Population estimate of the Cross River gorilla (Gorilla gorilla diehli) using a sweep survey of nests in Afi Mountain Wildlife Sanctuary, Southern Nigeria

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ABSTRACT

There is a dearth of information on the population status of the endemic Cross River gorilla. This study was carried out to ascertain the population size, number of bands and band size of the subspecies in Afi Mountain Wildlife Sanctuary, Southern Nigeria in March and September, 2012. A sweep survey was carried out in an attempt to obtain a total count of gorillas in the five blocks of the sanctuary. Mean, standard error of mean and chi-square ($\chi^2$) were used to analyse data generated. Results showed that the mean number of nests per block were 18.50 ± 1.23, 18.50 ± 0.25, 3.00 ± 0.50 and 2.00 ± 0.00 for the Northern, Central, Eastern and Southern Blocks respectively. Population estimate from the two study periods was 42 ± 1.50 individuals with a low density of 0.40 ± 0.02 gorillas/km$^2$. Number of bands was 4.50 ± 0.25 while an average band size of 9.38 ± 0.19 individuals/band and band density of 0.04 ± (2.00 × 10$^{-3}$) band/km$^2$ were recorded for the subspecies. There was no significant difference (p < 0.05) among the parameters measured and between the two censuses. Continuous ecological monitoring of the subspecies is needed to determine the current trends in population, biomass levels and densities. Well financed anti-poaching patrols are also needed to check poaching problem of the area.

Keywords: Population, estimate, gorilla, survey, wildlife, sanctuary.

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INTRODUCTION

The Cross River gorilla (Gorilla gorilla diehli), a subspecies of the western gorilla (Gorilla gorilla) is found in contiguous forest patches bordering South-Southern Nigeria and South-Western Cameroon, an area recognised as a biodiversity hotspot characterized by species diversity and endemism (Edet, 2011). The subspecies is one of the most critically endangered primates of Africa (Oates et al., 2008; IUCN, 2013). The subspecies is also one of the world’s 25 most endangered primates (Mittermeier et al., 2009). As humans extend their land use, Cross River gorilla habitat is rapidly disappearing, and this may have adverse effects on number of individuals within the subspecies. The Cross River gorilla (Gorilla gorilla diehli), chimpanzee (Pan troglodytes vellorosus) and drill (Mandrillus leucophaeus), though legally protected by the Endangered Species Decree 11 of 1985, are some of the primates hunted for bushmeat and other purposes (Edet, 2011). The major threat to the survival of the subspecies is lack of a thorough conservation strategy necessary for its protection. Wild animal species can be effectively conserved if adequate and reliable information on their numbers, age, sex ratio, productivity rates, distribution, daily activities and seasonal migrations are provided (Imong and Dunn, 2005). Obtaining reliable population estimates is imperative in managing wildlife populations (Krebs, 1999). Accurate information on the status and trends of animal populations obtained from inventory and socio-ecological studies is a prerequisite for successful wildlife conservation programs (Plumptre and Cox, 2006;
Leca et al., 2013). Thus knowledge of number of individuals within the subspecies, their distribution and abundance will form an aspect of ecological studies of gorillas and their habitat, especially in forested corridor that cuts across Afi Mountains and Mbe Mountains. The Mbe Mountains are a home to the nearest subpopulations of Cross River gorillas, and it is therefore high priority for the AMWS partnership to protect the forested corridor between the two areas, so as not to permanently isolate gorillas and other mammals in Afi Mountains. This will further engender conservation strategy and policies specifically designed to promote gorilla conservation in Afi and Mbe Mountains.

