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Population size, distribution, habitat use & feeding ecology of Boutourlini's Blue monkey (*Cercopithecus mitis boutourlini*) in Halu forest priority area, Hamuma Natural & Coffee forest East Ilubabor zone, western Ethiopia

A Thesis Submitted to Department of Biology, College of Natural Sciences, Jimma University in partial fulfillment of the requirement for the Degree of Master of Science in Biology

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List of Acronomies

AM= Adult Male

AF= Adult Female

JU=Juveniles

SAM=Sub adult Male

SAF=Sub adult Female

HNF=Hamuma Natural Forest

HCF=Hamuma Coffee Forest

IUCN = International Union for Conservation of Nature

ML=Mature Leaves

YL= Young Leaves

Abstract

The study on population size, distribution, habitat use and feeding ecology of Boutourlinis blue monkeys was carried out in Hamuma Natural and Coffee forests from November 2022 - May 2023 during dry season. Total counting method was used to count the total population size, distribution and habitat use of the Boutourlinis blue monkey and Scan sampling method was used to collect data for feeding ecology of Boutourlinis blue monkey. Data were analyzed using descriptive statistics and Microsoft excel. From one group sighted, a total of 27 and 17 individuals were counted in Hamuma natural forest and Hamuma Coffee forest during dry season respectively. The number of adult female was highest in both study area during the study period. The distribution and habitat use of Boutourlinis blue monkey in each study area varied among the study habitats. Out of the total 27 individuals, for Hamuma natural forest group, 16(59.25%) were recorded from thick forest and 11(40.74) were from bush land. Out of the total 17 individuals, for Hamuma Coffee forest group, 10(58.8%) was from Coffee plantation and 7(41.2%) was from bush land. A total of 12 plant species belonging to 10 families were consumed by Boutourlinis blue monkey in each study area during the study period. Ficus sur was the most consumed plant species which accounted for19.5%, followed by Syzygium guineens(18.5%),Albizia gummifera(15%),Landolphia buchanani(13%)Cordia africana(11.8%) were the top five plant species consumed in Hamuma Natural forest during the study period. The species frequently consumed young leave (31.2%), fruit (25.9%), mature leave (21.4%), seed (15.75%) and bark (5.7%). In Coffee forest, Syzygium guineense was the most consumed plant species which accounted for 18%, Psidium guajava(17.4%), Ficus sur(14.57%),Albizia gummifera(12.9%), and Cordial Africana(12%) were the top five plant species consumed in Hamuma coffee forest and they frequently consumed young leave(29.6%), fruit(26.6%),mature leave(22.6%), seed(15.2%) and bark (6%).Study on population size, distribution, habitat use and feeding ecology of blue monkeys could give important information about this species. Awareness creation among local people about the importance of forest, the species and how they protect and manage it from different anthropogenic activities should be forwarded.

Key words: Boutourlin's Blue Monkey, distribution, feeding ecology, habitat use

1. Introduction

1.1. Background of the study

Blue monkeys (*Cercopithecus mitis*) are forest dwelling species belonging to the Old World monkeys (Kingdon, 1971; Estes, 1992). There are 17 subspecies of blue monkeys spreading in different habitat types and forests of south, east and central Africa (Wolfheim, 1982).

They are among the most widely distributed of African arboreal primate species and inhabit a variety of forest types such as tropical moist forest (Butynski, 1990), tropical montane forest (Kaplin, 2001) and coastal dune forest including forest fragments across much of their range (Lawes, 1991). They are also known as the diademed monkey because they have a prominent row of forward pointing white fur just above the brow line (Rudran, 1978; Foster and Cords, 2005). The face is nearly naked, usually dark in colour (infrequently blue), and has a well-developed musculature. White whiskers are well developed in males (Lawlor, 1979). Males are larger than females. The canines of males are also slightly larger than those of females. They are catarrhine; the nostrils are close together facing downward. They have cheek pouches to store food while foraging (Rudran, 1978).

Cercopithecus 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 sexually mature at 5–6 years old and the males when they are older (Rowell, 1984). The mating season is influenced by nutritional availability, which corresponds to the rainy seasons (Swart and Lawes, 1996). In the southern range areas, the females give birth during the summer months, while reproduction is seasonal in the equatorial belt (Stuart, 1997).

Blue Monkeys are frugivorous and folivorous in nature, feeding mainly on fruits and leaves. They also consume seeds and arthropods (Cords, 1987a). As an omnivore, blue monkeys mostly feed on fruits, leaves, invertebrates, flowers, seeds, bark and shoots (Estes, 1992).

Cercopithecus mitis boutourlinii is a subspecies of *Cercopithecus mitis*, endemic to Ethiopia, and received its name, Boutourlini's blue monkey, from a Russian Count, Augusto Boutourline. He travelled in Ethiopia during years 1884–1887 and named this subspecies during his visit to Shewa, central Ethiopia, where this subspecies was widely distributed (Watkins and Grayson, 2009). According to IUCN (2005), 17 subspecies of blue monkeys are recorded in different parts of Africa, and Boutourlini's blue monkey is one of the endemic subspecies to Ethiopia. It is occurring from Lake Tana southwards along the western side of the Ethiopian Rift Valley (IUCN, 2018). Boutourlini's blue monkeys are social animals, and their social system is affected by habitat disturbances, increased group size and predation, illegal human activities, forest loss and fragmentation, and changes in vegetation structure and composition (Cowlishaw and Dunbar, 2000). Boutourlini's blue monkey is categorized as vulnerable in the IUCN Red List of threatened species (Jong and Butynski, 2020). According IUCN (2014), its greatest threats are destruction and fragmentation of forest habitat for agricultural land. To conserve such threatened species, information on the population size, diet selection and foraging behavior of species is very important (Sutherland, 1998).The ecological role of Blue monkey largely is in seed dispersal because of their frugivory.

The study has been conducted on the effect of Anthropogenic Habitat modification on Behavioral ecology of Boutoulini's Blue monkey in Halu woreda Hamuma kebele coffee forest (Meseret chane,2012). But no study have been conducted on population size, distribution, habitat use and feeding ecology of this animal In this study area. Therefore, the aim of this study was to provide information (data) on population size, distribution, habitat use & feeding ecology of Boutoulini's Blue monkey In Halu woreda Hamuma Natural &Coffee forests.

1.2. Statement of the problems

Africa contains a number of the world's biodiversity hotspots, including; the Western African Forests and the Eastern Arc and Coastal Forests of Tanzania and Kenya, all crucial habitats of *Cercopithecus mitis*. Blue monkeys are frugivoure primates which are sensitive to the removal of forest as it reduces the availability of food (Cordeiro *et al*., 2004).

Habitat loss due to commercial timber, agriculture and others means of human activities threatens forest specialist primates (Chapman *et al*., 2006). Boutourlini's blue monkeys are social animals, and their social system is affected by habitat disturbances, increased group size and predation, illegal human activities, forest loss and fragmentation, and changes in vegetation structure and composition (Cowlishaw and Dunbar, 2000).

As revealed by IUCN (2010), nearly half of the species are threatened with extinction due to habitat destruction and hunting. To conserve such threatened species, information on the population size, diet preference and foraging behavior of species is very important (Sutherland, 1998). In Halu woreda Hamuma Natural and Coffee forest, population size, distribution, habitat use and feeding ecology of Boutourlini's Blue Monkey may vary from one site to another. Boutourlini's Blue Monkey mainly depends on forest for their diet and habitat use. In addition to this in this study area, the forest becomes gradually destroyed. Hence, *C.mitis boutourlini* population is locally affected. Since no more study have been conducted on population size of *C.mitis boutourlini* in Halu woreda Hamuma Natural and Coffee forest of Ilubabor zone information (data) is lacking. Therefore, this study aimed to provide data on population size, distribution, habitat use, and feeding ecology of *C.mitis boutourlini* in this study area.

1.3. Research Questions

This study has the following basic research questions:-

1. What is the population size of the Boutourlini's Blue Monkeyin the study area?
2. What is the distribution pattern of the Boutourlini's Blue Monkey in the study area?
3. What is the feeding ecology of the animal in the study area?
4. What are the potential threats of this species in the study area?

1.4. Objectives

1.4.1. General Objectives

The general objectives of this study were:-

- To assess the population size, distribution, habitat use and feeding ecology of Boutourlinis blue monkey in Halu forest priority area, Hamuma Natural and coffee forest east Ilubabor zone, western Ethiopia

1.4.2. Specific objectives

The specific objectives of this study were:

- ✓ To record the population size of the Boutourlini's Blue Monkey in the study area
- ✓ To describe the distribution of the Boutourlini's Blue Monkey in the study area
- ✓ To identify the feeding ecology of the Boutourlini's Blue Monkey in the study area
- ✓ To examine habitat use of Boutourlini's Blue Monkey in the study area.
- ✓ To assess the potential threats of this animal in the study area.

