COLLEGE OF NATURAL AND COMPETETIONAL SCIENCE

DEPARTMENT OF ZOOLOGICAL SCIENCE

POPULATION SIZE, ACTIVITY PATTERNS AND FORAGING HABITES OF *COLOBUS GUREZA* IN DUBEN MOUNTAIN AWI ZONE ETHIOPIA.

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BY

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Declaration

I, Mulualem Amsalu, hereby declare that this thesis entitled "population size, activity patterns and foraging habits of *Colobus gureza* in duben mountain awi zone Ethiopia" submitted by me for the award of the Degree of Master of Sciences in Biology, Addis Ababa University is an original work of mine, and it has not been presented for the award of any other Degree, Diploma, Fellowship or other similar titles of any other University or institution.

Name: Mulualem Amsalu Signature _____ Date _____

APPROVAL OF DISSERTATION/ THESIS FOR RESULT

We hereby certify that we have examined this dissertation or thesis entitled "population size, activity patterns and foraging habits of *Colobus gureza* in duben mountain Awi zone Ethiopia by Mulualem Amsalu. We recommend that the thesis be accepted as fulfilling the thesis requirement for the degree of Sciences in Biology"

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LIST OF ABBREVIATIONS AND ACRONYMS

Spp.	Species
SPSS	Statistical Package for Social Sciences
$\chi 2$	Chi-square
LB	leaf bud,
ML	matured leaves,
YL	young leaves

ABSTRACT

Colobus gureza is distributed in forests and within savanna woodlands to the north of the moist forests of central Africa, often extending into highland or Montana forests. A study documents information on population size, feeding habits and activity pattern of C*olobus gureza* in Awi Zone Duben Mountain, Ethiopia. Data were collected using total count method, direct observation and scan sampling method from October 2023 to March 2024 seasonally from the study area. Descriptive statistics were used for data analysis, and the Chi-square test was used for testing. According to the data, there were 54 *Colobus gureza* on average were recorded .during the wet season and 57 during the dry season. There was no significant difference in the number of *Colobus gureza* during the wet (x^2= 0.96, df = 3, P > 0.05) and the dry (x^2= 22.8, df = 3, P > 0.05) seasons. During the wet season, leaves were the main food source for *Colubus gureza*, followed by fruits. They did, however, eat leaves, fruits, shoots, and flowers throughout the dry season. *Colobus gureza* sleep for long periods of time before eating, moving, and grooming. The activity budget varied significantly between the groups in both the wet (x2 = 129.54, df = 3, P < 0.05) and dry (x2 = 113.12, df = 3, P < 0.05) seasons. Duben mountain forest is highly threatened by the local community due to different activities. As a result, the Woreda Administration needs to engage the community more in order to prohibit harmful activities and safeguard the Forest. Additionally, in order to increase the population of *Colobus gurezas*, certain conservation methods should be considered.

Key words: Activity pattern, Colobus gureza, Feeding ecology, Duben Mountain, Population status

INTRODUCTION

1.1 Background of the study

The *Colobus gureza*, a member of the Old World monkey family Cercopithecidae, is distinguished by its striking coloration and unique adaptations to its environment. Their distinctive black and white fur and their highly specialized diet make them a fascinating subject for studying primate behavior and ecology (Kingdon, 2015).Ecological significance and dietary adaptations *Colobus gureza* are renowned for their folivorous diet, which primarily consists of leaves, seeds, and fruits. This dietary preference is supported by a highly specialized digestive system adapted to extract nutrients from fibrous plant material (Milton, 1999). The *Colobus gurezas* large, complex stomach and elongated intestines facilitate the fermentation and breakdown of tough plant matter. These dietary adaptations influence their foraging behavior and the time allocated to feeding activities, which can affect their overall activity patterns and social interactions (Struhsaker, 1997).The *Colobus gurezas* reliance on a folivorous diet also impacts its habitat use and foraging strategies. They are often found in forested areas where they can access a variety of leaf species throughout the year. However, seasonal variations in food availability can lead to changes in foraging behavior and habitat use. During periods of food scarcity, *Colobus gureza* may expand their range or shift their diet to include more fruits and seeds (Fashing, 2001).

