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Population Status, Group Size, and Threat to Boutourlini's Blue Monkeys (*Cercopithecus mitis boutourlinii*) in Jibat Forest, Ethiopia

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Abstract

The present study was conducted to determine population and group size, and identify major conservation challenges to the blue monkey (*Cercopithecus mitis boutourlinii*) in Jibat forest. Data were collected from July 2012 to April 2013 through direct field observation, focus group discussion, interview, and questionnaire survey. Individual count was used to determine the current population size, seasonal distribution, and sex and age structure of blue monkey. Data were analyzed using descriptive statistics. Chi-square test was used to compare the sex and age ration, and their distribution among the counting blocks. The mean estimated population of Boutourlini's blue monkeys in the study area was 188 individuals. Of which, adult males and adult females comprised 18.61% and 33.77%, respectively. There was statistical difference between the number of adult males and adult females (χ^2=8.495, df=1, p<0.05). The proportion of young and infant groups was 27.12% and 20.47%, respectively. There was no statistical difference among the age categories of blue monkey in the Jibat forest (χ^2=11.277, df=3, p>0.05). The sex ratio of adult males to adult females was 1:1.81, and adult female to infant was 1:1.65. Blue monkeys in the study area were seen mostly in groups and occasionally in pairs. The range of troop size varied from 2 to 21 with mean of 11 individuals of various sex and age categories. Major threats for blue monkey recorded in the study area were deforestation, poaching, agricultural land expansion, overgrazing, human encroachment, tree cutting and cultivation. Increasing human population density with the absence of participatory forest management has accelerated deforestation of the natural ecosystem and loss of wildlife.

Keywords: Endemic-mammal; Population size; Age structure; Threat

Introduction

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 [1]. Along with the variety of habitats found within the continent, Africa contains a great diversity of primate community [2].

Ethiopia is one of the world's rich biodiversity countries [3]. 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 [4] of which 31 species are endemic [5].

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 monkey as subspecies [6]. *Cercopithecus mitis boutourlinii* is a sub-species of *Cercopithecus mitis*, endemic to Ethiopia [7]. They occur from Lake Tana southwards along the western side of the Ethiopian Rift Valley, but its distribution does not reach Lake Turkana [8].

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 [9].

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 [10]. The objective of the present study was to determine the population size, group and age structure, and identify major threat to Boutourlini's blue monkey in the Jibat Forest of Ethiopia.

Materials and Methods

Study area

Jibat montane Forest is one of the Important Bird areas of Ethiopia located in the Oromia Region of western Ethiopia. It covers an area of 30 km^2. It is located at 200 km of North-East of Addis Ababa, the capital city of Ethiopia (Figure 1). It lies between 37° 21'–37° 30'E; and 8° 43'–8° 51'N. The elevation ranges from 1800 to 2984 meters above sea level. The vegetation type in Jibat forest is described as tall tree dominated forest including bamboo forest and plantations of *Junipurus* and other tree species [11].

Rainfall occurs from April to October, but heavy rainfall occurs in July (355 mm) and August (344 mm). Mean annual rainfall is 1474

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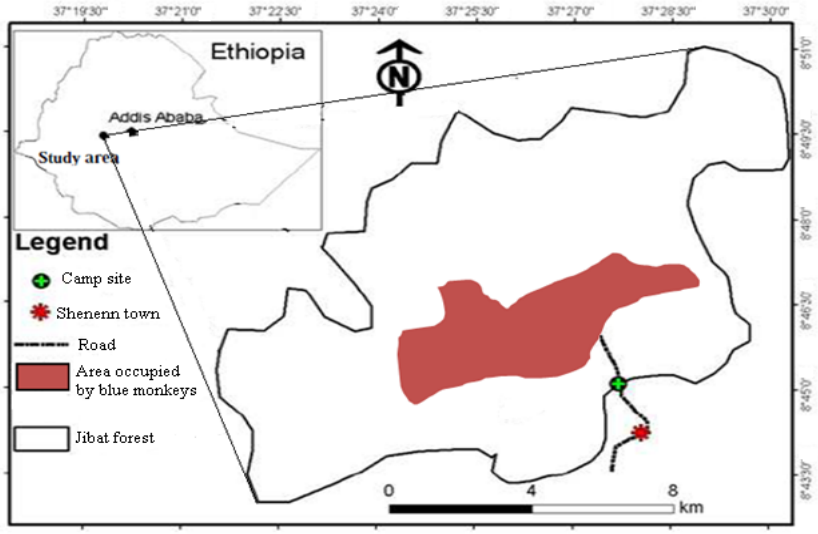

Figure 1: Map of the study area.

