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Effects of Farming Activities on the Population of Three Sympatric Species of Guenons in Afi Mountain Wildlife Sanctuary, Cross River State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors JOB and VTE designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors JOB and SAA managed the literature searches, analyses of the study, performed the structural equation modeling and discuss the conclusion. All authors read and approved the final manuscript.

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ABSTRACT

A survey was conducted to determine the effects of farming activities on the population of three sympatric species of guenons in Afi Mountain Wildlife Sanctuary (AMWS), Cross River State, Nigeria. Line transect method was adapted to determine the status and population density of guenons, while plant species composition of the study was determined using the Total Enumeration Count Method of vegetation sampling. Snowball sampling technique was used to administer hundred (100) semi structured questionnaire representing five (5) percent sampling intensity of inhabitants population for collection of information on farming indices. Two censuses

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were carried out in each of the ten (10) transects (2.0 km length, 0.02 km width) and at interval of 1.0 km randomly selected. Direct method of animal sighting was employed. The three species of guenon monkeys sighted had low mean population densities of 4 / km^2. This implied that the population of guenons in the study area was affected, while the vegetation assessment revealed the study area to compose mainly of tropical plants species, though seriously modified through farming activities. More than seventy (70) percent of the respondents were farmers predominantly youths (25 – 35 years) who farm within the sanctuary. This age was considered a threat to wildlife conservation in the study area due to their energetic and restive characteristics. It was therefore recommended that alternative form of employment be provided to the youths to check further encroachment through farming activities.

Keywords: Line transects; direct sighting; wildlife conservation; population density and guenons.

1. INTRODUCTION

Afi Mountain Wildlife Sanctuary is a biodiversity hotspot with rich species diversity and endemism [1]. The sanctuary, established in 2000 to protect significant portion of the Afi River Forest Reserve in Cross River State, Nigeria, has suffered severely from anthropogenic activities for decades [1]. The area has suffered from activities such as illegal farming, hunting and logging operations, thereby threatening important flora and fauna species including guenons which constitutes an integral part of the habitat [2].

Forest guenons are the most species-rich group of African monkeys [3]. Forest guenons belong to the genus *Cercopithecus* [4,5], the family *Cercopithecidae* [6] and the subfamily *Cercopithecinae* (the old world monkeys). However, as observed by Melnick and Pearl [6], their taxonomy does not enjoy unanimity among zoogeographers. In a study conducted by Bukie [2], three geospecies of guenons, the Mona guenon (*Cercopithecus mona*), the red eared guenon (*Cercopithecus cephus*) and the putty-nosed guenons (*Cercopithecus nictitans*), were directly sighted during a survey of all known guenon species in Afi Mountain wildlife sanctuary, Nigeria [2].

The *Cercopithecus mona* group are relatively small, long tailed and predominantly arboreal monkeys found in moist and dry forests from Senegal and the Gambia east to the Western Rift valley. Although there has been great disagreement as to the number of species best recognized in this group, according to Oates [3], the local representatives of this geospecies, found in West and some parts of Central Africa, include: Mona monkey (*Cercopithecus mona*), Campbell's mona monkey (*Cercopithecus campbelli*) and Crested mona monkey (*Cercopithecus pogonias*) distinguishable by their coat patterns, male loud calls and distinctive pink lips.

The red-eared guenons, according to Grubb [7] include the species *Cercopithecus cephus, Cercopithecus ascanius, Cercopithecus erythrogaster, Cercopithecus erythrotis, Cercopithecus petaurista* and *Cercopithecus sclateri*. These diverse geospecies, found in the moist forest zone from Guinea-Bissau east to the Great Lakes region of East Africa, are small, agile, long tailed, brightly patterned and highly arboreal rainforest monkeys that spend much of their time in the forest under storey with the exception of the Bioko red-eared monkey.