Understanding these seasonal dynamics is critical for assessing the impact of environmental changes on their populations. The social structure of *Colobus gureza* is complex and is typically organized into groups consisting of one or more adult males, several adult females, and their offspring. The matrilineal nature of their social organization means that female *Colobus gureza* often remain in their natal groups, while males may migrate to new groups upon reaching maturity (Oates, 1996). This social structure plays a crucial role in reproductive success and group cohesion, affecting population dynamics and stability. Population size and composition are important indicators of the health of *colobus gureza* populations. Factors such as birth rates, mortality rates, and the sex ratio within groups can provide insights into their reproductive strategies and overall population viability (Madden,

2004). The size and composition of *Colobus gureza* populations can be influenced by a range of factors including habitat loss, human-wildlife conflict, and disease outbreaks (Dunbar, 1992). Seasonal changes in the environment can significantly impact the foraging behavior of *Colobus gureza*. In tropical forests, where *Colobus gureza* are commonly found, the availability of food resources can fluctuate between wet and dry seasons. During the wet season, when food is more abundant, *Colobus gureza* may exhibit different foraging patterns compared to the dry season when resources are scarcer (Pavelka & Knopff, 2007). These seasonal variations can affect not only the quantity and quality of food consumed but also the time spent foraging and the social interactions within groups.

Foraging behavior is closely linked to the health and reproductive success of *Colobus gureza*. During periods of food scarcity, the increased time spent foraging can lead to higher levels of stress and reduced health, which may impact reproductive rates and infant survival (Whitten, 1982). Therefore, monitoring seasonal changes in foraging behavior is essential for understanding the overall well-being of *colobus gureza* populations and for developing effective conservation strategies.

Conservation and Management Implications of *Colobus gurezas* in the Awi Zone is vital due to the threats posed by habitat loss and human encroachment. Agricultural expansion, logging, and other forms of habitat destruction have led to significant declines in suitable habitat for *Colobus gurezas* (Bennett & Davies, 1994). These pressures can lead to fragmented populations, reduced genetic diversity, and increased vulnerability to extinction. Effective conservation strategies must address both habitat preservation and the mitigation of human-wildlife conflict. This includes establishing protected areas, implementing habitat restoration projects, and engaging local communities in conservation efforts. In addition to this, understanding the ecological and behavioral aspects of colobus monkeys is crucial for developing targeted management plans that can ensure their long-term survival (Tadesse, 2017).

1.2 Statement of the problem

The taxonomic status of many East African primates is still under debate and the geographic distribution and conservation status of many primate taxa are still poorly understood. (Temesgen Tafesse, 2019). Little is known about the behavioral flexibility of *Colobus gureza* in their natural and fragmented habitats, despite the fact that the majority of other subspecies of the species have been the subject of extensive research (Chapman et al., 2007). Additionally, the population and ecology of *Colobus gurezas* in certain regions of Ethiopia have been the subject of very few studies (Dereje, 2018). Its conservation strategies may be negatively impacted by their inadequate knowledge of the behavioral ecology of monkeys, which could lead to the eventual extinction of the species. Thus, knowledge of the fundamentals of quantitative natural history a successful conservation effort requires knowledge of primate species. Nevertheless, specific information regarding the guerezas in duben mountain of Awi zone's population size, feeding habits, and activity patterns is lacking. It used to be possible to walk through a wide expanse of forest, but because of human activity, this area is currently becoming less accessible. Transition zones are becoming larger over time as a consequence. The wildlife population, including colobus monkeys, is certainly forced to decrease in size or gather within the remaining portion of the forest as a result guerezas and other primate field studies must include an analysis of activity patterns, population sizes, and feeding ecology. In order to better protect the animal and its habitat in some parts of the country conservation efforts will be facilitated and information will be provided by addressing the parameters of population size, activity pattern and feeding ecology in Duben Mountain Awi Zone Ethiopia.

1.3 The objectives of study

1.3.1 General objective of study

The general objective of this study is to investigate the population size, activity patterns and foraging habits of *Colobus gurezas* in Duben mountain Awi zone Ethiopia.

1.3.2 Specific objectives

The specific objectives of this study are:

- To determine the population size of *Colobus gurezas*
- To examine seasonal diet items and food preference of *Colobus gureza*
- To examine the diurnal activity patterns of *Colobus gurezas*

1.4 Research question

- ✓ What is the population size of *Colobus gurezas* in the mountain?
- ✓ Which diet item is most preferred wet and dry season by *Colobus gurezas*?
- ✓ What are the major daily activities of *colobus gureza* how much time devoted to each activity in wet and dry seasons?