1.5. Significance of the study

Since, no study have been conducted regarding to population size, distribution, feeding ecology and habitat use of Boutoulini's Blue monkey in this study area, This study may provide insight information about population size, distribution, feeding ecology and habitat use of C.mitis boutoulini The study will also provide information for policy makers and stakeholders about existing situations of *Cercopithecus mitis boutourlini* to plan measures to mitigate improper natural resource management , identify gaps for researchers who would like to conduct detailed and comprehensive studies either in public or private institutions and recommend some possible ways of protecting the *Cercopithecus mitis boutourlini* in the study area

2. Literature Review

2.1. Discovery and taxonomic classification of Blue monkey

The gentle monkey *Cercopithecus mitis* (Wolf, 1822) is a widespread species endemic to sub-Saharan Africa, and the only forest-dependent guenon (tribe Cercopithecini) with a wide distribution in eastern and southern Africa. This species is the most ecologically diverse member of its genus, occupying many types of primary and secondary forest, including riparian, gallery, swamp, mangrove, coastal, groundwater, lowland, mid altitude (transitional), montane, and bamboo forest (Lawes *et al*. 2013). Unlike other Cercopithecus spp., *C. mitis* is tolerant of poor-quality habitats (Lawes, 1990), including suburban areas with wooded gardens near forest, and occurs over a wide altitudinal range (0–3,800 m above sea level) (De Jong and Butynski 2018). Documenting the morphological variation and biogeography of a rapidly radiating, highly polytypic, taxonomically complex, and fossil-poor species such as *C. mitis* is necessary for a better understanding of its evolutionary history, phylogeny, and current evolutionary trajectories. Here, we review the taxonomy of the eight subspecies of *C. mitis* currently recognized for Kenya and Tanzania and present an overview of their geographic distribution and pelage coloration and patterns. We also describe a new subspecies of *C. mitis* endemic to Tanzania, offer hypotheses for its origin and phylogenetic affinities, and assess its conservation status and conservation needs.

2.2. Geographical range of Blue monkey

Cercopithecus mitis is endemic to Africa and has an extensive geographic range. There is an isolated population (*C. m. mitis*) that is endemic to Angola. Otherwise, this species ranges from central Democratic Republic of Congo (DRC) east to the Indian Ocean. It is present from southwest Ethiopia in the north to east South Africa in the south (Lawes *et al*., 2013). It lives in Altitude from sea level to 3,800m asl (Rwenzori Mountains, Uganda). There are 17 subspecies recognized: *Cercopithecus mitis albotorquatus* (Pousargues's Monkey).Endemic to Kenya and south Somalia. Present along the Kenya coast in Boni National Reserve, Dodori National Reserve, Kipini Conservancy, Lamu Archipelago, Witu Forest Reserve and inland to Tana River Primate National Reserve, Meru National Park, and Kora National Park.

In the coastal forests of south Somalia, perhaps as far north as Kismayo (Butynski & Jong, 2014).*Cercopithecus mitis kolbi* (Kolb's Monkey). Endemic to the Central Highlands of Kenya east of the Rift Valley (including Nairobi, Ngong Hills, Aberdares Range, Mount Kenya and Laikipia Plateau). There is no evidence that *C. m. kolbi* occurs at Marsabit as sometimes stated.*Cercopithecus mitis albogularis* (Zanzibar Sykes's Monkey). From Kilifi Creek on the Kenya coast southwards to the Ruvu River, north Tanzania, including Mount Kilimanjaro, Mount Meru and Zanzibar Island. This may be the subspecies present from Kilifi Creek to the Sabaki River, Kenya (Jong & Butynski, 2009).*Cercopithecus mitis francescae* (Red-eared White-collared Monkey). West of Lake Malawi, from Mount Chombe in north to Mount Ntchisi in south.Only known from Mount Waller and the Vipya Plateau, Malawi (Kingdon, 2013).

Cercopithecus mitis moloneyi (Moloney's Monkey).From northeast Zambia west of the Luangwa River, to north-most Malawi, to the Southern Highlands and Lake Rukwa, south Tanzania.They appears to be in a phenotypic cline with *C. m. monoides* in the Udzungwa Mountains (Jong & Butynski,2009).*Cercopithecus mitis erythrarchus* (Stairs's Monkey or Samango Monkey).From the Mlanje Plateau in southern Malawi, south to Zimbabwe, much of Mozambique (although the coastal limits are uncertain), to Limpopo Province and northern KwaZulu-Natal in South Africa. Not south of Umfolozi River (Lawes *et al*., 2013

Cercopithecus mitis labiatus (Samango Monkey).Endemic to the highlands of east South Africa;Limpopo Province, Mpumalanga, KwaZulu-Natal and Eastern Cape. *Cercopithecus mitis heymansi*(Lomami River Monkey).Endemic to DRC between Lualaba River and Lomami River (Kingdon 2013).*Cercopithecusmitisopisthostictus* (Rump-spotted Monkey). From Katanga Province (Shaba) in DRC, north to ca. 6°N on the left bank of the Lualaba River to west and south-east shores of Lake Tanganyika. In northwest Zambia west of the Luangwa River (Lawes *et al*., 2013).*Cercopithecusmitis mitis* (Angola Pluto Monkey).Endemic to western Angola (Kingdon 2013).*Cercopithecus mitis boutourlinii* (Boutourlini's Blue Monkey).Southwest Ethiopia from Lake Tana southwards along the west side of the Ethiopian Rift, but does not reach Lake Turkana (Kingdon 2013).*Cercopithecus mitis stuhlmanni* (Stuhlmann's Blue Monkey).Widespread. In DRC from the Uele River and Congo River, east of the Itimbiri Riverto the Ituri Forest and Semliki Forest, Uganda, southwards to about 6°S and east of the Lualaba River.

In south Sudan, north Uganda (Imatong Mountains, Kidepo Valley), and southwest Kenya west of the Eastern Rift Valley (including Mount Elgon, Kakamega Forest, Mau Forest Complex and the Cherangani Hills (Butynski& Jong, 2014).*Cercopithecus mitis schoutedeni* (Schouteden's Silver Monkey).Endemic to eastern DRC on the islands of Idjwi and Shushu in Lake Kivu, and west Virunga Mountains southwest to Bobandana.*Cercopithecus mitis doggetti* (Doggett's Silver Monkey).High lands of eastern DRC, north Burundi, northwest Tanzania, through Rwanda and southwest Uganda.*Cercopithecus mitis kandti* (Golden Monkey).Eastern DRC near L. Kivu, Virunga Mountains of Rwanda and Uganda, and Nyungwe National Park, southwest Rwanda.*Cercopithecus mitis zammaranoi* (Zammarano's Monkey).Endemic to south Somalia along the Jubba River and Webi-Shebeli River (Gippoliti 2006).*Cercopithecus mitis monoides* (Tanzania Sykes's Monkey).

2.3. Morphology of Blue monkey

The blue monkey or diademed monkey is a species of Old World monkey native to Central and East Africa, ranging from the upper Congo River basin east to the East African Rift and south to northern Angola and Zambia. It sometimes includes Sykes', silver, and golden monkeys as subspecies (Groves, 2005*)*. Throughout the evergreen and bamboo forests of Central and East Africa lives a monkey with quite a peculiar look. Its facial coat gives the appearance of chipmunk-like cheeks paired with an extensive unibrow over piercing caramel-colored eyes. The blue monkey, which isn't blue at all, has an olive-gray coat with yellowish patches on its face. Blue monkeys are significant seed dispersers in this ecosystem, keeping fruit flourishing in the jungle. Their size ranges from 50 to 65 centimeters (22 to 26 in) in body length, with females weighing about 4 kilograms (9 lb) and males up to 8 kilograms (18 lb). Their long tail acts as a counterbalance of the blue monkey has evolved to encompass a wide range of foods. Leaves, tree bark, and assists in the movement necessary for canopy life (Hutchins *et al*.,2004).The digestive tract bamboo, fungi, flowers, invertebrates, birds, eggs, snakes, lizards, and sometimes even small mammals like bats, rodents, and squirrels supplement the blue monkey. However, over 50% of their diet will be various fruits if available. As they move through the forest, their droppings leave behind fertilized fruit seeds which help replant and feed future generations of blue monkeys and other biodiversity in the jungle (Lee *et al*., 2021).

Female blue monkeys dominate the social structure as they stay in their family groups, while young males leave once they reach adulthood. Extremely territorial, blue monkey females are aggressive towards other groups (Cords and Marina, 2002).These 'girl gangs' are also combative to other species, except for red-tailed and red colobus monkeys. Interspecies grooming, the most intimate behavior, has been observed between these monkeys. During the onset of the warm, rainy season is when breeding begins for blue monkeys. Females will attract males with body language that they are ready to copulate. Males will mate with multiple females, but females only mate with one male for life. Every two years, a female will give birth with a gestation period of about five months (Strawder, 2016).

2.4. Habitat Association of Blue monkeys

Cercopithecus 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 in Angola, Burundi, The Democratic Republic of Congo, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Somalia, South Africa, Sudan, Swaziland, United Republic of Tanzania, Uganda, Zambia and Zimbabwe.

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 fore legs, and a long tail which improves its balance (Rowell, 1984). 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 (Twinomugisha *et al*., 2006).

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 (Rowell, 1984).

2.5. Feeding Ecology of Blue monkey

Blue monkeys eat fruits, figs, insects, leaves, twigs, and flowers (Blue Monkey in Africa, 2020). They are primarily frugivores, with 50% of their diet consisting of fruit, with leaves or insects as their main source of protein, with the rest of the diet being made up of seeds, flowers, and fungi. They rarely eat vertebrates. They eat a variety of plants, but concentrate on a few species, which means their population density is generally dependent on plant species' richness and diversity (Monkey Worlds, 2020). *C. mitis* is mainly a frugivore but can also eat larger amounts of leaves, flowers and insects depending on the food supply (Fairgrieve&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 leavesand 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 stuhlmanni in the Kakamega forests in Kenya, where the highest intake of fruit was in the middle of the rainy and dry seasons. Blue monkey must optimize their time, and can flexibly adjust their activity budgets to deal with changeable environmental conditions (Mekonnen *et al*., 2018). Fruits are the most frequently used plant components of blue monkey's diet though high amounts of leaves and invertebrates are consumed periodically (Cords, 2002).