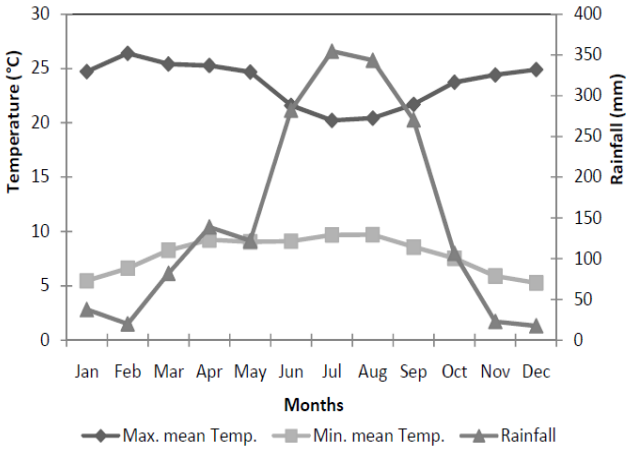

Figure 2: The minimum and maximum temperature and rainfall of the study area.

mm [11]. Minimum rainfall was recorded in the months between November-March. The lowest mean rainfall recorded was during December (18 mm). The Wet season includes July-October, and March-April. November-February is dry season. The average mean monthly minimum temperature was 5.3°C in December and the average mean monthly maximum was 26.4°C in February (Figure 2).

The present study was carried out during July 2012–April 2013 covering both wet and dry seasons. The seasons were classified into wet season I (July-August), wet season II (September-October), dry season I (December-January), and dry II (February-April). Direct field observation was made using 10 × 50 mm binoculars and necked eyes depending on the distance between the observers and animals. Quantitative and qualitative data were collected on the population number, group and age structure, and threats.

For the purpose of total count, block counting method was essential to estimate the population status and group size [12]. The entire study area was divided into six counting blocks (Figure 3). In this case, block means small areas with natural physical barriers like vegetation, topographical features, mountain hills; and artificial boundaries like roads and bridges. The distance and expanse of the consecutive counting blocks vary depending on the natural boundaries and the topography of the area [13].

Each block was assessed three times per month. Birth rate was estimated for each group as the number of infants per adult female at the time of the survey.

Method used during survey was walking slowly at 0.5 km/h, covering a distance of 6 km per day, stopping every 500 m to search the area by applying both visual and auditory senses simultaneously. When blue monkeys were encountered, locality and coordinates, detection time, activity and age-sex composition of the group were recorded. Counting was repeated two times to minimize bias in distinguishing age and sex of the groups [14].

During individuals counting, the size of each troop of blue monkeys was recorded. When the distance between individuals was less than 50 meters, they were considered as members of the same group [15]. Sometimes two or three individuals of blue monkeys were separately seen nearby and they were included as a group for the purposes of analysis [16].

Informant interviews, questionnaire survey, field observation, and focused group discussion were used to determine threats to the blue monkey. The collected data were triangulated for better strength. Field observation was employed to examine number of people collected firewood, number of livestock grazed in the forest, level of farm extension, number of new settlements occurred in and around the forest, and other activities of local communities of the area. The quantitative data were obtained by means of the questionnaire survey whereas qualitative data by means of the informant interviews, field observation and focus group discussion.

Semi-structured interviews could standardize, control and easy compare the responses to a question [17,18]. Information from key informants was collected with semi-structured interview. Semi-structured questionnaire was intended to collect demographic (age, sex, family size, education level), socio-economic information, and