1.5. Scope of the Study

The study was carried out in Fagita lecoma Woreda Awi zone of Amhara regional state. The study was delimited to Duben Mountain due to different factors. Due to these limiting factors, the study area will be restricted in duben mountain awi zone Ethiopia

1.6. Significance of the study

The study would further help to generate better understanding about the population size activity pattern and feeding ecology of *Colobus guereza* in Duben Mountain Awi zone Amhara region Ethiopia. In addition the study will used as a reference material for future related researches studies

2. LITERTURE REVIEW

2.1 Description and taxonomy of *Colobus gureza*

Black and white Colobus gureza belongs to order primate; Suborder Haplorrhini; Infraorder: Simiiformes; Family: Cercopithecidae; Genus: Colobus; and Species: *Colobus guereza* (Grooves, 2015). Known simply as the guereza, the eastern black-and-white colobus, or the Abyssinian black-and-white colobus, is one of the old world primates. The Colobus guereza got their name from the highly reduced or absence of the thumbs from its limbs. Although their thumbs are reduced, the other phalanges are very long. Their name is derived from the Greek word kolobos, which signifies multilated. The hind limbs in colobines are longer than the forelimbs, and they have long tails (TemesgenTafesse, 2019). The guereza is a large, sturdy colobus monkey with a black and white coat. The majority of the body is covered in glossy black fur, which contrasts with short white hair around the face and a long white mantle that forms a U shape and hangs down the shoulders and across the lower back. The tail is either a white or yellow Color from tip to base with a large white tuft at the end of the tail (Kim, 2002). The face is gray and has no fur. At birth, the hair of infant c.monkey is completely white, in striking contrast with the predominately black fur of the adult Colobus gureza

2.2. Distribution and biology of *colobus gureza*

The primate order is one of the most diverse and successful group of mammals with more than 630 taxa currently described (Mittermeier*et al*., 2011). Over the course of their evolutionary history, non-human primates display a great diversity of behavioral and morphological traits. Nonhuman primates have been documented in every continent colonized by placental mammals with the exception of Antarctica (Rowe and Myers, 2011). A number of primate societies have been subject to observational studies for many decades. These studies have focused on the behavior, ecology and social organization of primates in their natural environment and have transformed our understanding of their social systems and evolution (Rodrigues, 2012). The black and white colobus monkey is one of the five recognized species in the genus Colobus which inhabits a wide range of forest types in

tropical Africa from Ethiopia to Nigeria (Temesgen Tafesse, 2019). The species are folivorous and often, though not always, exhibits a preference for young leaves (Fashing, 2001). According to Kingdon *et al*., 2008), the species, contains eight subspecies, of which, two are endemic to Ethiopia: *Colobus gguereza* and *Colobus ggallarum*.

2.3 Activity patterns of colobus monkeys

Identifying how animals divide their activities throughout the day offers clear perception into their interaction with the environment and their strategies for maximizing energetic and reproductive success (TemesgenTafesse, 2019). Studies on the activity budgets of species in fragments in comparison to larger forest blocks can give an indication of habitat quality such as food availability, density and distribution at least in the short term (Zanette *et al.,* 2000). Activity budgets of Colobus monkeys are directly related to metabolism and energy needs those changes over the course of the seasons or in relation to reproductive stage (Halle and Stenseth, 2012). The availability and spatial patterning of food resources affect the activity and ranging patterns of many primates (Smith *et al*., 2013). Colobus monkeys in forests spend more time resting and feeding than moving or engaging in social activities. This variation in activity pattern can also be due to energy conservation strategies (Wijtten*et al*., 2012).). Difference in activity might be due to variations in habitats, from coastal forests to mountain forests

2.4 Feeding ecology and resource availability

Colobus gurezas are forest-dependent and live in groups of highly variable size, often forming mixed-species associations with other primates (Temesgen Tafesse,2019).Colobus *gureza* extremely depends on leaves and their special adaptation to exploit the foliage attributed to life in the gallery and dry forests (Bocian, 2007). Several studies reported that colobus *gureza* feed primarily on young leaves of different plant species (Oates 1977). From these plant species that contributed to the overall diet of the study species, the top three plant species, namely *prunus africana, Celtisafricana and Ficusvasta* accounted for more than 50% of their plant diet (Mohammed and Desalegn, 217).

2.5 Ranging ecology of *colobus* gureza

Information about species' home-range size, ranging and activity patterns is vital for understanding its behavioral ecology, habitat requirements, and vulnerability to extinction (Nkurununngi and Stanford, 2006). Researchers observe animal ranging behavior and habitat use to investigate the interaction between ecological influences and individual patterns of behavior (Zhou *et al*., 2014). Ranging patterns are thought to be influenced by a variety of ecological and behavioral factors, including food availability, distribution and quality (Olupot*et al*., 1997), rainfall patterns (Olupot*et al*., 1997), distribution of water (Scholz and Kappeler, 2004), group size (Van Schaik*et al.,* 1983), reproductive situation (Overdorff, 1993), location of sleeping site (Zhou *et al*., 2011), intergroup relationships and social interaction (Isbell, 1983), forest structure (Fan and Jiang, 2008), and parasite avoidance (Nunn and Dokey, 2006). Of these factors, primate ranging patterns are influenced primarily by the availability, distribution and quality of food (Zhou *et al*., 2011).

