Preliminary Studies on Population Status of Mona Monkey (*Cercopithecus Mona*) in Afi Mountain Wildlife Sanctuary, Cross River State, Southern Nigeria

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Abstract: Preliminary study on the population status of mona monkeys (*Cercopithecus mona*) was conducted in Afi Mountain Wildlife Sanctuary (AMWS) in April (wet season) and December (dry season) of 2014. Data were collected from 20 transects randomly selected from the Northern Sector (12 transects) and Southern Sector (8 transects) using the systematic segmented trackline sampling option. Data generated were analysed with density equation (D) and chi-square (χ^2) statistical analysis at 5% level of significance. Population parameters assessed are troop density and troop size. Wet season troop densities for the Northern Sector, Southern Sector and entire sanctuary were 8.69±1.80, 7.71±1.93 and 8.20±1.87 troops/km^2 respectively. Troop sizes recorded were 4.44±0.30, 3.80±0.36 and 4.12±0.33 individuals/troop for the Northern Sector, Southern Sector and entire sanctuary respectively for the same season. Dry season troop densities of 7.80±0.23, 6.66±2.04 and 7.23±1.14 troops/km^2 were also obtained for the Northern Sector, Southern Sector and entire sanctuary respectively. Within the same period, the values for troop sizes (individuals/troop) were 3.16±0.91 (Northern Sector), 3.20±3.30 (Southern Sector) and 3.18±0.61 (entire sanctuary). There is no significant difference (p>0.05) between the wet and dry seasons as well as between the Northern and Southern Sectors in relation to troop sizes and troop densities. The AMWS habours a high population of *Cercopithecus mona* as indicated in this study. It is recommended that regular population census should be conducted to ascertain more population parameters for effective conservation of the species.

Keywords: Population Status, Troop Density, Troop Size, Mona Monkey, Wildlife Sanctuary

1. Introduction

The Nigeria mona monkey is a *Least Concern status* species that is endemic to Nigeria and Cameroon (Mendoza and Palmqvist, 2006). Mona monkeys are small to medium-sized monkeys that live in groups of up to 35 (Groves, 2005). Current knowledge of the species population is scanty and based mostly on rough estimates. Poaching of mona monkeys to supply the bush meat trade is considered the greatest threat to their survival but habitat loss is also significant. A recently prepared IUCN action plan for the species lists the Cross

River rainforest as an Exceptional Priority Site (Mendoza and Palmqvist, 2006). Consequently, there is need to assess the population status of the mona monkey for adequate protection of the species in the wild.

The Nigeria mona monkey (*Cercopithecus mona*), is subject of serious concern to many interest groups (Mendoza and Palmqvist, 2006) because Nigeria contains the last great community of mona monkeys in Africa and the world at large (Eisenberg, 1990). There is limited information on the species beyond the primate communities (Oates *et al.,* 2008). Information on mona monkey distribution and abundance is very important to the understanding of their significance as

ecological driving force and their development for tourism purposes. This assessment is also vital in evaluating conservation hotspots, eco-tourism potential for game viewing, the nature and extent of human-wildlife conflicts and sustainable harvesting of bush meat by local communities (Newmark *et al.*, 1994; Naughton – Trevee, 1998).

In Nigeria, a major problem facing wildlife conservation is the increasing rate of habitat loss or modification due to human activities (Ogunjemite *et al.*, 2007). There is no doubt that there has been large-scale destruction and mismanagement of the forest ecosystems of Nigeria. Ecological disasters and climatic change have resulted in loss of soil fertility and greatly reduced biological productivity (Agbelusi *et al.*, 1999). Afolayan *et al.* (2004) observed that about 34% of the original wildlife habitat in Nigeria had been lost. This has affected wildlife resources within these ecological systems leaving only remnant populations of wildlife resources in protected areas including wildlife sanctuaries, game reserves and national parks.

A wildlife sanctuary is a naturally occurring refuge, in most cases within a protected area, where certain species are afforded total protection. A typical example is the Afi Mountain Wildlife Sanctuary in Cross River State. The sanctuary was carved out from the Afi River Forest Reserve with the sole aim of protecting the Cross River gorilla, chimpanzee, drill monkey and other primates including the mona monkey. Afi Mountains contains some of the relics of the primary rainforests of Southern Nigeria eco-zone and it is the major hope for the long-time survival of the remaining biological diversities of the region. The sanctuary is endowed with a complex assemblage of fauna and flora species. The area is one of the sites that will offer an excellent opportunity for the realization of the Nation's tourism objectives. The area has tourist features that can interest potential tourist in Southern Nigeria. The sanctuary is one of the most important protected areas within the internationally recognized Gulf of Guinea biodiversity hotspot (Myers *et al*, 2000; Oates *et al.*, 2004). This region is thought to be the last stronghold of a significant portion of pristine tropical forest in Nigeria and is said to be the most diverse protected forest in West Africa (Eniang *et al.,* 2008). It is part of the sites known to have high numbers of primate species in Nigeria.