Thus, as an omnivore, it mostly feeds on fruits, leaves, invertebrates, flowers, seeds, bark and shoots (Estes, 1991). Understanding an altered diet in fragmented habitats is important for conservation efforts because the shifts can impact many aspects of its ecology and behavior, and ultimately affect survival of the species.

Generally, the quality of food resources directly impacts health and body condition, which can affect birth and mortality rates as well as susceptibility to predation and disease (Chapman *et al*., 2005). To conserve the endemic Boutourlini's blue monkey in its current habitat, information on its population size, activity pattern, diet, and ranging ecology is very important. Currently, this subspecies is widely distributed in protected areas and remnant forest patches of the western and northwestern parts of Ethiopia including in Apini and Dokuma forests. However, it is not yet studied. This study, therefore, aimed to estimate population size of the Boutourlini's blue monkey.

2.6. Distribution of Blue monkey in Ethiopia

Primates are more abundant in tropical and subtropical regions of America, Asia, and Africa. Among these continents, Africa has the highest primate species abundance. Africa contains a myriad of habitats from multi-strata tropical rain forest to dry deciduous forest, woodland, savanna and desert. Along with the variety of habitats found within the continent, Africa contains a great diversity of primate community (IUCN, 1996). Ethiopia is one of the world's rich biodiversity countries (Yalden, 1992). It has diverse ecosystems ranging from humid forest and extensive wetlands to deserts. Ethiopia has a large land area, with varied topography from 110 meter below sea level at the Afar triangle to 4620 meters above sea level at Ras-Dashen Mountain. The variations in climate, topography and vegetation have contributed to the presence of large number of endemic species. Ethiopia possesses a diverse mammalian fauna of over 320 species grouped in 52 families (Cole *et al*.,1994) of which 31 species are endemic (Jacobs and Schloeder, 2001).

Blue monkey is a species of old World monkey and native to Central and Eastern Africa, ranging from the upper Congo River basin east to the East African Rift and south to northern Angola and Zambia. The blue monkey includes the skyes, silver and golden coat monkeys as subspecies. *Cercopithecus mitis boutourlinii* is a sub-species of *Cercopithecus mitis,* endemic to Ethiopia (Tesfaye n*et al*., 2013).They occur from Lake Tana southwards along the western side of the Ethiopian Rift Valley, but its distribution does not reach Lake Turkana.

Boutourlini's blue monkeys are social animals, and their social system is affected by habitat disturbances, increased group size and predation, illegal human activities, forest loss and fragmentation, and changes in vegetation structure and composition (Cowlishaw and Dunbar, 2000). Most of the wildlife population of Ethiopia has decreased at alarming rate over the past century in amount and distribution due to human induced factors.

2.7. Social Organization and Behavior of Blue monkey

An understanding of how animals divide their activities throughout the day and by season is important for understanding their life styles and indicates broadly how they interact with their environment and invest their energy and time for survival and reproduction (Defler, 1995). The time animals allocate to their various activities has an important influence on their survival and reflects demands made on them by local environmental conditions. The blue monkeys live in female-philopatric social systems where females stay in their natal groups while males disperse once they reach adulthood. As a result, blue monkey groups usually consist of one male with several females and infants, giving rise to matrilineal societies. Occasionally, solitary males are observed which are probably transient, having left their natal group in search of a new group (Li and Rogers, 2004).

In these female-bonded societies, only 5–15% of monkeys' activity budget is occupied by social interactions and the most common social interactions within a group are grooming and playing. Relationships between groups members vary: infants interact most frequently with their peers and adult or juvenile females and are rarely seen near adult males (Rudran 1978). Alloparenting is common among blue monkeys. The most common infant handlers are juvenile females and usually one infant is carried by a number of alloparents. One hypothesis is that this allows the infant to learn to socialize at an early stage in life (Li and Rogers, 2004).

Interesting female-female relationships exist among blue monkeys. This relationship is believed to be shaped by their feeding ecology, which, in turn, is shaped by between-group and within group competition. Blue monkey females' exhibit strong, aggressive competition between groups and between other species because of their territorial character but milder though more frequent competition within group.

Even though earlier beliefs were that blue monkeys are not territorial, more current extended research shows that earlier researched misinterpreted the results because social interactions overall are infrequent. Moreover, overall agonism rates in blue monkeys are very low. Within group conflicts are mild and infrequent because females tend to distance themselves from one another and feed at different sites, thus avoiding competition (Singh and Vinathe, 1990).

2.8. Conservation status of Blue monkey

Most primate species including blue monkey (*Cercopithecus mitis*) face ongoing habitat disturbance, yet not all species respond to such disturbance the same way (Chapman & Peres, 2001). While many primate species experience declines in population density when their habitats are disturbed, there are several primate species that do not, and these flexible species will generally require less conservation attention (Cowlishaw and Dunbar, 200). Habitat loss is perhaps the serious threat facing blue monkey inhabiting tropical forests (IUCN, 2012). As a result, they are adversely affected by the fragmentation of their habitat (Mekonnen *et al*., 2020). Boutourlini's blue monkey (*Cercopithecus mitis boutourlinii*) is a subspecies of blue monkeys (Grubb *et al*., 2003).

According to IUCN (2005), 17 subspecies of blue monkeys are recorded in different parts of Africa, and Boutourlini's blue monkey is one of the endemic subspecies to Ethiopia. It is occurring from Lake Tana southwards along the western side of the Ethiopian Rift Valley (IUCN, 2018). Boutourlini's blue monkey is categorized as vulnerable in the IUCN Red List of threatened species (Jong and Butynski, 2020).

Forest over-use and clearing for many uses leads to a decline in Blue monkey numbers. Clearing of forest for firewood by locals contributes to population declines but commercial logging poses a larger threat. Deforestation is currently the biggest threat to biodiversity in the tropics (Newbold *et al*., 2015).Among mammals; primates are particularly vulnerable to forest loss and degradation because most species depend on forests for survival (Estrada *et al*., 2018). Populations of many primate species now exist in small, isolated forest fragments surrounded by agriculture and other human dominated landscapes (Marsh, 2003).

Owing to its topographic and altitudinal variation, Ethiopia is home to at least six endemic primate species or subspecies (Fashing *et al*., 2019). Similar to endemic primates elsewhere, many Ethiopian endemics are threatened with extinction due to deforestation and other forms of habitat loss, especially in its biodiversity rich highlands (Zinner*et al*., 2018).

One of the endemic primates affected by this deforestation is Boutourlini's blue monkey (*Cercopithecus mitis boutourlinii*) which occurs in the highland forests west of the Rift Valley in Ethiopia (Butynski and Gippoliti, 2008).

Although the taxonomy of blue monkeys (*Cercopithecus mitis)* is the subject of debate, Boutourlini's blue monkey (*C. mitis boutourlinii*) is typically classified as a subspecies of C. mitis (Lawes *et al*., 2013). Some subspecies of blue monkeys are relatively well-studied and widely distributed throughout central and eastern Africa where they inhabit a variety of habitat types including moist, semi deciduous, evergreen forests and tropical montane forests (Cords, 2012). However, because of its geographic isolation and, until recently, a general dearth of research on Ethiopian forest primates, Boutourlini's blue monkey remains one of the least known *C. mitis* subspecies with only one detailed study of its ecology having been completed at a single site, Jibat Forest (Tesfaye *et al*., 2013).

3. Materials and methods

3.1. Description of the Study area

This study was conducted in Halu Wereda which is found in Ilubabor Zone, Oromia National Regional State in South Western part of Ethiopia. It is located at about 645 km from Addis Ababa in South West direction on the way to Gambella regional state main road (Fig.1).It is located at west of Alle Wereda, north West of Nono Salle Wereda, North of DiduWereda, East of Bure Wereda.

The total population of this woreda is 16,881, of whom 8,481 were men and 8,400 were women; 1,685 or 9.98% of its population were urban dwellers.(Population and Housing Census of Ethiopia, 2007).The majority of Halu Woreda forest priority area (Hamuma forest) is located in Alle woreda of a zone and positioned in the geographical coordinates of $07^{o}10'$-$08^{o}15'$N/ $34^{o}55'$-$35^{o}35$E'.The estimate size of Hamuma Natural and coffee forest is 20 ha and 30 ha respectively.

The altitude of the area is between 1,500– 1,900m asl., and receives a maximum rainfall of 2400mm. The area experiences the rainfall for nine months (OFWE- IAB, 2016). The driest month for the area ranges between December-February. The mean annual temperature of the area is 18.3^{o}c (23.5^{o}C max and 13.1^{o}C).

Floristically, the area shares both transitional and afro-montane forests and is the richest forest type in Ethiopia, with over 100 tree species and a diverse understory (Friis, 1992). Among these tree species, *Aningeriadolfi-friederici* is the largest and most important timber species and *Podocurpusfalcatus* is also a common timber tree species in the higher altitude of the forest.According to Friis (1992), the most important canopy tree of the area are *Ocote akenyensis, Sapium ellipticum, Macaranga capensis, Olea capensis, several Albizia species, Polyscia fulva, Schefflera abyssinica* and several Ficus species. There are also several understory trees like ferns (*Cyateam anniana*), found in moist and near water fall forests, *Dracaena steudneri, and Coffee Arabica* and *Phoenix reclinata*.