2.6 Habitat use and preference of colobus gurezas

The *colobus gurezas* is mainly found in forests and savannah woodlands within, and to the north, of the moist forests of central Africa, often spreading into highland or mountain forests (Oates *et al*., 1994). Other habitat types include primary, secondary, riparian, gallery, and upland forest, and moist lowland, medium-altitude and highland forests, rainforests, swamp forests and wooded grasslands (Harris and Chapman 2007). This species also inhabits disturbed, secondary, or colonizing forests, and prefers degraded forests to old growth when both are available (Lwanga, 2006). In addition, they can be found in high forests in mountainous areas, including altitudes up to 3300 m as well as areas under human use, such as eucalyptus plantations (Gron, 2009). The *colobus gurezas* desire to occupy the lower part of the tree if their area does not overlap with that of any other group of monkey. When trees are not densely spaced, *colobus gurezas* feed and travel on the ground

2.7 Threats to *colobus gurezas*

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, (the latter is listed as the 8th hottest hot spot in the world) all vital habitats of colobus monkeys (Myers *et al*., 2000). In addition to ongoing deforestation; hunting, diseases and climate change are major threats to colobus monkey populations in these forests (McGoogan*et al*., 2007). Particularly in East African tropical forests, rapid human population growth has had a drastic effect. These forests are increasingly used for bush meat, fuel wood, poles, timber and charcoal production and are labeled for growing crops and exotic trees. This has led to widespread forest fragmentation. *colobus gurezas* being highly arboreal are especially vulnerable to these threats, as they require leaves, fruits and seeds for survival (Anderson *et al*., 2007)

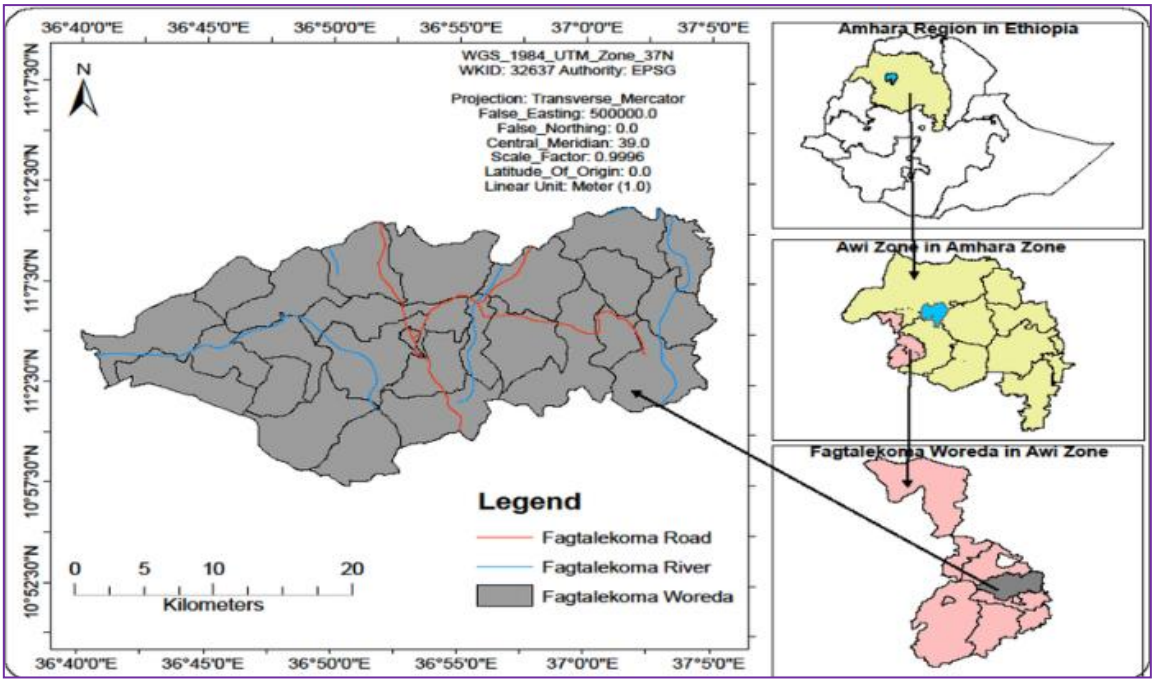
In Ethiopia *colobus gurezas* has no direct danger of local people because local community does not consider the species as crop pests, but it is indirectly in danger by the local people through deforestation and disturbance of their home range. This attitude has a positive impact for long term conservation of the *colobus gurezas* in the area (Mohammed and Desalegn, 2017). Consideration about the local people's attitude towards wildlife and particular aspects helping people's tolerance about conservation need to be studied as part of the process of developing modification strategies

3. MATERIALS AND METHODS

3.1 Description of the study area

Duben Mountain is found in awi zone Amahara region of Ethiopia. It is located in the coordinates of 8°22’ - 7°3’ N, Latitude and 45°9’- 56°3’ E, Longitude and covers a total area of 18ha which located 482 km far from Addis Ababa which is the capital city of Ethiopia and 112 km far from capital city of Amahara region Bahir Dar. The Rainfall distribution pattern of the District is characterized by four month wet season from late April to November. The mean annual rainfall of the study area was 2200.1mm. The temperature ranged from a low mean monthly minimum of 10.69°c in February to a highest mean monthly maximum of 20.52°c in November.

