Population Ecology of the White-Throated Monkey (*Cercopithecus erythrogaster*) in Afi Mountain Wildlife Sanctuary (AMWS), Cross River State, Nigeria

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Abstract A survey of White-Throated Monkey (*Cercopithecus erythrogaster*) in Afi Mountain Wildlife Sanctuary (AMWS), Cross River State, Nigeria, was conducted to determine its status, ecology and population density. Line transect method of wildlife population determination was used. Ten transects were randomly selected for the study. Transect length of 2.0km and widths of 0.02km were systematically established, 1.0km from each other. Each transect was covered by an observer and census was done simultaneously in all the ten selected transects. The census started simultaneously at an agreed time, dates and places, this lasted for six weeks with data collected weekly. During the census, each observer was equipped with a binocular for easy observation and field notebook to record the information. Direct method of animal sighting was used. Mean population density of White-Throated Monkeys in Afi Mountain Wildlife Sanctuary was 0/km^2, implying that the species was not sighted during the survey even though fecal matter and footprints suspected to be that of White-throated monkey were observed. The vegetation assessment revealed the study area to be composed of tropical rainforest plants species. Dominant species include: *Pycnantus angolensis*, *Bailonella toxisperma*, *Tetrapleura tetraptera*, *Clapacca standtii* and *Cola* spp. Observation also revealed that serious anthropogenic activities were on-going. Therefore, it is recommended that more population surveys of white-throated monkey be carried out in AMWS possibly using methods other than direct sighting. There is also need to carry out research on the ecological requirement and biology of the numerous species, especially the endangered Cross River Gorilla and the Drill Monkey in the study area.

Keywords White-throated Monkey, Population density, Line transect, Two censuses, Animal sighting

1. Introduction

The rainforest of Cross River State is one of the richest in species diversity and endemism in the world, and it is home to two endemic and endangered primates, the Cross River Gorilla (*Gorilla gorilla diehli*) and the Drill monkey (*Mandrillus leucophius*) [1]. Although some studies such as Oates [2] have opined that the White Throated Monkey exist only on the west of River Niger, several reports by hunters in and around the study area with a description of what look like the White Throated Monkey motivated this survey to ascertain if this species also exist in the species rich AMWS.

The quality of the habitat can be determined by the presence or absence of certain species of wildlife [3]. Primates are important indicator species because; they are visible, often threatened, and endangered, have great public appeal and can be sensitive indicators of low-level disturbance [4].

According to Oates [5], if there is a full complement of primate species present and at high population density then the forest habitat is providing the required resources and hunting is not excessive. However, if some species are missing or population densities are depressed, then adverse conditions are affecting primates and probably other wildlife as well.

The white-throated monkey (*Cercopithecus erythrogaster*) is one of the world's most threatened primates [6]. Although, the species is protected by the Nigeria endangered species decree number 11 of 1985, it is conserved and protected only in National Parks, Games Reserves and Wildlife Sanctuaries [7]. No record is available of previous survey of the White Throated Monkey in AMWS despite its ecotourism potentials. Deforestation often caused a disturbance in the habitat, leading to a decline in the number of animal species present either through death or migration to more stable habitats. Indiscrinate hunting is also another major problem causing population decline of many animal species in any habitat [8]. The White Throated Monkey is a threatened species [9]. Therefore, this study assesses and estimates the

population status and ecology of White Throated Monkeys in Afi Mountain Wildlife Sanctuary.

Few works and reports are available on the White Throated Monkey (*Cercopithecus erythrogaster*) in Nigeria, with only [7] focusing attention on its population density in Okomu National Park. These reports include; [10], [11], [12], [13], [14] and [9]. The outcome of this study is therefore important for effective conservation of primates in the study area.

2. Materials and Methods

2.1. Study Area

Afi Mountain Wildlife Sanctuary (AMWS) is in Boki Local Government Area of Cross River State, Nigeria and geographically lies between Latitude 6°25' and 6°30' North and Longitude 8°45' and 9°15' East. The sanctuary (approximately 100km^2) is a rocky massif and located within the confines of host communities such as Buanchor, Olum, Ndemechang, Esekwe, Bitiah and Katabang. The climate of the study area is characterized by an extreme rainfall pattern of 3500 – 5000mm with mean temperatures of 27°C and Relative humidity of about 65% during the afternoons throughout the year. It is the sole water shed of the sixteen surrounding communities.