Interms of mammal species, Squirrels Vervet Monkey, Blue Monkey, DeBrazas Monkey, Colobus Monkey, Anubis Baboon, Jackals, Hyena, Leopard, Warthog, Giant Forest Hog, Bush-Pig and Common Bushbuck are common in the study area. Lion is also present rarely. Most of the area is occupied by farmers who cultivate maize and root crops, keep bees, and collect and/or cultivate forest species, particularly coffee and the endemic spice Aframomumcorrorima. The greatest threat to these forests is the development of estates growing cash-crops (Gumaro tea state) on the side of Alle Woreda. The forest has been cleared and replaced by tea plantations, and settlement with agriculture expansion mainly Maize farm is becoming high (OFWE-IAB, 2016). The district was once covered by extensive forest but on 2007 year few fragments of forests remain (Ayele and Zemalek, 2011). A survey of land in this district showed that 73.7% is cultivable, 17.3% pasture and 2.7% forest and 6.3% unusable.

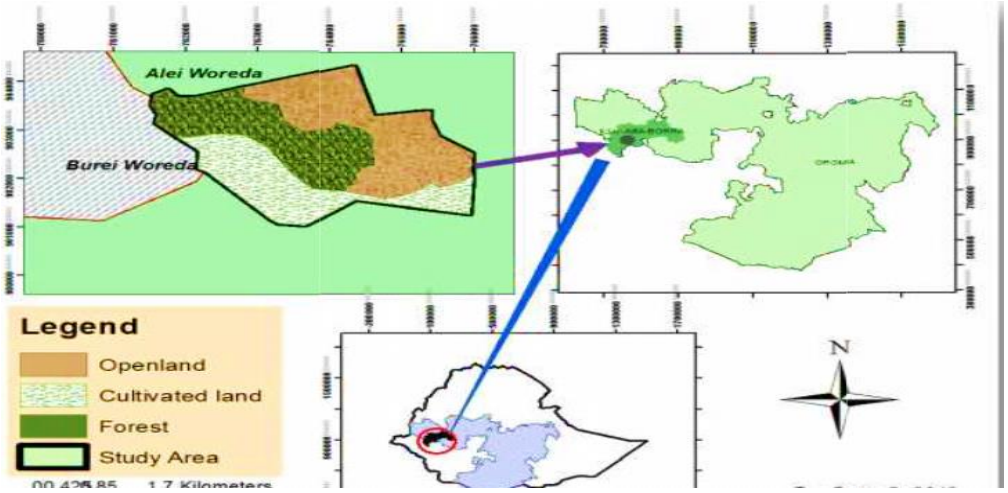


Figure 1: Map of Hamuma Forest Halu woreda (Source: Sena Gashe, 2018)

Plate1: view of Hamuma Forest (photo: Wase Dereje, Feb.2023).

3.2. Materials

Materials used to undertake the study was GPS, Digital Photographic Camera, Topographic Map, Plant press and Standardized check list.

3.3 Methods

3.3.1 Preliminary surveys

A preliminary survey was conducted for 5 days in November 2022 to identify the study sites and to familiarize with the Topography, vegetation types, climatic condition and habitat types of the study area.

Plate 2 : View during preliminary survey (photo: Wase Dereje, Nov.2022).

3.4. Research design

Among thirteen kebeles of Halu woreda,Hamuma kebele Natural and Coffee forest was selected purposively as study site based on getting abundant information and accessibility. The habitat type of the study site was identified and divided in to three categories: thick forest, coffee plantation and bush land.

Three study habitats were established by using roads and rivers to get representative sample. This study was conducted during November 2022 - May 2023 during dry seasons.

3.4.1. Data Collection

3.4.1.1Total direct count method

A total direct count method was used to record population size, distribution and habitat use of Boutoulini's Blue monkey in the study habitats. To record the data Four field assistant were trained to gather data. The data record was conducted twice in a day, between 7:00-11:00 a.m. during the morning and from 14:00-18:00 p.m. in the afternoon. When animal was observed, the number of individuals, sex and age distribution and habitat use were recorded through direct observation by naked eye while moving on foot in the study habitats.

3.4.1.2 Scan sampling

Scan sampling method was used to record the feeding ecology of Boutourlinis blue monkey through direct field observation by naked eye while moving on foot in the study habitats.

3.5. Population size

A total direct count method was carried out during dry season using direct observation by naked eye while moving on foot at each habitat. The study area was divided into three counting habitats. The criteria for the classification of the study areas into habitat in both forests were roads and rivers boundaries. To count the population of Boutoulini's Blue monkey, people were trained and assigned in each habitat. For each counting habitat, one trained individuals was assigned to each counting habitat in order to make more reliable and counting was carried out at the same time (simultaneously) to avoid double counting. The time for counting was suitable from 7:00 to 11:00 a.m. in the morning and 14:00 to 18:00 p.m. in the afternoon when the Boutourlinis blue monkey were most active during both wet and dry seasons.

The age and sex categorization was done based on information from different literature regarding to physical appearance and body size of Boutoulini's Blue monkey. Standardized check lists (that is used for recording the number of individuals) was used to collect data.

3.6. Distribution and Habitat use

The data on the distribution and habitat use of Boutoulini's Blue monkey was taken through assessing the presence or absence of Boutoulini's Blue monkey using direct observation by

naked eye while moving on foot in each habitat of the study site (Hamuma natural and coffee forest) in dry season. The analysis of habitat use and distribution was determined from the expected number of Boutourlini's blue monkey sightings in each habitat type based on the proportion of each habitat that was actually used. Then, the distribution and habitat use of Boutoulini's Blue monkey in the study site (Hamuma natural and coffee forest) in dry season was compared.

3.7. Feeding Ecology

Data on feeding ecology of Boutourlini's Blue monkey was collected using scan sampling method through careful direct field observation by nacked eye while moving in each study habitats. During scans, when Boutourlini's Blue monkey was observed feeding, the type of diet item and plant parts consumed was recorded (Addisu Mekonnen et al., 2018). During the feeding activity of Boutourlinis blue monkey, the type of diet items were categorized as: young leaves, fruits matured leaves, Seed, and barks consumed was recorded (Fashing, 2001b; Fairgrieve and Muhumuza, 2003; Di Fiore, 2004). The percentage of foraging time devoted to a specific plant item was calculated as the total time spent eating that item divided by the total amount of continuous observation time that monkeys were seen to feed (Chapman and Fedigan, 1990).The type of plant species consumed was labeled using local names and plant species identification was carried out by the professional from Department of Biology, Jimma university herbarium.

Plate 3: View of plant identification at JU herbarium (Photo:Wase Dereje, March 2023)

3.8. Data Analysis

The data obtained from field observation by naked eye while moving on foot in each study habitats in the study site(Hamuma natural and coffee forest) during dry season regarding to Population size, distribution, habitat use and dietary items of Boutourlinis Blue Monkey was analyzed by using descriptive statistics and Microsoft excel.

4. Results

4.1. Population size

From one group sighted, the total numbers of individuals of Boutourlininis blue monkey counted in the study habitats of Hamuma Natural and Coffee forest during the dry season were 27 and 17 respectively. From 27 individuals counted in HNF 16 were from thick forest habitat and 1 individuals were counted from bush land (Fig.2) From 17 individuals counted in HCF, 10 were from Coffee plantation and 7 were from bush land (Fig.3) The total population count of Boutourlinis blue monkeys in the Hamuma natural and Coffee forest showed that there were relatively more Individuals in Hamuma natural forest than in Hamuma coffee forest

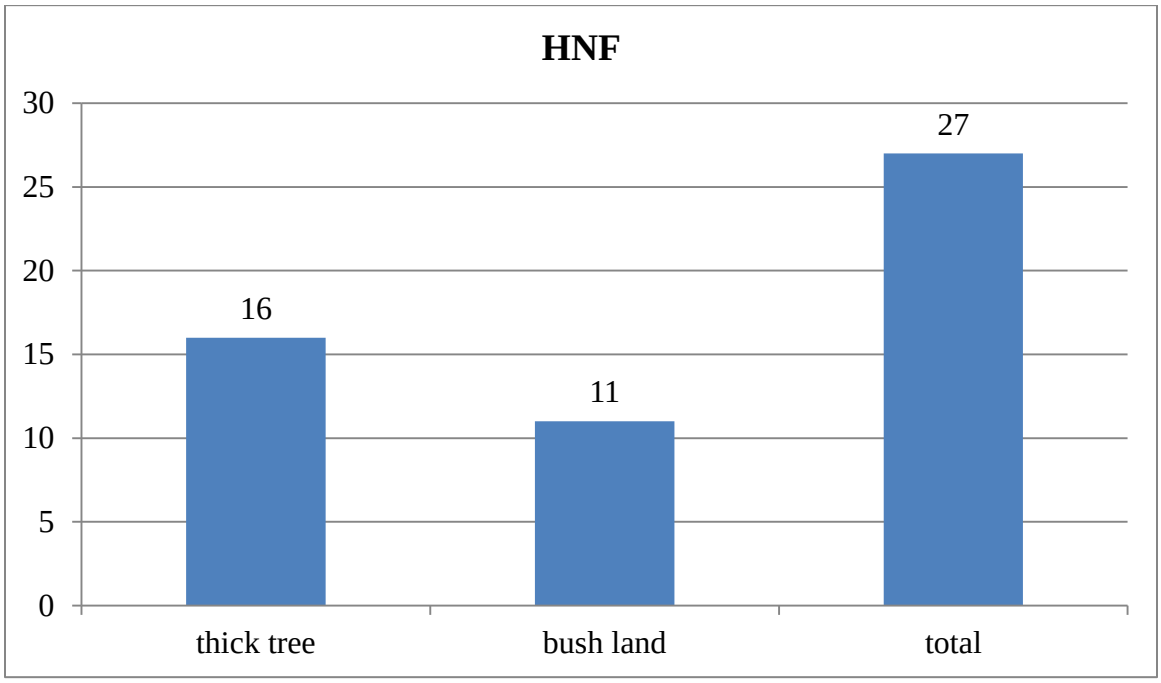


Figure 2: The individual number of Boutourlinis blue monkey counted in each habitats of HNF