Figure 1:-Map of the study area



3.2 MATERIALS

Materials used in this study were Digital camera, tape meter, GPS 72, compass, papers, bag, data collection sheets, and plant press.

3.3. DATA COLLECTION

3.3.1. Pilot survey

A pilot study was carried out in October 2023 prior to the real data collection. A sample area was selected during this period.

3.6.2. Population Estimation

During the dry and wet seasons, the total count method was used to estimate the population size of the *Colobus gurezas* in the study area (Fentahun *et al.,* 2017). Using both artificial and natural boundaries, the study area was divided into four blocks (B-I, B-II, B-III, and B-IV). In both the wet and dry seasons, censuses were regularly taken in the early morning and late afternoon in each block. Binoculars and unaided eyes were used for the counting. During census, individuals were identified based on age and sex. Surveys were carried out to find whether *colobus gurezas* were present in various areas of the study area or not.

3.6.3. Activity pattern

The scan sampling method was used to gather information on the *Colobus gurezas* activity patterns, Age and sex-based differences was used to select the focal animal. Observation was conducted for five minutes at every 15 minutes interval from early morning (6:00) to late afternoon (18:00) during the wet and dry seasons. Activities such as feeding, playing, grooming, chasing, fighting, and sleeping were recorded. The scan sampling method was used to collect behavioral data on multiple group members (Altman, 1974). During activity scan sampling, the activities of monkeys were recorded for 5 minutes at 15 minute intervals to combat observer's fatigue. The activity recorded for each visible individual was the first activity that lasted for 5 seconds. Data was collected for the first 1-5 visible adults, sub-adults or juveniles. The group was scanned each time from left to right to avoid possible biases towards eye-catch activities like grooming, fighting or mating. The identity of the scanned individuals was recorded and assigned to one of the following age/sex classes: adult male, adult female, sub-adult male, sub-adult female, juvenile An individual scan was recorded when monkey performed one of the following behavioral records on the standardized data

sheet: feeding, moving, resting, playing, aggression, grooming, sexual activity and others (Fashing, 2001). Feeding was recorded when *Colobus gurezas* was manipulating, masticating, or ingesting a particular food item. Moving was recorded when monkeys changed spatial position, included walking, jumping, or running. Resting was recorded when monkeys was inactive, either sitting or lying down. Aggression was recorded when the monkey chased, bit, grabbed, displaced, threatened another monkey, or vocalize in an aggressive context. Grooming was recorded when a monkey used its hands to explore or to clean its body or the body of another monkey. Sexual activities was recorded when an individual engaged in copulatory behavior. Others activities was recorded when the monkey performs activities such as vocalizing or defecating that wasn.t fit into the main categories (Addisu *et al*., 2010).

3.3.4. Feeding Ecology

Focal sampling and repeated standard observation were employed to observe the feeding ecology. Focal sampling involved using binoculars or an aided eye to observe an individual for 10 min, depending on how distance the *Colobus gureza* was from the observer. Plant species, the portion of the plant consumed, and the amount of time spent foraging were recorded. (Fashing., 2001)

3.3.5. Data analysis

Microsoft Excel and SPSS software version 20 were used for data analysis**.** Descriptive statistics was used to calculate population size. Comparisons of food items consumed were computed using chi-square test across seasons.

4. RESULTS

4.1. Population Estimation

In the study area, the highest recorded number of *Colobus gureza* during the dry season was 57, while during the wet season was 54.There was no significant difference in the number of *colobus gurezas* during the wet and dry season (x^2 = 0.96 df = 3, P >0.05). However, there was significant difference in the number of *Colobus gureza* among blocks (x^2 = 51.5, df = 3, P < 0.05). Of the total individuals sighted in the study area, 33.33% constituted adult female, 26.1% adult male, 18.9% sub adult male, 9.8% sub adult female and the remaining 10.8% constituted unidentified juveniles. The number of animal group significantly differed during the wet (x^2 = 22.28, df = 4, P < 0.05) and the dry (x^2 =86.81, df = 4, P < 0.05) seasons.. During both the wet (33.33%) and dry (33.4%) seasons, adult female groups were the largest. Whereas sub adult female groups constituted the least value during wet (11.1%) and dry (8.8%) seasons..