The rapid growth of human populations is almost at the expense of wildlife populations, particularly of large animals. Widespread destruction of wildlife and its habitats had led to decline in wildlife population especially the primates, which however precedes the establishment of sedentary agriculture and animal husbandry. Primates are the closest relatives of man in the entire living world. They survive in the tropical forests and savanna woodlands within the tropics. They are wide spread but no longer safe as a result of intensive anthropogenic impacts such as poaching, indiscriminate collection of non-timber forest products (NTFPs), unsustainable agriculture, felling of wild trees for timber, indiscriminate bush burning (Edet *et al.*, 2005). Growing human populations which are expanding into forest habitats, and clearing of forests for agriculture are the major causes of forest loss (Cowlishaw and Dunbar, 2000). Since primates are at their highest diversity in tropical forest, the loss of these forests is widely regarded as the factor that mostly threatens their survival (Chapman and Peres, 2001).

Report by IUCN (2005) shows, that there are about 625 distinct kinds of primate species and subspecies, and almost all are endangered. Like other large mammals, primates are relatively easy to survey because they are conspicuous to the degree of hunting pressure (Ransom, 2004) and thus make them indicator species. In this view, flourishing primates' population serves as a good indicator of the general health of a rainforest ecosystem (Mcfarland, 1999 and Oates, 2001). Threats created by forest loss, leading to wildlife declination include forest fragmentation, primate crop raiding, hunting of primates for use in medicines, as pets, and for food have adversely affected the ability of primates to survive in the near future.

Little about population characteristics and habitat requirements of most endangered species has been known (Botkin and Keller, 1997). Of a fact, wildlife can only be effectively and efficiently managed if available information or data on their numbers, age, sex ratio, and reproductive rates are known. Thus the census of wild animals, including mona monkeys, at prescribed intervals will reveal some knowledge of their distribution, daily activities and seasonal migration (Imong and Dunn, 2005). To effectively manage and conserve mona monkeys and prevent their extinction, it is important to obtain reliable population estimates and identify major threats to their survival in Afi Mountain Wildlife Sanctuary. Such data will aid management plans and decisions for the conservation of the species in line with the recent regional action plan launched by Nigeria and Cameroon towards the conservation of the species. The study therefore, assessed the population status of mona monkey (*Cercopithecus mona*) taking into cognizance troop density and troop size in Afi Mountain Wildlife Sanctuary.

2. Material and Methods

2.1. Study Area

The study was carried out in Afi Mountain Wildlife Sanctuary (latitude 6° 15' – 6° 25' North, longitude 8° 55' - 9° 15' East), a biodiversity hotspot in Southern Nigeria (Ransom, 2004). The sanctuary is located within the Afi River Forest Reserve in Boki Local Government Area of Cross River State, Nigeria. Following renewed international attention in the late 1980s, the creation of a wildlife sanctuary at Afi Mountains for the conservation of the endemic Cross River Gorilla and other wildlife species was recommended (Edet, 2010). Thus in May 2000, the Cross River State Government established the Afi Mountain Wildlife Sanctuary covering approximately 104km^2 (Edet *et al.*, 2012).

The Afi Mountain Wildlife Sanctuary generally falls within the tropical high forest vegetation zone. The rainforest occupies the foot of the mountain and at about 700m part of the forest structure changes gradually into sub-montane

vegetation while the eastern portion of the sanctuary is characterized by rock outcrop vegetation. Edet *et al.* (2012) identified some common tree species on Afi Mountain to include *Pterocarpus osun, Albizia zygia, Parkia bicolor, Pycnanthus angolensis, Irvingia gabonensis* and *Monodora myristica.*

According to Edet *et al.* (2014) the sanctuary is inhabited by notable endemic and endangered species of wildlife. These include the Cross River gorilla (*Gorilla gorilla diehli*), Nigeria chimpanzee (*Pan troglodytes vellorosus*) and drill (*Mandrillus leucophaeus*). Other known primates which are protected by the Endangered Species Decree 11 of 1985 include the red-eared guenon (*Cercopithecus erythrotis*), mona guenon (*Cercopithecus mona*) and red river hog (*Potamochoerus porcus*). Wild bird species include the Shelley's eagle owl (*Bubo Shelleyi*), African piculet (*Sasia africana*), migrating European barn swallows (*Hirundo rustica*), and the rare bare-necked rock fowl (*Picarthertes oreas*) (Knoop, 2005; Imong, 2005).