Putty-nosed guenons are relatively large, long-tailed, arboreal guenons, widespread in African forests. *Cercopithecus nictitans* is found throughout the forests of Western equatorial Africa extending to Northern Senegal River and parts of the Cameroon Highlands [3]. However according to Oates [3] only the subspecies *Cercopithecus nictitans nictitans* occur in West Africa. Although variations in the coloration of these monkeys makes it difficult to ascertain the actual number of subspecies, the few recognized subspecies included *Cercopithecus nictitans martini* on Bioko Island, *Cercopithecus nictitans ludio* in eastern Nigeria and southwestern Cameroon, *Cercopithecus nictitans insolitus* in Central and Western Nigeria, and *Cercopithecus nictitans stampflii* in Cote d'Ivoire and Liberia [3].

As observed by TEAM Network [8], primates are among the most noticeable of tropical mammals owing to the role they play as indicators of low level habitat disturbance. Thus, high representation of primate species present in an area with high population density is indicative of the fact that the forest habitat is providing the required resources for their sustenance and

disturbance is minimal. However, the absence of some species or a depression in population densities of primate species is an indication of the onset of adverse conditions affecting primates as well as other wildlife species [3].

The objectives of the study were to evaluate the population density of guenons, the effects of farming activities on the guenon population and on the available plant species. Findings from this study will promote effective conservation of biodiversity within the sanctuary and proffer solution to the menacing problem of illegal farming activities in the study area.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in Afi Mountain Wildlife Sanctuary (Fig. 1). It is located within the Afi River Forest Reserve in Boki Local Government Area of Cross River State, Nigeria, at the bordering region of South-Eastern Nigeria and South-West Cameroun [1]. The area lies approximately between Latitude 6°15' and 6°25' North and Longitude 8°55' and 9°15' East [1] and is characterized by mountainous and relatively rugged rainforest.