Table 1: *Colobus gurezas* population during the wet and dry seasons

Season	B-I	B-II	B-III	B-IV	Total
Wet	11	14	16	13	54
Dry	11	15	18	13	57
Mean	11	14.5	17	13	55.5

Out of the total number (55.5) of *Colobus gurezas* recorded during this study,14.5(26.1%) were adult males,16(33.33%)were adult females, 10.5 (18.9%) were sub-adult males, 6 (9.8%) were sub adult females, and 6.5 (10.8%) were juveniles/young (Table 2). During the wet season, most individuals were adult females (33.33%) followed by adult males (24.1%), while the remaining 18.5%, 11.1%, and 13% were sub-adult males, sub-adult females, and juveniles, respectively. During the dry season, 33.4% were adult female while sub-adult males accounted for 28.1% of the population and 19.3%,8.8%,and 10.5% were adult male, sub-adult females, and juveniles, respectively. There was no significant deference among the age and sex groups counted across seasons (df 4, P<0.05).

Table 2: Age and sex class composition of the *Colobus guereza* population in the study area.

Season		Adult male	Adult female	Sub-adult male	Sub-adult female	Juvenile	Total
	Sum	13	18	10	6	7	54
wet	%	24.1%	33.33%	18.5%	11.1%	13%	100%
	Sum	16	19	11	5	6	57
Dry	%	28.1%	33.33%	19.3%	8.8%	10.5%	100%
	Mean	14.5	18.5	10.5	5.5	6.5	55.5
Total	%	26.1%	33.33%	18.9%	9.8%	10.8%	100%

Sex and age ratio of *Colobus gurezas* differed ($P<0.05$) across seasons. The sex and age ratio of adult females and sub adult females (3:1) were greater during the wet season while the sex and age ratio of adult females and sub adult females (4: 1) were greater during the dry season

Table 3: Age and sex ratio of *Colobus gurezas* during the wet and dry season in the study area

	AM: AF	SAM: SAF	M: F	AM: SAM	AF: SAF
Wet	1:1.5	2:1	1: 1	1.5:1	3.1
Dry	1:1.5	2.5: 1	1:1.5	2:1.5	4: 1

4.2. Feeding Ecology

In the study area, *Colobus gurezas* were observed feeding on eleven plant species belonging to nine families during both the wet and dry seasons. The plant species were trees and shrubs. There was significant variation the type of food consumed during wet ($x2 = 155.4$, $df = 1$, $P < 0.05$) and dry seasons ($x^2 = 205.8$, $df = 3$, $P < 0.05$). *Albizia sechimperiana* was the most frequently consumed food item during the wet (34.7%) and dry (20.1%) seasons. On the other hand, *Olea africana*, *Rhusglutinosa*, *Persea americana* and *Hibiscus rosasinensis* were

not consumed by *Colobus gurezas* during the wet season (Table 3). The majority of the food consumed by *Colobus gureza* during the wet season (97.7%) was young leaves, with the remaining 2.3% being fruits. However, their diet consisted of young leaves (58.8%), fruits (23.2%), shoots (16.6%), and flowers (1.4%) during the dry season. There was significant variation ($x^2 = 43.12$, df = 3, $P < 0.05$) in parts of plant consumed by *Colobus gurezas* during the wet and dry seasons (table 4)

The monthly percentage of feeding records of different food items from different plants in the diets are presented in Table 4. The young leaves were the top food item for most months (range 30.88- 64.47%). during the study period. They also feed fruits (3.48-37.98%) and petiole (4.32-5.24%) during almost all months of the study period. Leaf bud (0.0-0.77%), fungi (0.025.87%), and flowers (0.0-2.4%) were recorded in few for one to four months

Table 4: Percentage of food items consumed by *Colobus gurezas* during wet and dry seasons

Common name	Species	Family	Relative Percentage	
			Wet season	Dry Season
Large podded albizia	Albizia sechimperiana	Fabaceae	34.7	20.1
Bitter leaf("grawa")	*Vernonia amygdalina*	Asteraceae	17.3	3.4
Acacia("girar")	*Acacia abyssinica*	Febaceae	2.7	6.7
Wild olive(Ambacho)	*Olea africana*	Oleaceae	9.3	2.8
	Rhusglutinosa	Anacardiaceae	0	12.8
Large leaved cordial	*Dracaena steudneri*	Dracaenacaea	4	8.9
	Rhusglutinosa	Anacardiaceae	0	7.8
Mango	*Mangiferaindica*	Anacardiaceae	5.3	17.3
Avocado	*Perseaamericana*	Lauraceae	0	6.1