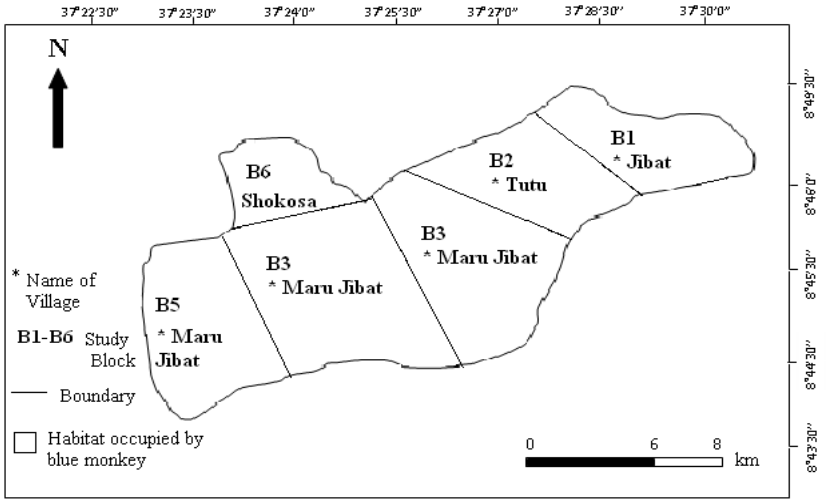

Figure 3: Division of the study area in to six blocks.

conservation challenges in the study area. A total of 50 key informants were provided the semi-structured questionnaire. The respondents were selected purposefully with snowball sampling technique based on their ability, awareness and knowledge to contribute to the overall research objectives.

Focus group discussion makes the discussant free to move the conversation in any direction of interest and explore a topic broadly, and the researcher can explore a situation in short period of time and reinforce questionnaire data [19]. Two FGD was employed, and the group size in each discussion ranged 9-12 people. Staff members of Oromia forest and wildlife enterprise, scouts of the forest, Woreda agricultural officer, experts from culture and tourism office of the district, Kebele governmental administrators, elders of villages, members of females association, and local leaders were involved in the discussion. The discussion focused on changes, problems, and challenges to conservation of blue monkeys.

Data Analysis

Data were analyzed using SPSS software for Windows Evaluation Version 20. Statistical tests used were two-tailed with 95% confidence intervals. Chi-square test was used to compare the statistical differences between age groups and population size in seasons.

Results

The average number of blue monkeys counted in the study area was 188. The mean of Boutourlini's blue monkey's individuals during the wet and dry seasons was 191 and 185, respectively. The variation in mean number of individuals of wet and dry seasons was not statistically significant (χ^2=0.096; df=1, p>0.05). The population number of blue monkey in the study area was increased during the wet season than the dry season (Table 1).

The maximum individuals were 202 during the wet season; and minimum number was 174 during the dry season II. More number of individuals was counted during the wet season in block 3 and less in block 4. However, there was no significant difference in all cases (p>0.05). On the other hand, more number of Boutourlini's blue monkeys was observed during the dry season in block 2 and less in block 3. Generally, among the blocks, highest mean counted was recorded in block 2 and the lowest was in block 4 (Figure 4).

Season	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Total
Wet I	38	23	47	27	22	45	202
Wet II	18	44	37	19	27	35	180
Mean	28	33.5	42	23	24.5	40	191
Dry I	33	42	22	45	38	14	194
Dry II	30	40	19	21	40	24	174
Mean	31.5	41	20.5	33	39	20	184
Total mean	29.75	37.25	31.25	28	31.75	30	188
± SE	± 0.77	± 0.79	± 1.18	± 1.09	± 0.76	± 1.24	

Table 1: The mean number of blue monkeys counted during dry and wet seasons.

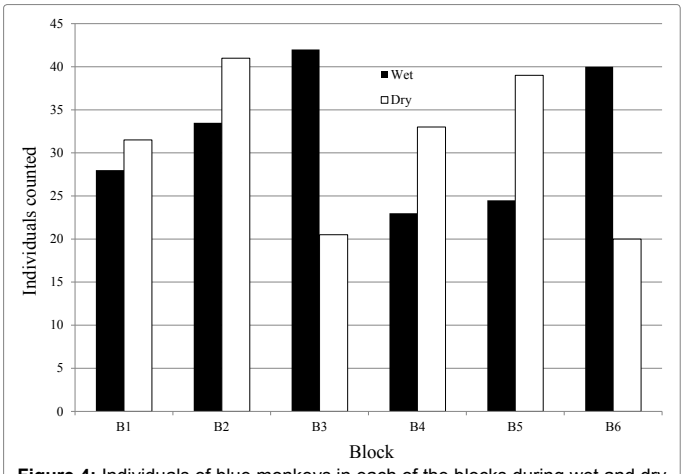

Figure 4: Individuals of blue monkeys in each of the blocks during wet and dry seasons.