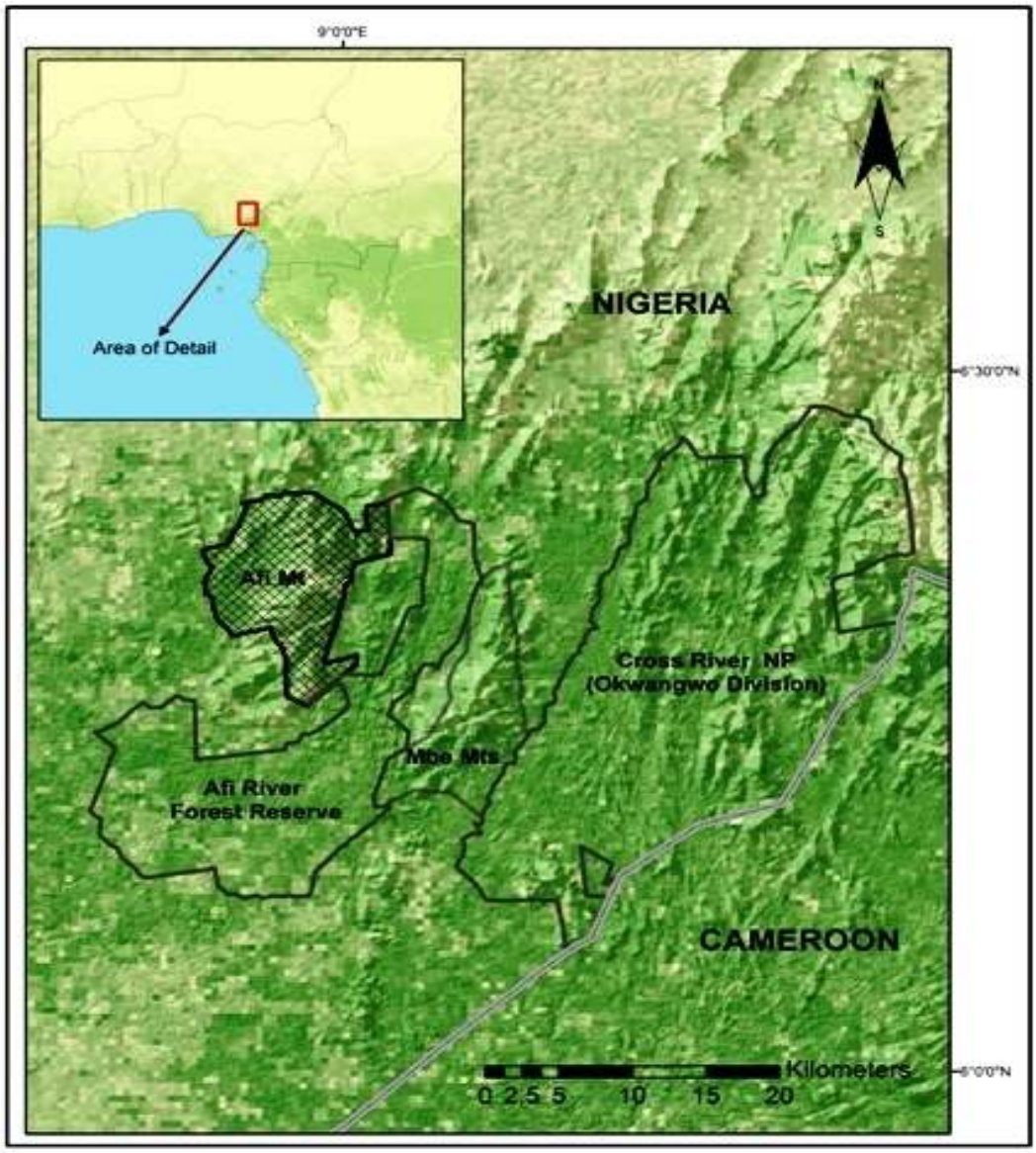

Fig. 1. Map showing location of Afi Mountain Wildlife Sanctuary [9]

Following renewed international attention in the late 1980^s, a wildlife sanctuary was created at Afi Mountain for the conservation of the endemic Cross River Gorilla and other wildlife species was recommended. Later on in May, 2000, the Cross River State Government gazette the Afi Mountain Wildlife Sanctuary covering approximately 104 km^2 [1].

Afi Mountain Wildlife Sanctuary is categorized as a tropical high rainforest vegetation zone with annual rain fall of between 3,000 mm at the lowland areas and 3,800 mm uphill. Rainy season starts around late March/early April to September with a break in August. The dry season starts from October and ends in March. The mean monthly maximum temperature ranges from 22.2℃ to 27.4℃ [1].

Notable endemic and endangered wildlife species found in Afi Mountain include the Cross River Gorilla (*Gorilla gorilla diehli*), Nigeria Chimpanzee (*Pan Trogldytes vellorosus*), and Drill Monkey (*Mandrillus leucophaeus*). Other known wildlife species found in Afi Mountain Wildlife Sanctuary also protected by the endangered species Decree 11 of 1985 include the Red-eared Guenon (*Cercopithecus erythrotis*), Mona Guenon (*Cercopithecus mona*) Putty-nosed Guenon (*Cercopithecus nictitans*) and the Red River Hog (*Potamochoerus porcus*). Presently, the sanctuary harbors the world's largest roosting site for migrating European barn swallows (*Hirundo rustica*) and also an important nesting site for the rare Bare-necked Rock Fowl (*Picarthertes oreas*) [10].

2.2 Data Collection

Line Transect Method was used for the population estimate of Guenons in Afi Mountain Wildlife Sanctuary, following the general guidelines for standardizing line transects by [11].

However, because Afi Mountain Wildlife Sanctuary has a very rugged terrain ten (10) transects were selected randomly from existing rangers patrol routes; two (2) each from the 5 blocks of the study area mapped out by Edet [11]. This method was also employed by Bassey [12]. Transects of 2.0 km length and 0.02 km width, spaced 1.0 km apart were marked with flagging tapes for easy identification of animals locations on the transects. Each transect was covered by an observer and the census was carried out simultaneously at the same time, date and pace of 1 km / hr. during the survey, the following were recorded:

1. Transect number
2. Approximate right angle distance to the observation walked by observer
3. Approximate distance of observer to animal sighted
4. Number of animal sighted
5. Species of guenons sighted
6. G.P.S coordinate at time of sighting

Using the information above, the population density of guenons was determined.