Neem	*Azadirachtaindica*	Meliaceae	26.7	8.9
	Hibiscus rosa-sinensis	Malvacaea	0	5.2
Total	100			100

. Mature leaves were recorded (0.0-26.47%) for five months out of six months during the whole study period (table 5)

Table 5: Percentage of monthly feeding records of different food items during the study period

Month	LB	Bark	Fruit	Fungi	ML	YL	:tiole	Flower	TOTAL
March	0.00	8.50	34.94	7.86	8.73	41.92	5.24	.31	100
April	0.00	0.00	37.98	2.40	7.69	45.2	4.32	2.40	100
May	6.75	6.14	3.48	25.87	0.00	64.47	5.01	0.39	100
June	0.00	0.00	37.98	0.00	9.16	45.2	4.32	2.40	100
July	0.00	8.90	37.94	0.00	26.47	30.88	4.90	0.00	100
August	0.54	8.60	37.94	0.00	26.47	30.88	4.90	0.00	100

LB=leaf bud, ML=matured leaves, YL=young leaves

4.3. Activity Pattern:

Different activities of *Colobus gurezas* were observed in the study area. The major activities were resting, feeding, traveling and grooming. There was significant variation in terms of activity budget of Colobus monkey ($x^2 = 113.12$, df = 3, $P < 0.05$ during wet season and ($x^2 = 129.54$, df = 3, $P < 0.05$) dry season. From the total observation, the animal spent 74.3% of its time for resting, 14.5% for feeding, 8.7% for traveling and the remaining 2.5% for grooming during the wet season. On the other hand, the study animal spent 78.4% of its time for resting, 9.5% for feeding, 9.5% for traveling and 2.7% for grooming during dry season. There was significant variation ($P<0.05$) in terms of the activity budget among different age groups. From the total activities conducted by all age groups, juveniles showed the largest

percentage for traveling (46.2%) and grooming (54.6%). While adults and sub adults spent more time for resting (55.7%) and feeding (43.1%), respectively during the wet season. On the other hand, juveniles spent most of their time for feeding (41.3%), traveling (41.3%) and grooming (17.4%) where as adults used more time for resting (42.2%) than other age groups during the dry seasons

Table 6: seasonal activity time budgets of *Colobus gurezas*

Activities %									
Season		Aggression	Feeding	Grooming	Moving	Others	Playing	Resting	Sexual activity
Dry	N=2871	3.00	14.83	4.60	30.58	1.99	4.90	39.88	0.22
Wet	N=2970	2.92	17.50	6.80	28.82	2.70	4.25	35.52	0.92

N= number of observations

Figur 2 Resting activity of colobus gureza

Figur 2. feeding activity of Colobus gureza

5. DISCUSSION, CONCLUSIONAND RECOMMENDATIONS

5.1 DISCUSSION.

Because of Colobus gurezas ability to tolerate forest degradation, *Colobus gurezas* are still quite common and abundant, and they are thought to be among the least threatened *Colobus gurezas* species (K. Jensz and L. Finley 2011). In the Duben mountain Forest, there are more edible herbs and seedlings under a canopy during the wet season, but the local guereza population did not change significantly between seasons, agreeing with the findings of (Gebeyehu and Bekele (2009). This also indicates fairly steady food quality and availability across seasons According to the age structure of *Colobus gurezas*, adults are the most common age group, followed by sub adults, and juveniles are the least common.

A population's viability can be inferred from its size as well as from the age and sex composition of that population (S. Harris, 1998). There are more adult female participants in the current study than adult male participants. A female-biased sex ratio and a fairly high proportion of juveniles indicate a healthy population (Doku *et al,.* 2007). Group size in primates is associated with various benefits and costs in relation to food availability and predators (Harris, 1998). Large groups should face greater within-group competition for food than smaller groups (Isbell,Young Jaffe, Carlson, and Chancellor, 2009) .

When group size increases, the individual probability of being the target of a given attack by predators decreases (Harris, 1998). Since the population and group size did not significantly

change across seasons, this indicates that food availability and predation risk did not greatly change across seasons However ,during the dry season, we found that most groups moved to an area with plenty of fruits and leaves (food availability was limited to a certain area at that time). During this period of low food availability, we observed that two or three groups combined and foraged together. They seemed to gather around the diminishing resources rather than dispersing. (Ohsawa and Dunbar 1984) found that the largest monkey groups happened to be in the middle of the dry season, perhaps to avoid open habitats due to seasonal removal of leaf shading with higher predation risk but group size was also smaller in habitat indicating that individuals were not adjusting group size as expected according to predation risk. Primates can regulate their time budgets in response to seasonally low food availability and to climate change (Lia and Rogers 2004). Studies showed that animals are exposed to more stressful conditions during the dry season (Hemingway and Bynum 2005). Feeding time for guereza was high during both seasons, which depends on high food availability and quality. Usually, the dry season affects forage availability. (Iwamoto, 1993) stated that during dry season forage, protein content becomes decrease in response feeding time of *Colombus guereza* becomes increase .A possible reason that guerezas still spent more time feeding than on any other activities during the wet season could be that they require more energy for thermoregulation during the wet season like other primates (Zewdu,Gurja and Afewerk,2013).