2.2. Reconnaissance Survey

Reconnaissance survey was carried out in the month of February 2014, to acquaint the researchers with the terrain of the Afi Mountain Wildlife Sanctuary. Information from the sanctuary management and review of previous literature on mona monkey (*Cercopithecus mona*) in the protected area constituted part of the reconnaissance survey. This aided in choosing the ecological survey method used.

2.3. Sampling Design

The sampling design was made in distance with 3 km transects placed using the systematic segmented track-line sampling option as described by Wanyama et. al (2010). The angle at which the transects were run was varied to assess which direction provided the most even probability of sampling each corner of the sanctuary, and the north-south orientation proved to be the most balanced design. A total of twenty transects (each 15 m in width) were randomly selected for the study; 12 and 8 transects in the Northern and Southern Sectors of the sanctuary respectively. To avoid incidence of multiple location, track-lines were separated by 1km while transects on track-lines were separated by 0.1km.

2.4. Ecological Survey

The survey was carried out in April 2014 (wet season) and was repeated in December 2014 (dry season). Daily survey of mona monkeys was carried out as early as between 8 am and 12.00 noon, with the assistance of one research officer and two rangers from the sanctuary in each of the transects. The early morning census was desired since primates are inactive and sluggish in the afternoon, and detection may be difficult and liable to error. Moreover, according to Williamson and Feistner (2011), primates leave their nests as early as 6.20 am. At the beginning of each daily survey of mona monkeys on the transects, information on location, date, time and weather conditions were obtained.

2.5. Data Collection

Data were collected on transects, as described by Jayaraman (1999), to obtain estimate of troop density and troop size in the area of study. A line transect is a fixed path independent of external features along which survey will take place. The transect method has the following general setting:

- Assume that one has an area of known boundaries and size and the aim is to estimate the abundance of some wildlife (mona monkey) population, in the study area.
- The use of line transect sampling requires that at least one line of travel be established in the area. The number of detected animals (s_i) is noted along with the perpendicular distances (x_i) from the line to the detected animals. Otherwise, the sighting distance r_i and sighting angle θ_i are recorded from which x_i can be arrived at using the formula $x = r \sin \theta$.
- Let n be the sample size. The corresponding sample of potential data is indexed by (s_i, r_i, θ_i, $i = 1,..., n$). A graphical representation of line transect sampling is shown in Figure 1.
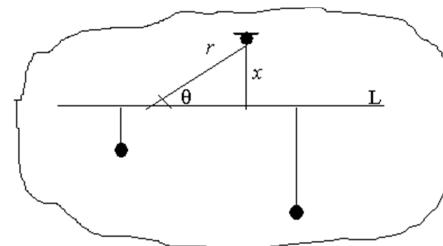
Source: Jayaraman (1999)

Fig. 1. *Pictorial representation of line transect sampling.*

Materials that were used for data collection include observation sheets, prismatic compass, digital camera, global positioning system (GPS) units, binoculars, sextant and 50m tape.

2.6. Data Analysis

Data obtained from the study were used to estimate the density of the species. Estimate of density was computed using the equation

$$D = \left[2\pi L^2 \sum_{i=1}^{n} \frac{x_i^2}{n^3}\right]^{-0.5}$$

where D = density of species, L = transect length (km), x = perpendicular distance (km) and n = number of observations.

The relative standard error or coefficient of variation (CV) of the density estimate was also computed using the equation

$$CV(D) = 100 \sqrt{\frac{1}{n} + \frac{1}{2n}}$$

Troop size was estimated with the equation $\frac{AS}{n_i}$, where AS = number of animals sighted and n_i = number of observations.

Chi-square (χ^2) statistical analysis was used to test if troop sizes as well as troop densities differ significantly between the wet and dry seasons and also between the Northern and Southern Sectors. The tests were conducted at 5% level of significance.