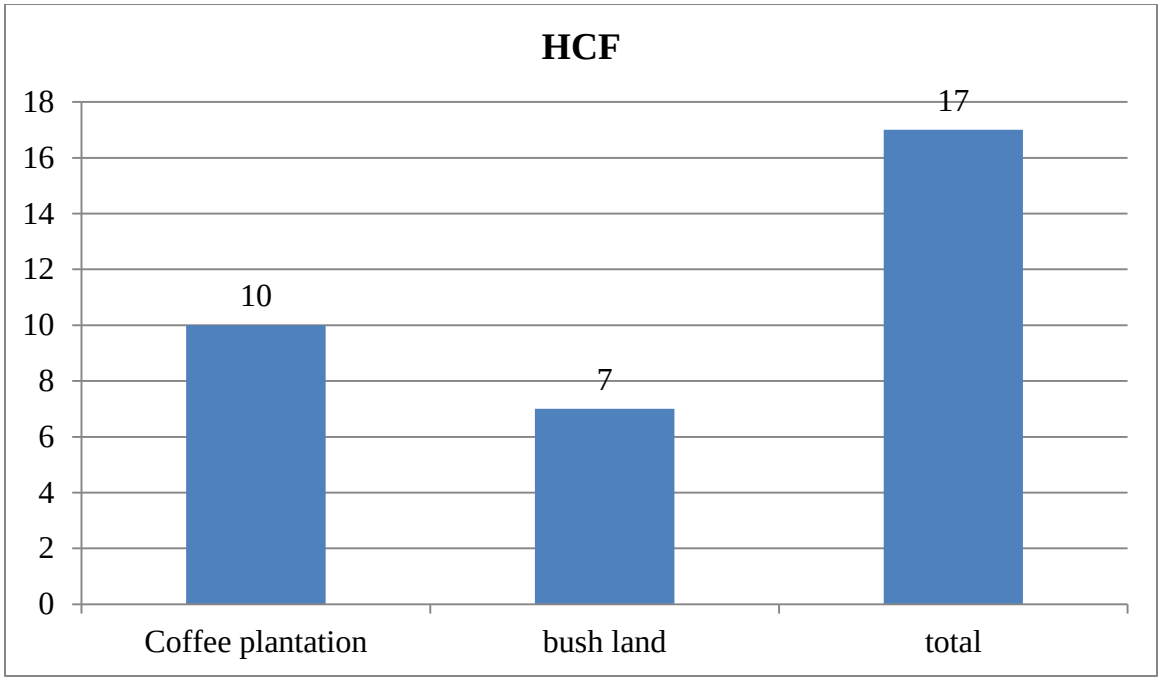


Figure 3: The individual number of Boutourlinis blue monkey counted in each habitats of HCF

4.2. Age & sex distribution of Boutourlinis blue monkeys

Out of the total (27) individuals of Boutourlinis blue monkey recorded in Hamuma natural forest during the dry season, 11(40.74%) were adult female; 7 (25.9%) Sub adult females; 4(14.8%) adult male, 3(11%) were juveniles and 2(7.4%) sub adult male. Out of the total (17) individuals of Boutourlinis blue monkeys recorded in Coffee forest during dry season, 7(41.17%) were Adult female; 4 (23.5%) Sub adult female; 2 (11.76%) Juveniles; 2(11.76%) sub adult male and also 2(11.76%) were adult male.

The population structure during the dry season in Hamuma natural forest, adult female (40.74%) accounted the highest percentage followed by sub adult females (25.9%), while the remaining 14.8%, 11% and 7.4% were adult males, juveniles and sub-adult male respectively(Fig.4) On the other hand, in Hamuma Coffee forest during the dry season, adult female (41.17%) accounted the highest percentage followed by sub adult females (23.5%), while the rest 35.28% of the population were accounted for adult male, sub adult male and juveniles(Fig.5)

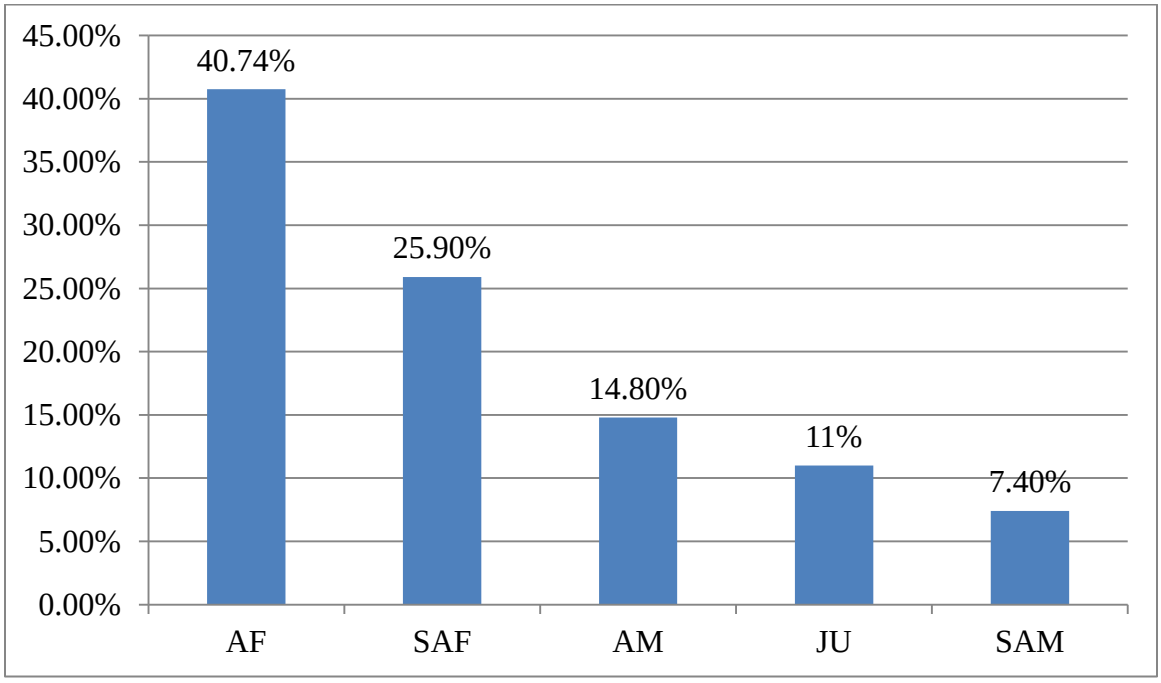


Figure 4: Total number of Boutourlinis blue monkey at different age and sex groups in Hamuma natural forest during dry season