The other study reported by Kifleetal.(2013) in harsh areas found that feeding activity of primates such as geladas was low during the dry season. Oatesetal, (1994) reported that some primates such as Ateleschamek spent more time feeding during the rainy season. They found that guerezas travel short distances to conserve energy and mostly rest through the day, feeding on relatively abundant food items (Chapman, Wasserman, and Gillespie 2006) . Similarly, guerezas in the Duben Mountain Forest spend more time resting and feeding than socializing and moving. In the present study, 31%of *Colobus gureza* feeding observations were on young leaves, and 22% were on mature leaves, in line with Hussen and Ejigu (2021) and Mekonnen and Hailemariam (2017).

Another study found that plant leaves comprise an even greater proportion (78–94%) of the

guereza diet (Usongo and Amubode, 2001). Another study conducted in Cameroon indicated that 35–75% of their diet was on young leaves due to their high digestibility and low toxicity (Petros,Mekonen,Gena, and Mesfin 2018).Oates and Davies (1994) stated that *Colobus gureza c*onsume more than 30% mature leaves when there is food scarcity. Guerezas are therefore consistently highly folivorous. Although guerezas eat unripe fruits, mostly to avoid competition with other primate species for ripe, fleshy fruits, this is not the problem (Harris and Chapman 2007). Guerezas in the Duben mountain Forest consumed 11 plant species. Out of the food plant species in ourstudy,9species were the same as Hussen and Ejigu's (2017) study in Gidabo Forest,8 plants were the same as those reported in (Petros, Mekonen, Gena, and Mesfin2018) study in Bale Mountains National Park, and 5species overlapped (2021). The number of plant species consumed by guereza in our study was much higher than that in Mekonnen and Hailemariam (2021) (19species),HussenandEjigu (2017) (15species),and Petrosetal (2018) (8species).

A higher number of deferent plant species consumed is expected in the dry season, as plants are of lower nutritional quality and so *Colobus gurezas* would have to forage from a greater variety to meet their nutritional needs (Tesfaye *et al*.,2019) Anecdotally, we discovered that guerezas are unlikely to face resistance from the local population. Local communities have a more positive attitude towards Colobus guereza than towards other primate species the habitats of these primates are currently diminishing due to the clearance of vegetation and extension of cultivated areas. Understanding the attitude of local peoples towards wildlife conservation is important for developing mitigation strategies against threats to wildlife.

5.2. CONCLUSION

The current study provided relevant information on the population size, activity patterns and feeding habits of *Colobus guereza* in Awi Zone Duben Mountain Ethiopia. The age and sex composition of the population indicates to a stable healthy population. Feeding and resting were the most frequent activities recorded. *Colobus guereza* mainly forage on leaves, especially young leaves, in line with previous studies. As the area provides a rich food base, but the local guereza population is small relative to other areas of similar size, a conservation area should be developed to protect the species in this valuable natural habitat. Therefore, attention should be given by the government officials and concerned bodies to protect the natural habitat of the species and the primates. Community leaders should also be given the opportunity to create awareness among the people living around the area in order to protect these primates

5.2 RECOMMENDATIONS

Based on the findings of this study the following recommendations were forwarded.

- ✓ The daily activity time budgets of *Colobus guereza* are associated with the availability of food plants therefore special attention should be given to conserve diet plants of this animal.
- ✓ Dietary plants preferred in the mountain should have to be a mixed type of species with different fruit bearing trees that serve as a food source for *colobus gurezas* than monoculture types. The most preferred plant species in the guereza diet should be monitored to get an understanding of food available in the area. The nutritional content of food plant species should also be investigated to give special conservation emphasis and enhance plantation to highly nutritious preferred dietary plants. This may reduce the daily travel of species and expenditure of energy and make them to invest their time more on productive activities
- ✓ I suggest that repeating the survey reported here with a longer period for data collection (e.g., for one year) would result in a more comprehensive abundance estimate

- ✓ I also recommend studies that would address activity-time budget and population demographics of these monkeys. Our results provide a reference line for future studies in this area, particularly to evaluate population trends of *colobus gurezas*.

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