The counted individuals were categorized into adult male, female, young, and infant (Table 2). Out of the total number of blue monkey counted during the present study period, 18.61% were adult males, 33.77% were adult females, 27.12% were young, and 20.47% were infants. There was no statistical significant difference among the age categories of blue monkey in the Jibat forest (χ^2=11.277, df=3, p>0.05). The mean sex ratio of adult males to adult females was 1:1.81 during wet and dry seasons. There was significant difference between the number of adult males and adult females (χ^2=8.495, df=1, p<0.05).

Mean sex ratio of infant to young was 1:1.32. There was significant difference in the sex ratio observed during the wet and dry seasons

Season	No. of Adults		No. of. Young	No. of Infant	Total	Sex ratio		
	Male	Female				AM:AF	I:Y	AF: I
Wet	37	65	47	42	191	1:1.76	1:0.89	1:1.55
Dry	33	62	55	35	185	1:1.88	1:1.57	1:1.77
Mean	35	63.5	51	38.5	188	1:1.81	1:1.32	1:1.65
Percentage	18.61	33.77	27.12	20.47	100			

AM: Adult male; AF: Adult female; Y: Young; I: Infant

Table 2: Age and sex structure of blue monkeys in the study.

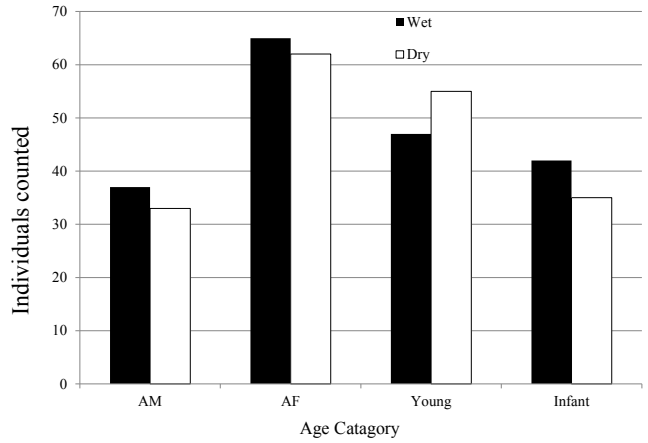

Figure 5: Age structure of Boutourlini's Blue Monkeys in the study area.

(χ^2=30.54; df=2, p<0.05). On an average, 52.38% of the total individuals were adults, 27.12% was young, and the rest 20.47 % was infants.

The age structure of blue monkeys did not show significant variation between seasons. However, adult females exceeded more than 60 during the dry and wet seasons (Figure 5). Adult males comprised minimal count during the dry and the wet seasons.

The troop size ranged from 2 to 23 individuals. Maximum number of troops was 11 and 14 in the wet and dry seasons, respectively (Table 3). The maximum and minimum range of troop size was 23 and 2 individuals respectively.

Out of the total respondents, 70% was males, and 30% was females. There was a significant difference in the number of male and female respondents (χ2=8.000, df=1, p<0.05). Most of the respondents were farmers (80%), followed by government workers (10%), business men (6%), and students (4%). There was significant difference among occupations of the respondents (χ2=81.040, df=3, p<0.05). The majority of respondents were illiterate (58%) and the remaining were literate (42%). Out of the total respondents, 68% were married, single (14%) and divorced (18%).

Field observation, focus group discussion, and interview with local communities and governmental officials provided information about the major threats to blue monkeys of the area. Charcoal production (90%), poaching (76%), human encroachment (82%), Fuel wood collection (94), overgrazing (86%), deforestation (80%), and agricultural land expansion (78%) were reported as the major threats to the population of blue monkeys in the study area (Table 4). There was insignificant difference among the threats that affect the blue monkey population in the study area (χ2=1.549, df=6, p>0.05).

Based on the questionnaire, more than half of the respondents were aware of forest management and threats to wild animals. However, due to low income and lack of participation, local people harvested trees

Season	Number of troops	Range of troop size	Mean troop size
Wet	11	2 – 23	12
Dry	14	2 – 20	11
Mean	12.5	2 – 21	11

Table 3: Troop size of blue monkey during the wet and dry seasons.