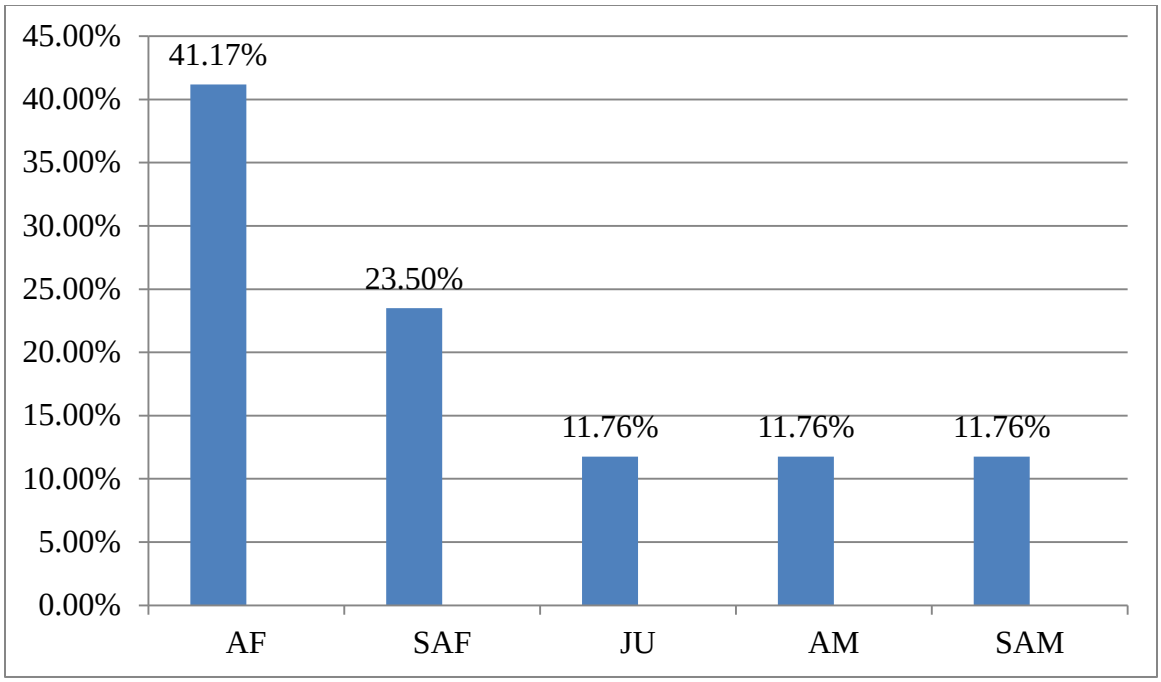
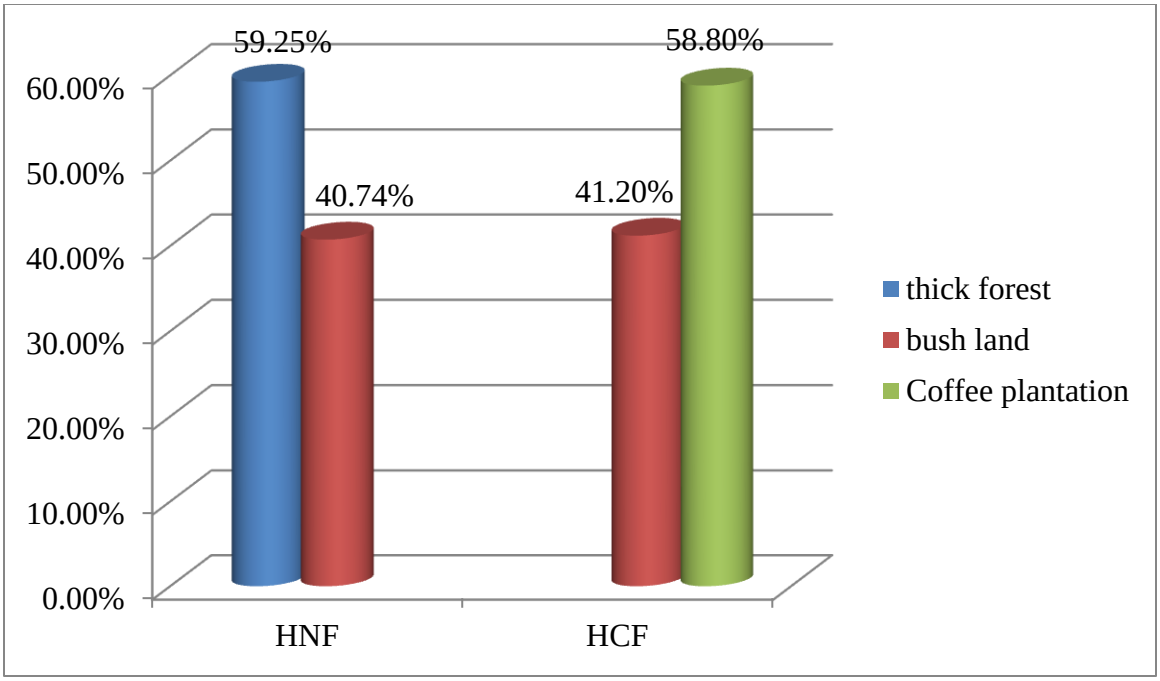


Figure 5: Total number of Boutourlinis blue monkey at different age and sex groups in Hamuma Coffee forest during dry season

4.3 Distributions and habitat use

Boutourlinis blue monkey were observed in different habitat type of the study area. From a total of 27 individuals counted in HNF habitats, 16(59.25%) were from thick forest and 11 (40.74%) were from bush land. From a total of 17 individuals recorded from HCF habitats, 10 (58.8%) were from Coffee plantation and 7(41.2%) were from bush land. The distribution of Boutourlinis blue monkey showed a slight variation among habitats during dry season. Populations of Boutourlinis blue monkey were not uniformly distributed over the study habitats (Fig.6)



HNF: Hamuma natural forest, HCF: Hamuma coffee forest

Figure 6: Percentage of distribution and habitat use of Boutourlini's blue monkeys in different habitat types of the study area.

4.4. Feeding Ecology of Boutourlinis Blue monkey

A total of **933** feeding observations were recorded from scan sampling of Boutourlinis blue monkey in Hamuma natural forest during dry season. According to the feeding activity recoded result, Boutourlinis blue monkey were observed feeding on **12** plant species belonging to **10** families. The percentage contribution and food items consumed are given in (Table1 below). Based on the overall percentage contribution of plant species consumed by Boutourlinis blue monkey during dry season in Hamuma natural forest, *Ficus sur* was the most consumed plant species which accounted for 19.5%, *Syzygium guineense, Albizia gummifera, Landolphia buchanani & Cordia africana* ranked second, third, fourth and fifth of the overall diet of Boutourlinis blue monkey (18.5%, 15%, 13% and 11.8%), respectively (Fig. 7) Family Moraceae Myrtaceae and Fabaceae were contributing 53% of the diet, family euphorbiceae and Apocynaceae were contributing 18.76% of the diet and the other families shared 28.2

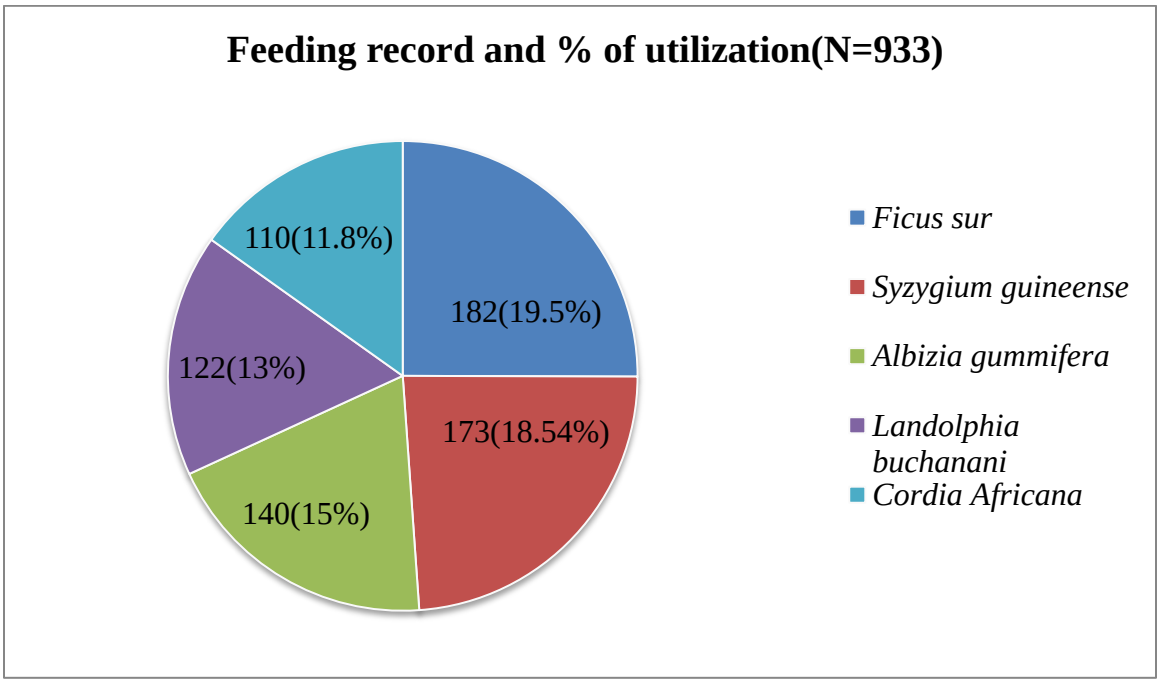


Figure 7: The top five plants consumed by Boutourlinis blue monkey in Hamuma natural forest during dry season

Table 1: Percentage plant species contribution and items consumed by Boutourlinis blue monkey in Hamuma natural forest.

S.N	Local Name	Scientific Name	Family Name	Parts Consumed	Life form	Feeding record	% of utilization
						Dry	Dry
1	Harbuu	*Ficus sur*	*Moraceae*	BA, FR, YL	Tree	182	19.5
2	Baddeessaa	*Syzygium guineense*	*Myrtaceae*	YL,ML, FR	Tree	173	18.54
3	Hambabeessa	*Albizia gummifera*	*Fabaceae*	YL,ML	Tree	140	15
4	Geebboo	*Landolphia buchanani*	*Apocynaceae*	YL, FR	Liana	122	13
5	Waddeessa	*Cordia africana*	*Boraginaceae*	FR, YL,ML	Tree	110	11.8
6	Somboo	*Ekebergia capensis*	*Meliaceae*	FR,SE, YL	Tree	72	7.7
7	Abbayyii	*Maesa lanceolata*	*Myrsinaceae*	YL,ML, SE	Tree	56	6
8	Bosoqa	*Sapium ellipticum*	*Euphorbiaceae*	YL	Tree	37	3.96
9	Meexxii	*Phoenix reclinata*	*Arecaceae*	FR	Tree	20	2.14
10	Bakkanniisa	*Croton macrostachyus*	*Euphorbiaceae*	ML,YL, FR,SE	Tree	13	1.4
11	Lolichiisaa	*Bersama abyssinica*	*Meliantha ceae*	BA, YL	Tree	5	0.54
12	Agamsa	*Carissa spinarum*	*Apocynaceae*	FR,YL, SE	Shrub	3	0.32
Total						**933**	**100**

YL: Young leaves, ML: Mature leaves, FR: Fruit, SE: Seed, BA: Bark

Based on the overall percentage contribution of plant parts to the diet of Boutourlinis blue monkey in Hamuma natural forest from each species, young leaves were the largest contributor to the overall diet followed by Fruit, accounting for 31.2% and 25.9% of all feeding records, respectively during dry season (N=933). Other common items were included mature leave (21.4%); Seed (15.75%) and Bark (5.7%) (Fig. 8).