2.2. Data Collection:

The Line transect method was used for the population estimate and status of the white-throated monkey as stipulated by [15] and [4]. Ten transects (two from each of the five blocks mapped out by Edet [16] were randomly selected from the study area. Transect length of 2.0km and width of 0.02km were systematically laid 1.0km from each other. Distances along transects were marked with flagging tapes at intervals of 0.5km for easy identification of animal locations on transects (figure 1). Each transect was covered by an observer and census was done simultaneously in all the ten selected transects, with the use of an electronic stop watch, which each observer had. This was done to reduce the incidence of double counting. The census started simultaneously at an agreed time, (10:00hrs), date and places (1km/hr). During the census, each observer was equipped with a binocular for easy observation and field notebook to record the following information.

1. Transect number.
2. Approximate right angle distance to the path of observation walked by observer.
3. Approximate distance of observer to animal sighted.
4. Number of white-throated monkeys sighted.

Using the information above, the population density of white-throated monkey was determined using the formula:

$$D = \frac{N}{2LW} \quad [17]$$

Where:
D = animal population density (Number/Km^2)
N = number of animals sighted
L = distance walked by observer (Km)
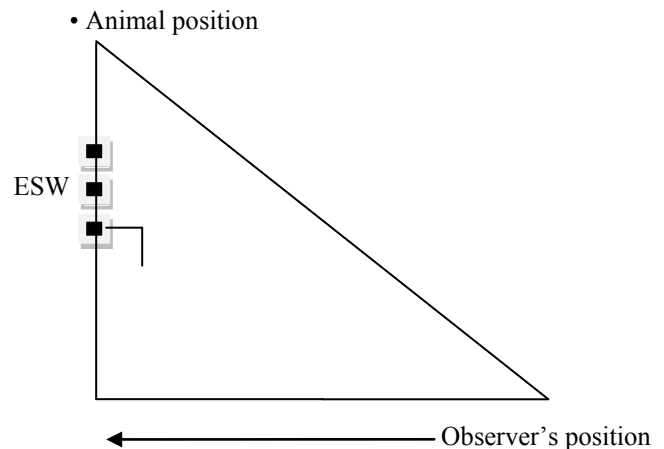W = Effective Stripe Width (ESW) Km

Figure 1.   Diagram of Line transect

Ten (10) individuals conducted simultaneous surveys in the five blocks of Afi Mountain Wildlife Sanctuary (AMWS) on September 21 and October, 22, 2012. Officers and Rangers of AMWS were engaged in the surveys.

The Total Enumeration Count was used in determining the vegetation composition of the study area. This method of vegetation sampling was described by Hall and Swaine [18] and used by Wirkikfea *et al.* [19]. This involved the establishment of 25m x 25m plots or quadrants and all plants of 1m and above height and diameter of not less than 10cm were enumerated. In this study, 20 plots or quadrants were sampled, 4 from each block of AMWS. All tree plants above 1m height, and diameter of not less than 10cm were enumerated. Data collected in each quadrants were: Total counting of all tree plants above 1m height and diameter ≥ 10cm and total enumeration of each plant species according to their families.

Plant density was therefore calculated as:

$$\text{Plant Density} = \frac{\text{Total number of trees counted}}{\text{Total area sampled}}$$

The basal area (BA) per tree was calculated using the expression:

$$BA = \frac{\pi D2}{4} \, x \, 0.0001$$

Where D = mean diameter at breast height (cm)
BA = Basal area (m^2)

While the Basal Area for each plot was expressed as:

$$BAP = \sum_{i=1}^{k} BA$$

Where BAP = Basal Area per plot

$\sum_{i-1}^{k} BA$ = Summation of basal areas of all trees and

plants above 1m height within sampled plots.

Data Analysis:

The student's 't'-test (test of independent means) was used to test the results of the white-throated population densities in the two censuses. The test criterion is given as:

$$\text{'t'} = \sqrt{\frac{/X1-X2/}{SP2\left(\frac{1}{ni}+\frac{1}{n2}\right)}}$$

Where;

X_1= Mean density of first census
X_2 = Mean density of second census
Sp^2 = Pooled variance
n_1 = Frequency of sight in first census
n_2 = Frequency of sight in second census

Pooled variance Sp^2 =

$$\frac{\left[\sum x_1^2 - \frac{(\sum x_1)^2}{n_1}\right] + \left[\sum x_2^2 - \frac{(\sum x_2)^2}{n_2}\right]}{(n_1-1)+(n_2-1)}$$

Or

$$\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{(n_1-1)+(n_2-1)}$$

Where;

S_1^2 and S_2^2 are variances for the first and second censuses respectively. The statement of hypothesis (in the null form) is, there is no significant difference in the mean densities of the two censuses.