Total enumeration count of vegetation sampling as described by Hall and Swaine [13] was used. This involved the total count of all tree plants above 1 m height, and diameter of not less than 10 cm, from 25 x 25 m^2 quadrants (plots), within 1 hectare. Each hectare had a total of 16 possible plots of 25 x 25 m^2. Four (4) out of the 16 plots were randomly selected from each of the five blocks giving a total of twenty (20) plots.

The following data were collected within each sampling plot:

1. Total count of all tree plants above 1 m height and diameter ≥ 10 cm
2. Total count of all tree plant species and family to which they belong.

Stratified random sampling method as described by Emaikwu [14] was used to select 4 communities including Ebranta, Kakubok, Bitiah and Buanchor from the 16 communities. With the aid of semi structured and validated questionnaires, a total of 100 farmers out of a population of 2000 adults were sampled using snowball sampling technique at five (5) percent sampling intensity. Oral interview were also conducted and recorded with the aid of a tape recorder as Adopted by Abere et al. [15]. This was used to obtain information regarding farming activities and farming methods.

Ten (10), individuals conducted simultaneous surveys in the five blocks of Afi Mountain Wildlife Sanctuary. Officers and Ranger of Afi Mountain Wildlife Sanctuary were engaged in the surveys.

2.3 Data Analysis

The data generated from the study were analyzed using descriptive and inferential statistics. Descriptive statistics was used to analyze data on farming activities. For guenon's population density, the student's t-test (test of

independence means) was used to test the results of guenon's population densities in the two censuses. A null hypothesis which stated that there is no significant difference in the densities of the two censuses was structured.

For the plant species composition, the data was analyzed as follows:

Plant Density = [(Total number of trees encountered / Total area sampled) x 100]

3. RESULTS

Results from the study were presented in tables and charts as shown below.

3.1 Spatial Distribution and Population Density of Guenons in Afi Mountain Wildlife Sanctuary

Table 1 shows the spatial distribution and population density of Guenons in Afi Mountain Sanctuary.

3.2 Plant Species Composition in AMWS

Species composition of some plant species found in the study area is shown in Table 2.

3.3 Indices of Farming Activities in AMWS

Indices of farming activities in some Buanchor and Okubuchi axis of the study area are shown in plates 1 and 2

Plate 1. An encroached farm in Buanchor axis of the study area

Plate 2. An encroached farm in Okubuchi axis of the study area

4. DISCUSSION

The spatial distribution and population density of guenons in the study area is shown on Tables 1. In the two censuses, there was no significance between the means of the two population densities. This population densities means were very low compared with that of 14/km^2 of white throated monkeys in Okomu National Park [16].

However, it was higher than the population density of 0.5/km^2 recorded for Nigerian chimpanzee in the same study area [17]. Based on a report by Oates [3], the low and depressed population could be attributed to the effect of adverse conditions such as farming activities on the population of primates.

The plant species composition of the study area is shown on Tables 2. The overall results shows that seven hundred and seventy eight (778) tree plants were enumerated, this number of plant species enumerated is more than (102) trees enumerated by [1]. However, the occurrence of cash crops species such as cocoa (*Theobroma cocoa*), Banana (*Musa paradiasica*), plantain (*Musa sepientum*) and oil palm (*Elaies guineensis*), representing 5.13%, 1.29% and 3.21% of all plant species sampled, was an indication that the study area had been encroached by illegal farmers. This finding agreed with the report of Mattermieier et al. [18] that there were illegal farms present in the study area.

