel* where as Blue monkey in a group II spent most of their time feeding on young leaves of *Ficus vista*

- ➢ The present study shows that there is a human-blue monkey conflict around chato forest. The extent of crop damage by blue monkey leads to negative attitude of local people toward the blue monkey.

## 6.2 Recommendation

Based on the finding of the present study the following points are recommended.

- ❖ Local people should minimize deforestation, livestock grazing, hunting and encroachment to redevelop the fragmented area of Chato natural forests.
- ➢ Awareness creation program should be prepared for local people to ensure the sustainability of the Chato forest as well as blue monkey for their economic benefits.
- ❖ Local people should participate in the process of conservation and resolving the existing conflict in order to foster positive outlook towards the blue monkey and their habitat.

- ❖ The results of the present study have several conservation and management implications for the blue monkeys and their habitat. Therefore, the survival of blue monkey depends heavily on planning and implementing on the conservation and management of the Chato forest.
- ❖ Long term research should be carried out on the other aspects of these animals.
- ❖ The topography of Chato Natural forest and the surrounding area is very attractive and interesting and thus they have a great potential for tourism. But facilities such as roads, experienced wildlife experts for the area and field guides are lacking. Tourism development can contribute positively to the benefits of local people. This will develop positive attitude among locals toward Chato Forest and Blue monkey conservation.
- ➢ The illegal cutting of trees and deforestation of the Chato forest by the local people for commercial purposes and for farmland expansion could impose threat to the Blue monkey populations in the future. If this trend continues, the population of Blue monkeys could be affected in the future. Management action should be taken to conserve the most important food resources of blue monkey such as *Mimusops kummel ,Ficus vista,Syzygium guineense* subsp *afromontanum* trees.
- ❖ Habitat positions that these monkeys occupy face imminent threat from anthropogenic factors. Therefore mitigation measures to reverse this trend should be put in place by the relevant authorities i.e. Ethiopian Forest Service and Ethiopian Wildlife service.

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# Appendixes

## Appendix 1. for Focus group discussion

1 Have there been any conflicts between humans and wild life around chato forest.

2 If there is a conflict what is the cause of the conflict.

3 What is the attitude of the community toward wild life around the forest .

4 Do you think the presence of the forest close to your area benefited the community?

5 In what way and what benefits have been realized up until now?

Blue monkey groups during foraging (Photo by Alemu Tolera)

Views of tree dominated area of Chato Natural forest