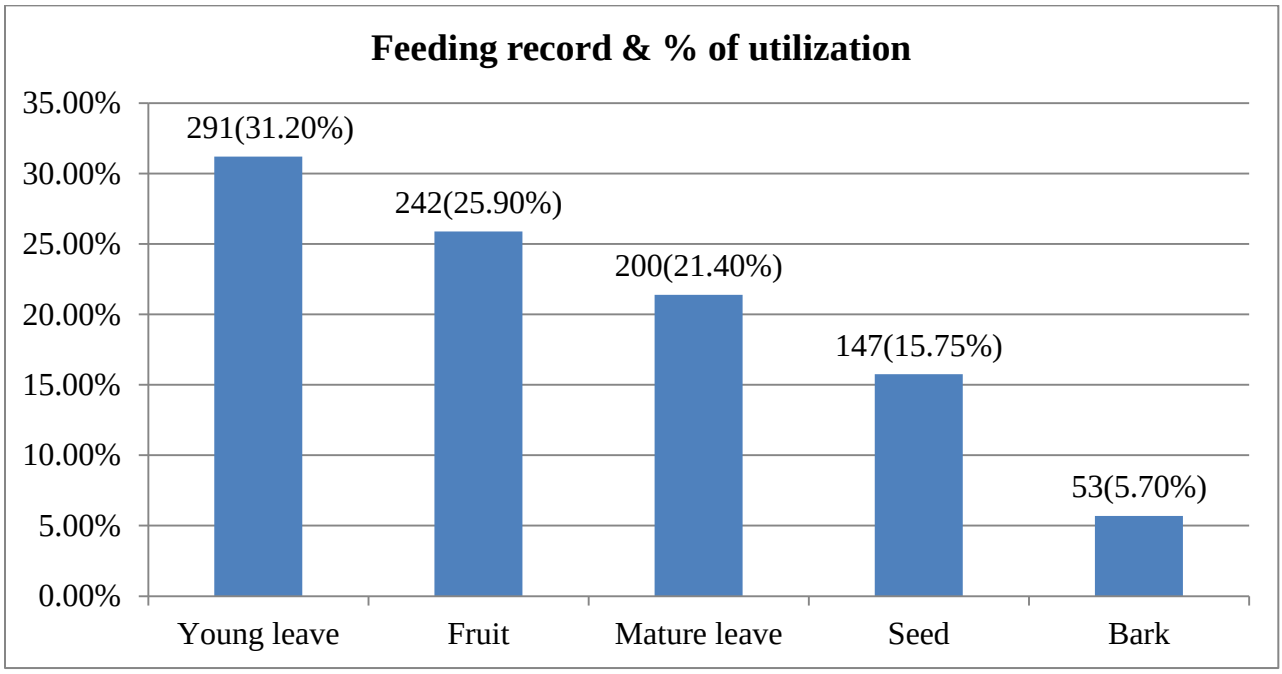


Figure 8: Plant parts preferred by Boutourlinis blue monkey in Hamuma natural forest during dry season and their percentage frequency of consumption

A total of **885** feeding observations were recorded from scan sampling of Boutourlinis blue monkey in Hamuma coffee forest during dry season. According to the feeding activity recoded result, Boutourlinis blue monkey were observed feeding on **12** plant species belonging to **10** families. The percentage contribution and food items consumed are given in (Table 2 below).

Based on the overall percentage contribution of plant species consumed by Boutourlinis blue monkey during dry season in Hamuma Coffee forest, *Syzygium guineense* was the most consumed plant species which accounted for 18%, *Psidium guajava, Ficus sur,Albizia gummifera and Cordia africana* ranked second, third, fourth and fifth of the overall diet of Boutourlinis blue monkey (17.4%, 14.57%, 12.9% and 12%), respectively(Fig. 9)

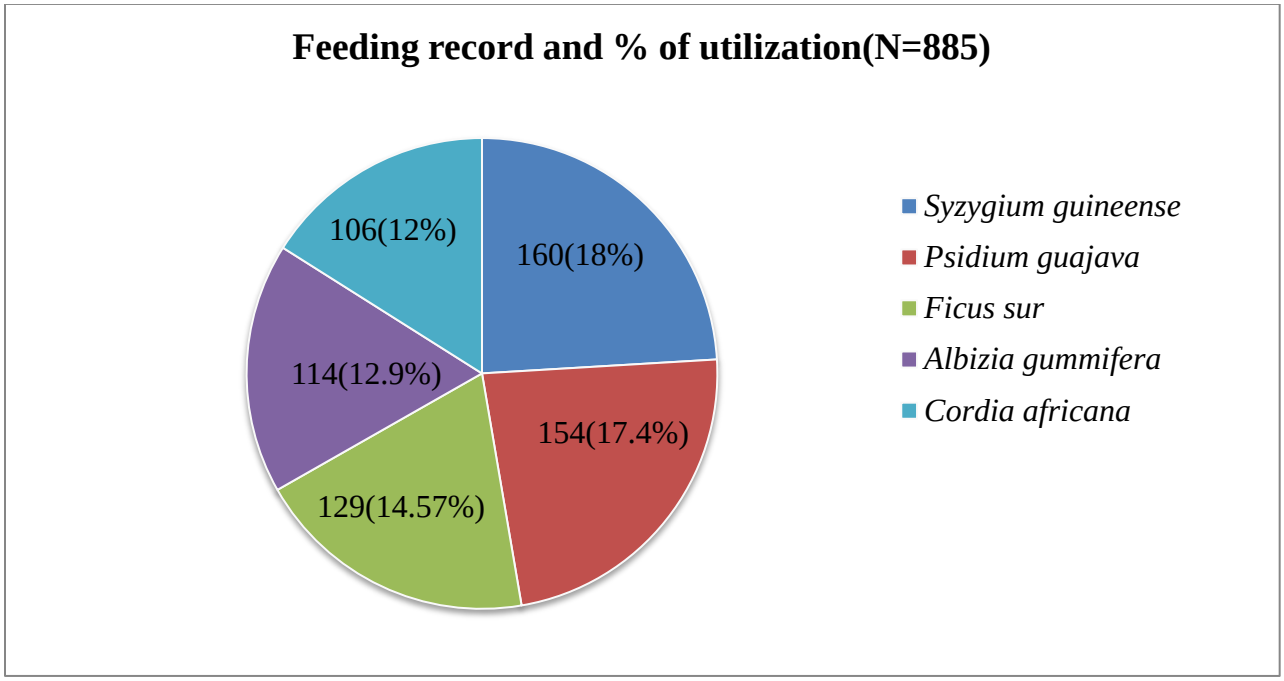


Figure 9: The top five plants consumed by Boutourlinis blue monkey in Hamuma coffee forest during dry season

Table 2: Percentage plant species contribution and items consumed by Boutourlinis blue monkey in Hamuma coffee forest.

S.N	Local Name	Scientific Name	Family Name	Parts Consumed	Life form	Feeding record	% of utilization
						Dry	Dry
1	Baddeessaa	*Syzygium guineense*	*Myrtaceae*	YL,ML, FR	Tree	160	18
2	Zeetuunaa	*Psidium guajava*	*Myrtaceae*	FR,SE, YL	Shrub	154	17.4
3	Harbuu	*Ficus sur*	*Moraceae*	BA,FR, SE	Tree	129	14.57
4	Hambabeessa	*Albizia gummifera*	*Fabaceae*	YL,BA, FR	Tree	114	12.9
5	Waddeessa	*Cordial africana*	*Boraginaceae*	YL, FR,SE	Tree	106	12
6	Coffee	*Coffee arabica*	*Rubiaceae*	FR, SE,	Shrubs	80	9
7	Bayaa	*Olea welwitschii*	*Oleaceae*	BA,YL, ML	Tree	57	6.4
8	Bakkanniisa	*Croton macrostachyus*	*Euphorbiaceae*	YL, ML,FR	Tree	39	4.4
9	Geebboo	*Landolphia buchananni*	*Apocynaceae*	YL,ML	Liana	23	2.6
10	Qilxuu	*Ficus vasta*	*Moraceae*	FR	Tree	12	1.35
11	Goraa	*Lepidotrichilia volkensii*	*Meliaceae*	FR,YL	Shrub	6	0.68
12	Dheertuu	*Phragamanthera macrosolen*	*Loranthecaeae*	YL	Epiphytes	5	0.56
Total						**885**	**100**

YL: Young Leaves, ML: Mature Leaves, FR: Fruit, SE: Seed, BA: Bark

Based on the overall percentage contribution of plant parts to the diet of Boutourlinis blue monkey in Hamuma coffee forest from each species, young leaves were the largest contributor to the overall diet followed by Fruit, accounting for 29.6% and 26.6% of all feeding records, respectively in both seasons (N=885).Other common items were included mature leave (22.6%); seed (15.2%) and Bark (6%) (Fig. 10).