3. Results and Discussion

The mean population densities of white-throated monkeys in the study area are 0 individuals/Km^2 and 0 indiviudal/Km^2 for the first and second census respectively (Table I and II).

Table 1. Population Density of White-throated Monkeys in the first Census

Transect Number	Right angled effective distance walked by observer L (Km)	Strip width W (Km)	Number of Monkeys sighted N	Animal population density D
1	2.0	0.00	0	0
2	2.0	0.00	0	0
3	2.0	0.00	0	0
4	2.0	0.00	0	0
5	2.0	0.00	0	0
6	2.0	0.00	0	0
7	2.0	0.00	0	0
8	2.0	0.00	0	0
9	2.0	0.00	0	0
10	2.0	0.00	0	0

Mean population density = O/km^2

Table 2. Population Density of White-throated Monkeys in the Second Census

Transect Number	Right angled effective distance walked by observer L (Km)	Strip width W (Km)	Number of Monkeys sighted N	Animal population density D
1	2.0	0.00	0	0
2	2.0	0.00	0	0
3	2.0	0.00	0	0
4	2.0	0.00	0	0
5	2.0	0.00	0	0
6	2.0	0.00	0	0
7	2.0	0.00	0	0
8	2.0	0.00	0	0
9	2.0	0.00	0	0
10	2.0	0.00	0	0

Mean population density = O/Km^2

Density of White-throated monkeys in AMWS

$$= \frac{0 + 0}{2} = \text{O/km}^2$$

The statistical test of significance between the two population density means, showed no significant difference ($P< 0.05$). From the two censuses, the overall density of white-throated Monkeys in AMWS is 0/km^2

A population density of zero White-throated Monkey per square kilometer in AMWS is very low compared with that of 0.5 individual of the Nigerian/Cameroon Chimpanzee in the same study area [20] or that of 14 individuals per kilometer square in Okomu National Park [7]. This result may agree with previous report like that of Stuart and Stuart [14], and [9] that in Nigeria, this species is found only in the rain forest ecological zone west of the River Niger. Although, hunters in the area reported sighting it, this survey did not sight it probably be because the survey did not cover the entire Wildlife Sanctuary. Physical observations and indices of foot prints, calls, faeces and feeding places revealed the presence of diverse wildlife species.

The results also show that seven hundred and seventy eight (778) plant species of twenty seven (27) families were enumerated, with *Pycnantus angolensis* (5.14%) having the highest incidence, followed by *Bailionella toxisperma* (4.5%) and *Tetrapleura tetraptera* (3.86%). The least encountered plants species were those of *Uapaca acuminata* and *Garcinia manii* (0.26%), followed by *Cola lepidota*, *Elaies guineensis*, *Uapaca staudtii* and *Antrocaryon micraster* (0.39%).

The result also shows that more plants species in fewer families were enumerated than that by [21], again, the encounter of cash crop species such as *Musa paradiasica* (3.21%), *Theobroma cacoa* (2.57%) and *Musa sepientum* (1.29%), is an indication that the study area is seriously affected by human activities. Furthermore, because this study was carried out after the landslide of July, 2012 in the study area, it is possible that some plants families

encountered by [21] were not encountered in this study may have been washed away by the landslide.

4. Conclusions

The sampled population density of white-throated Monkeys in AMWS is zero due to the fact that this species was not sighted directly during the survey of the wildlife sanctuary. Apart from the white-throated Monkeys, physical observation and other indices revealed the presence of diverse mammalian, and *herpertofuana* species including chimpanzees, drill monkeys, porcupine, duiker and citatunga.

Therefore, it is recommended that more population survey of white-throated monkey be carried out in AMWS possibly using methods other than direct sighting. There is also need to carry out research on the ecological requirements and biology of the numerous species, especially the endangered Cross River Gorilla and the Drill Monkey in the study area. Government, NGOs and individuals should encourage research on these species through adequate logistics and financial support.

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