3. Results and Discussion

3.1. Results

The following tables contain population data on mona monkeys (*Cercopithecus mona*) obtained from the Northern and Southern Sectors of Afi Mountain Wildlife Sanctuary (AMWS).

Table 1. Wet season population data of mona monkeys at the Northern Sector of AMWS.

Transect	Number of animals sighted (AS)	Number of observations (n_i)	Troop size (AS/n_i)	[(Total perpendicular distance)^2] km^2	Density (Troops/km^2)
NT$_1$	22	5	4.40	0.011739	
NT$_3$	24	4	6.00	0.007427	
NT$_4$	30	6	5.00	0.010623	
NT$_6$	14	4	3.50	0.007699	
NT$_7$	10	3	3.33	0.007306	8.69±1.80
NT$_8$	20	5	4.00	0.007291	
NT$_{10}$	16	4	4.00	0.007944	
NT$_{11}$	21	4	5.25	0.009682	
Grand total		35	35.48	0.069711	
		Mean ± S. E	4.44±0.30		

Note: Total transect length=3km × 12 transects = 36.00km. No observations were made on NT$_2$, NT$_5$, NT$_9$ and NT$_{12}$

Table 2. Wet season population data of mona monkeys at the Southern Sector of AMWS.

Transect	Number of animals sighted (AS)	Number of observations (n_i)	Troop size (AS/n_i)	[(Total perpendicular distance)^2] km^2	Density (Troops/km^2)
ST$_1$	15	3	5.00	0.009275	
ST$_3$	13	4	3.25	0.006049	
ST$_4$	5	2	2.50	0.003656	
ST$_6$	23	5	4.60	0.007889	7.71±1.93
ST$_7$	17	4	4.25	0.010964	
ST$_8$	19	6	3.17	0.026355	
Grand total		24	22.77	0.064188	
		Mean ± S. E	3.80±0.36		

Note: Total transect length = 3km × 8 transects = 24.00km. No observations were made on ST$_2$ and ST$_5$

Table 3. Wet season population data (combined) of mona monkeys in AMWS.

Sector	Troop size	Density (Troops/km^2)
Northern	4.44±0.30	8.69±1.80
Southern	3.80±0.36	7.71±1.93
Mean ± S. E	4.12± 0.33	8.20±1.87

Table 4. Dry season population data of mona monkeys at the Northern Sector of AMWS.

Transect	Number of animals sighted (AS)	Number of observations (n_i)	Troop size (AS/n_i)	[(Total perpendicular distance)^2] km^2	Density (Troops/km^2)
NT$_1$	11	4	2.75	0.005821	
NT$_2$	6	2	3.00	0.003546	
NT$_4$	11	5	2.20	0.008786	
NT$_5$	5	1	5.00	0.001849	
NT$_7$	21	6	3.50	0.007846	
NT$_9$	19	5	3.80	0.008893	7.80 ± 0.23
NT$_{10}$	5	3	1.67	0.007985	
NT$_{11}$	7	2	3.50	0.002965	
NT$_{12}$	3	1	3.00	0.001521	
Grand total		29	28.42	0.049212	
		Mean ± S. E	3.16 ± 0.91		

Note: Total transect length=3km × 12 transects = 36.00km. No observations were made on NT$_3$, NT$_6$ and NT$_8$.

Table 5. *Dry season population data of mona monkeys at the Southern Sector of AMWS.*

Transect	Number of animals sighted (AS)	Number of observations (n_i)	Troop size (AS/n_i)	[(Total perpendicular distance)^2] km^2	Density (Troops/km^2)
ST_4	6	2	3.00	0.004105	
ST_5	8	3	2.67	0.002354	
ST_6	13	3	4.33	0.004941	6.66 ± 2.04
ST_8	10	4	2.50	0.007601	
Grand total		16	16.00	0.025523	
		Mean $\pm$ S. E	3.20 ± 0.30		

Note: Total transect length = 3km $\times$ 8 transects = 24.00km. No observations were made on ST_1 ST_2, ST_3 and ST_7

Table 6. *Dry season population data (combined) of mona monkeys in AMWS.*

Sector	Troop size	Density (Troops/km^2)
Northern	3.16 ± 0.91	7.80 ± 0.23
Southern	3.20 ± 0.30	6.66 ± 2.04
Mean $\pm$ S. E	3.18 ± 0.61	7.23 ± 1.14

Table 7. *Chi-square (χ^2) analysis (at p =0.05) for troop size and troop density.*