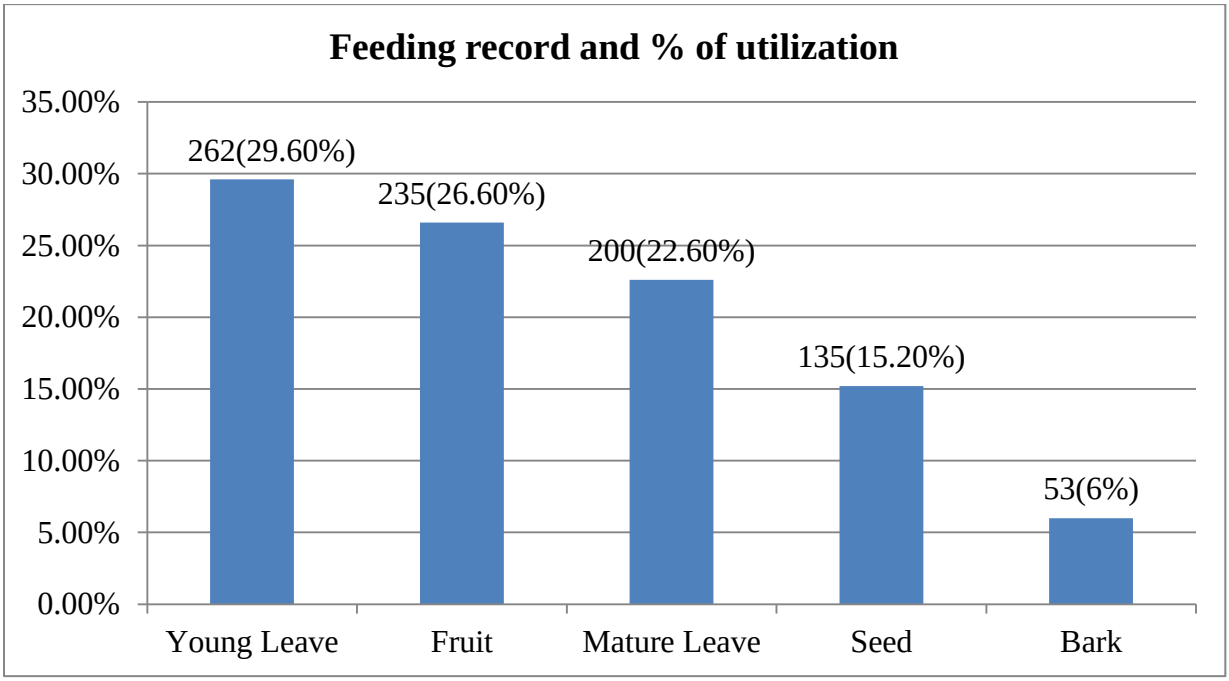


Figure10: Plant parts preferred by Boutourlinis blue monkey in Hamuma coffee forest during dry season and their percentage frequency of consumption.

5. Discussion

Population size of Boutourlinis blue monkeys in the Hamuma natural forest was more than coffee forest. This might be due to relatively less disturbance of Hamuma natural forest by humans than that of coffee forest. Majority of Boutourlinis blue monkey were counted from each habitat in Hamuma natural forest (27) than that of counted in Coffee forest habitats (17). Nearer to this study, Leighton M (1993) stated that *Blue monkeys* exhibited a tendency to spend more time in forest habitats, which may be linked to both fruit resource availability and structural characteristics such as larger fruit patches. This could be due to the relatively more availability of food in Hamuma natural forest than coffee forest. Similarly, Chapman and Chapman (2000) described that the densities of primates are directly related to the availability and distribution of food tress. With this intension, the distribution of *Boutourlinis blue monkey* across habitats is based on the availability of food and the distance from human settlement.

The age and sex categories were dominated by adult females in both Hamuma natural and coffee forest during dry seasons. The number of *Boutourlini's Blue monkey* in the study area varied among habitats. The species is not evenly distributed across habitats. Forest and fragment forests are the major shelter for *Boutourlini's Blue monkey* and strategically, they are distributed at the fragment forest (Tesfaye *et al*., 2013).The highest number of individuals of *Boutourlini's Blue monkey* was observed in Natural forest, thick forest habitat (16) followed by the same area of Bushland habitat (11)

Regarding the distribution and habitat use of *Boutourlinis Blue monkey* at Hamuma Natural forests, out of the total 27 individuals, 59.25% and the rest 40.74% were recorded from thick forest and bush land habitat respectively. For Hamuma Coffee forest, out of the total 17 individuals, 58.8% was from Coffee plantation and the remaining 41.2% was recorded from bush land habitat. This condition indicated that the truth background of fruit existence in tree forests than other habitat type and *Boutourlinis Blue monkey* highly hunt the fruit than other plant parts. In the related concern according to (Kaplin, 2001) *Boutourlinis Blue monkeys* showed high movement pattern to encounter fruit when there is fruit scarcity.

The progressive changes in resource abundance and availability have fundamental effects on the behavior and ecology of primates (Dunbar, 2013). The abundance and productivity of important food resources may be better indicators of habitat quality; a more food species rich and dense habitat may ultimately provide more foraging options than a habitat where only species diversity is high (Poulsen *et al*., 2001). In the present study, food abundance was greater in the natural forest than coffee forest habitats. This might possibly be due to different spatial and temporal distribution of food resources in HNF and CF habitats.

Regarding the feeding ecology, a total of 933 and 885 feeding observations were recorded during dry season in HNF and CF respectively. According to the feeding activity recoded result, *Boutourlinis blue monkey* were observed feeding on 12 plant species belonging to 10 families both in Hamuma natural and Coffee forest. This might be because in HNF there is sufficient food availability that makes the *Boutourlini's blue monkey* concentrated at specific habitats.

The top five plant species consumed by Boutourlinis blue monkeys from a total of 12 plant species consumed during dry season In Hamuma natural forest were *Ficus sur* (19.5%), *Syzygium guineense* (18.5%),*Albizia gummifera* (15%),*Lindolphia buchanani*(13%)*and Cordia Africana (*11.8%) respectively were as, the top five plant species consumed by Boutourlinis blue monkeys from a total of 12 plant species consumed during dry season In Hamuma coffee forest were *Syzygium guineense (*18%) *Psidium guajava*(17.4%) *Ficus sur(*14.57%), *Albizia gummifera(*12.9%) and *Cordia Africana (*12 %), respectively.

Blue monkeys classified as folivores and frugivores. They consumed different food items and mostly, they feed 31.2% of time on young leaves and 25.9% on fruits during dry season in the Hamuma natural forest and 29.6% of time on young leaves and 26.6% on fruits in the Hamuma coffee forest during dry season. This showed that they considered as folivores and frugivoures. Similarly, Dereje Tesfaye et al., (2013) showed that blue monkeys spent more time feeding on young leaves and fruits. In the present study the Hamuma natural forest group and coffee forest groups spent most of the time constantly feeding on young leaves on different trees and fruits during the study period. This might be due to high abundance of leaves and fruiting plants in both sites. Similarly, groups of Boutourlinis blue monkeys spent most of their time feeding on leaves of different lianas and trees as recorded by Dereje Tesfaye (2010).

In addition, blue monkeys spent most of their time feeding on young leaves and fruits of different plants in Komto protected forest, Ethiopia (Mosissa Geleta and Afework Bekele, 2016).

As the whole point of view of the study, the highest number of *Boutourlinis blue monkey* was observed in Hamuma Natural forest 27 (61.36%) while the least were recorded in Coffee forest habitat 17(38.63%). This difference probably results both from the more diverse nature of the forest in less-disturbed sites and the selection of primary food sources at Hamuma Coffee Forest that are largely ignored at other sites. Similarly, many of the staple foods consumed by Boutourlini's blue monkeys at Hamuma Coffee Forest are eaten in much lower quantities at Komto Protected Forest and Jibat Forest, Ethiopia (Chane, 2020).

6. Conclusion and recommendation

6.1 Conclusion

Study on population size, distribution, habitat use and feeding ecology of Boutourlinis blue monkeys could give important information about this species population size, distribution, habitat use and feeding ecology in Hamuma natural and coffee forests.

During the entire study period Boutourlinis blue monkeys consumed different food items from Hamuma natural and coffee forest. Thus, young leaves, fruits, mature leaves, seed and bark were consumed from variety of plant species during the study periods. Boutourlinis Blue monkeys consumed different plant species in the study sites. However, this subspecies is threatened due to habitat destruction since there is high deforestation of the habitats and agricultural expansion by local people. In addition, local people in the nearby forest extracted woods from the forest for different purposes such as fuel wood, house construction, furniture and for other purposes. Hence, the forest habitat is constantly changing in size and quality which may not support different wildlife species including Boutourlinis blue monkey

6.2 Recommendation

Based on the present finding the following recommendation will be forwarded

- Awareness creation among local people about the importance of forests and how they protect and manage it from different anthropogenic activities should be forwarded.
- Further investigation should be conducted to determine the sustainable and beneficial level of harvesting some plant species mainly *Ficus sur, Syzygium guineense, Psidium guajava* and other important plants to participate the local people in benefit sharing so that they become responsible to ensure sustainable conservation of resources in the area.
- In order to prevent future decline of this species in the area, conservation practice involving local people as well as awareness creation about vulnerability and importance of the species is required.
- Habitat situations that these monkeys inhabit in, as they take part in these activities are facing alarming threat from anthropogenic factors; therefore mitigation actions to reverse this trend should be put in place by the relevant authorities' of the country i.e. Environmental Protection, Forest and Climate Change Authority as well as Wildlife Conservation Authority.

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Appendices

Appendix 1: Photo shown deforestation of the study area by local people

(Photos: Wase Dereje, Feb, 2023)

Appendix 2: Photos shown some of identified plant species

Psidium guanjava *Syzygium guineense* *Ficus sur*

(Photos: Wase Dereje, Feb, 2023)