Major threats to blue monkey	Number of respondents	Percentage
Charcoal production	45	90
Poaching	38	76
Human encroachment	41	82
Fuel wood collection	47	94
Deforestation	40	80
Over grazing	43	86
Agricultural expansion	39	78

Table 4: Response of local communities to the threats to blue monkey.

from Jibat forest. From the total respondents questioned 66% were fully dependent on the forest, 20% were partially dependent and the remaining 24% were not dependent on the forest. Livelihood activities such as farming, fuel wood extraction and processing forest trees were common local communities' activities to generate income.

Discussion

Boutourlini's blue monkey is one the endemic wild mammal found in Ethiopia. According to Lawes [20], blue monkey are widely distributed and not threatened species. The average number of Boutourlini's blue monkey observed in the entire study area was 188 individuals. The total number of Boutourlini's blue monkey counted was 191 during the wet season, and 185 during the dry season. There was no significant difference between the wet and dry season's individual counts. Female blue monkey give birth once every two years, during the onset of the warm and rainy season [21]. According to Chapman and Chapman [22], densities of primates were related to food quality and availability. During the wet season the individual number of blue monkeys slightly increased due to more quality and availability food than during the dry season.

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 [23]. The group size was greater during the dry season than the wet season. Similarly, Ohsawa [24] found that the largest multi-troop occurred more in the middle of the dry season than wet season. During the dry season the troop size increased and foraged together to an area where plenty of fruits and leaves were available. The group size may vary in seasons. During the dry season, food availability was limited to a given habitat. Therefore, two or three troops were mixed as one troop and foraged together; as a result the group size increased. Average sex ratio of adult male to adult female was 1:2 and infant to young was 2:1. Similarly, Beyene [25] found 1:2.8 adult sex ratios during the wet and dry seasons. Adult females' number was higher than adult males due to earlier maturation of females.

According to Isbell [26], larger groups have longer day range lengths and use larger home range areas than smaller troops. The troop varied both in size and sex composition. Variation in troop size was common in larger, more mobile primates than small troop size. Troops were largest in sites with less forest cover. These results suggested that a function of grouping in Boutourlini's blue monkey was concerned with availability of food, protection of infant and territorial defense. Adult males were more committed to the defense of the territorial boundaries [27]. Troops usually protected themselves in all directions and produced warning sound by any one of the troop members when disturbed. Adults of both females and males had roles in the protection of the troop, through careful watch from dangers. Similarly, Chapman and Chapman [22] found, the aggregation of large troop during the dry season in a limited area and splitting into large troops and dispersal to a wider area were due to in search of food, and as a result of habitat destruction by humans.

Local people remarked that there were more blue monkeys in the past. According to Mekonnen et al. [28], population of bale monkeys decreased due to overexploitation of local people. Similarly increased human settlements and farming in the forest area resulted in reduction of the total size of Boutourlini's blue monkeys from time to time. Forest trees extraction was the main factor. Similarly, Baranga [29] reported that habitat destruction can cause prolonged periods of food scarcity and sometimes permanent depletion of food resources. Hence, blue monkeys and other primate species in Jibat forest may face food scarcity and permanent depletion of food resources in the future.

Local people of the study area occupied the new land for different purposes. Cutting of trees for fuelwood, charcoal production, construction of house and fence, and timber production were commonly observed practices of the local communities in the study area. Similar result was reported by Abie and Bekele [30]. Demand for food, farmland and settlement would increase as the human population number increases. This causes constriction of ranges and led to change on composition and structure of the habitat [31].

Conclusion

The largest multi-band troop occurred in the middle of the dry season than the wet season. Due to shortage of food during the dry season, troop size increased and foraged together to an area where better fruit and leaves were available. Out of the188 counted individuals, adult females were larger than other sex categories. There was an increase of individual number during the dry season compared to the wet season. Different forms of forest exploitation occurred in Jibat forest. Most of the ecological communities in this area was being fragmented and intensively extracted by the local people. Local people in the nearby forest extracted woods from the forest for different purposes such as fuel wood, house construction, furniture making and for fence. Hence, the forest habitat was constantly changing in size and quality.

Conflict of Interests

Authors did not declare any conflict of interest.

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