Table 1. Spatial distribution of guenons in AMWS

Transect number	Location	Block	Length (km)	Width (km)	First census			Second census		
					GPS coordinates	Species sighted	Number sighted	GPS coordinates	Species sighted	Number sighted
1	SRP	South	2.0	0.02	-	-	-	-	-	-
2	SRP	South	2.0	0.02	-	-	-	-	-	-
3	BCC	West	2.0	0.02	-	-	-	-	-	-
4	BCC	West	2.0	0.02	-	-	-	-	-	-
5	LCC	Center	2.0	0.02	-	-	-	-	-	-
6	LCC	Center	2.0	0.02	-	-	-	-	-	-
7	OLC	East	2.0	0.02	-	-	-	-	-	-
8	OLC	East	2.0	0.02	06,23,799 09,58,782	Mona	20	06,23,935 09,01,777	Mona	15
9	NRP	North	2.0	0.02	06,23,565 08,55,699	Red-Eared	15	06,24,127 09,01,414	Red-Eared	20
10	NRP	North	2.0	0.02	06,23,522 08,57,961	Putty-Nosed	13	06,23,522 08,57,961	Putty-Nosed	15

Note: SRP = Southern Rangers Post, BBC = Boje Base Camp, OLC = Olum Base Camp. LCC = Lower Cave Camp, NRP = Northern Rangers Post

Table 2. Species composition of some plant species sampled

Family	Scientific name	Common/ vernacular name	Number	%
Meliaceae	*Khaya ivorensis*	Iroko/ nshi	20	2.57
Meliaceae	*Melicea excels*	Iroko/ nshi	15	1.93
Moraceae	*Musanga cercropoides*	Umbrella tree/ bukobe	5	0.64
Moraceae	*Treculia africana*	Oken	10	1.29
Musaceae	*Musa sepientum*	Banana	25	3.21
Musaceae	*Musa paradisiacal*	Plantain	10	1.29
Theobromaceae	*Theobroma cacoa*	Cocoa	40	5.13
Palmae	*Elaies guineensis*	Oil palm tree/ Owaree	3	0.39

Indices of farming activities in the study area are shown on Plates 1 and 2 and Fig. 2. Plates 1 and 2 shows some illegal farms located in the study area. Fig. 2, showed that slash and burn type of farming was the dominant farming practice in the study area (55%), followed by shifting cultivation (41%) while the conservation friendly method of Agro Forestry was the least practiced method (4%). The results confirmed reports by Mittermier [18] that there were over 200 illegal farms in the study area.

The farmers who had encroached into the sanctuary were mostly youths of age class of 25-35 years. This age class was considered a threat to wildlife conservation in the study area because these youths are restive and energetic. This age class was also found to be responsible for hunting activities in and around Okomu National Park, Edo State, Nigeria [19].

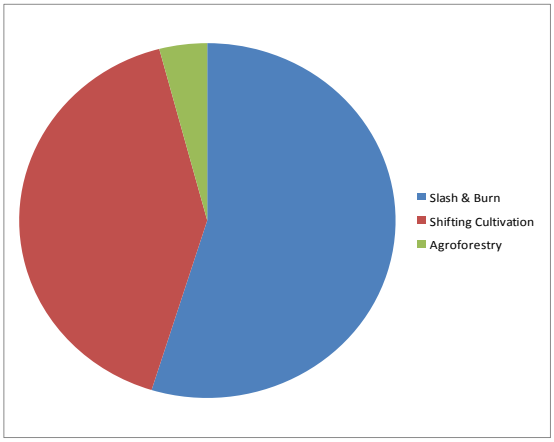

Fig. 2. Types of farming methods in the study area

5. CONCLUSION AND RECOMMENDATIONS

Conclusively, it has been shown that three (3) species of guenons, the Mona guenon (*Cercopitheces mona*), the Red-eared guenon (*Cercopithecus erythrotis*) and the Putty-nosed guenon (*Cercopithecus nictitans*) were sighted directly during the survey of guenons in Afi Mountain Wildlife Sanctuary with low population densities were low ($4/km^2$) resulting predominantly from farming activities carried out by the youthful population of people living around the sanctuary.

It was therefore recommended that alternative employment be provided to the youths living in the surrounding communities to discourage them from farming activities in the sanctuary.

It was also recommended that more research and extensive surveys be carried out to establish the ecological requirement and biology of the numerous species, especially those classified as endangered species, in the study area.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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