	Troop size		Troop density	
	Wet season	Dry season	Wet season	Dry season
Northern Sector	4.44 (4.29)	3.16 (3.31)	8.69 (8.76)	7.80 (7.73)
Southern Sector	3.80 (3.95)	3.20 (3.05)	7.71 (7.64)	6.66 (6.73)
χ^2_{cal}	0.3034		0.1332	
χ^2_{tab}	3.84		3.84	
Decision	Not significant		Not significant	

3.2. Discussion

Data on population status of mona monkeys (*Cercopithecus mona*) were obtained for the wet and dry seasons of 2014. As indicated in Tables 1 and 2, troop densities of mona monkeys for the dry season in Afi Mountain Wildlife Sanctuary were 8.69 ± 1.80 and 7.71 ± 1.93 per km^2 for the Northern and Southern Sectors respectively. The implication is that the troop densities of mona monkeys for the two sectors are high. According to Oates *et al.* (2008), though the species has been impacted by large scale habitat loss, and hunting for bush meat, it appears that the species can adapt well to secondary habitats, and remains common in its range including the Afi Mountain forest. The highest wet season troop density recorded for the Northern Sector may be as a result of the intensive anti-poaching patrol n the Northern Sector of sanctuary. The Northern sector is also close to Okwangwo Division of Cross River National Park and there exist collaborations among managements of the protected areas, Wildlife Conservation Society (WCS), Nigeria Conservation Foundation and other NGOs on how best to protect wildlife species especially primates common to the two protected areas.

Mean troop sizes of monas for the wet season are 4.44 ± 0.30 and 3.80 ± 0.36 individuals for the Northern and Southern Sectors respectively. This is far less than the average of 12 and 35 individuals per group as reported by Oates *et al.* (2008) and Groves (2005) respectively. The combined data for the two sectors as shown in Table 3 indicated a mean troop size of 4.12 ± 0.33 individuals while mean density was 8.20 ± 1.87 troops per km^2.

For the dry season as shown in Table 4, 5 and 6, 3.16 ± 0.91, 3.20 ± 0.30 and 3.18 ± 0.61 individuals per troop were recorded for the Northern Sector, Southern Sector and entire sanctuary respectively. On the other hand the Northern Sector, Southern Sector and entire sanctuary recorded 7.80 ± 0.23, 6.66 ± 2.04 and 7.23 ± 1.14 troop per km^2.

Chi-square (χ^2) statistical analysis shows that there is no significant difference (p>0.05) between the wet and dry seasons as well as between the Northern and Southern Sectors in relation to troop sizes and troop densities (Table 7). Thus the data for troop size and troop density obtained from the wet season reflect the same trend as that of the dry season. Troop density results were relatively higher than other species of primates in the sanctuary (Ukpong, 2001; Ransome, 2004; Edet *et al.* 2014). The higher troop density was responsible for the smaller troop size. According to Irwin (2008), troop size of most mammals is inversely proportional to its troop density; that is the larger the troop size the smaller the troop density.

4. Conclusion and Recommendations

The data obtained from the study shows that the troop density of mona monkeys (*Cercopithecus mona*) is high, though the area is still under threats from anthropogenic impacts from encroachment. In order to encourage higher population of arboreal species in the sanctuary adequate conservation and management of plant and soil ecosystem should be improved as the habitat resources continue to serve as sources of food, cover and breeding spaces for the arboreal population that inhabit the protected area.

The following recommendations are made based on the

findings of this study.

1. Regular population census of *Cercopithecus mona* in the sanctuary should be conducted to ascertain other population parameters for effective conservation of the species.

2. The sanctuary should improve the Research Department through appointment of more wildlife experts and procurement of biological equipment so as to provide useful data and information on the existing wildlife species and their habitats which could serve as baseline information for adequate management.

3. Encroachment in the sanctuary in form of logging, farming and poaching should be totally discouraged as soon as possible so as to preserve the existing population of flora and fauna resources.

4. The protected area should encourage the establishment of more anti-poaching units especially along the sanctuary boundaries for effective monitoring.

5. The sanctuary should always encourage the protection staff through regular review of anti-poaching patrol allowance; training and retraining of sanctuary staff on modern patrol techniques, to enable them detect and control activities of poachers in the sanctuary.

6. It is also very important for the management of the sanctuary to establish a very good relationship with all the local communities adjoining the boundaries of the protected area so that these communities could support the conservation efforts of the sanctuary.

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