Cross River gorilla population estimation is necessary to know the quality of the habitat in which they live. Gorillas, like most primates, are useful indicator species (Ajayi et al., 2011), and their abundance in most ecosystems may provide clues to degree of hunting pressure, disease, and resource availability for protection. According to Edet (2011), if there are full compliments of species present each at high population density, then the habitat is providing the required resources and hunting is not excessive. However, if some indigenous primate species are missing or population densities depressed, then adverse conditions are affecting the species and probably other forest mammals as well (McFarland, 1999). The Cross River gorilla population estimation is also justifiable because of the role it may play in the development of eco-tourism in the tourism sector of the Nigerian economy. Gorilla tourism is a high return type of tourism (Blom, 2001). According to Boulos (2013), gorilla tourism is big business, and permits costs 500.00 US dollars per day at the Bwindi Impenetrable National Park, Uganda. There are conditions to develop such tourism in Afi Mountain Wildlife Sanctuary. More so, habituation of the species is been proposed by the Cross River State Forestry Commission (Sam, 2005), however this cannot be achieved without the knowledge of a current estimate of this important endemic primate in Afi Mountain Wildlife Sanctuary. In order to start habituating gorillas in Afi Mountain Wildlife Sanctuary, it was essential to have a better understanding of their distribution and densities.

Previous studies by Ransom (2004) estimated 35 to 40 individuals from nest sample counts while Imong and Dunn (2005) estimated 23 to 27 individuals from line transect approach. There is, therefore, a need to provide an update of population status of the Cross River gorilla using another approach (sweep survey of nests in the entire study area) other than sample counts and line transects which often give biased estimates. The sweep survey of nests avoids sampling estimates, but takes into consideration all sleeping nests constructed by all living individual gorillas in the entire protected area. Gorillas are shy, elusive primates and it is difficult to count them directly, thus counts of their sleeping nests (with fresh dung) will produce an estimate of the population size (Mehlam and Doran, 2002). Each gorilla in a group (other than infants) normally makes a new nest every night so that the number of nests constructed each evening is equivalent to the number of gorillas in the protected area.

MATERIALS AND METHODS

Area of study

The study was carried out in Afi Mountain Wildlife Sanctuary (AMWS), a protected area in South-Southern Nigeria. According to Edet et al. (2012) and Conservation International (2005) the Sanctuary is situated within the mountainous and relatively rugged rainforest block in the border region of South-Eastern Nigeria and South-Western Cameroon, an area recognised as one of Africa's biodiversity hotspots characterised by species diversity and endemism. The sanctuary has an approximate area of about 104 km² and lies between latitude 6°05'0"N and 6°30'0"N, and longitudes 8°52'0"E and 9°13'0"E East (Figure 1) in Boki Local Government Area of Cross River State, Nigeria (Edet, 2011).

The Cross River State Government established the protected area in May, 2000 for the protection of the endemic Cross River gorilla and other species of wildlife, most of which are endangered as a result of anthropogenic impacts such as poaching and unsustainble use of the forest.

The Afi Mountain Wildlife Sanctuary generally falls within the tropical high forest vegetation zone. Edet et al. (2012) identified 102 tree species in 35 families. Common tree species on Afi Mountain include Albizia bipindensis, Pterocarpus osum, Albizia zygia, Parkia bicolor, Pycnanthus angolensis, Trichophiton scleroxylon, Mitragyna stipulosa, Ceiba pentandra and Xylophia africana. 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 vellorumus) and drill (Mandrillus leucophaeus). The red-eared guenon (Cercopithecus erythorhryus) and mona guenon (Cercopithecus mona) are other common primates present in the area. The area is also noted as a very important roosting and nesting site for the European barn swallows (Hirundo rustica) and rock fowl (Picaribetra orea) respectively (Edet et al., 2012; Edet, 2011).

Data collection and analysis

A sweep survey of the entire mountain was carried out in an attempt to obtain a total nest count of gorillas in the sanctuary. This approach was used by Nwufho (2003) for monitoring of gorillas in Mbe Mountains, Cross River State. So, rather than continue with the highly labour-intensive daily monitoring of the gorillas in the area, we adopted a sweep survey of the entire mountain using a number of survey teams. Five (5) separate teams were engaged in the census to cover the five blocks (Northern, Southern, Eastern, Western and Central) of the sanctuary. The researchers, five rangers of the Cross River State Forestry Commission and ten educated, but reformed gorilla hunters participated in the survey. All the rangers and reformed hunters were trained at once to ensure uniformity and standardisation of methodology. All the five blocks of the mountain were searched simultaneously and intensively for a period of one week (7.00 am to 4.00 pm daily), with each team located at a central location or camp in each block. The camps were Base Camp (Central Block), Irruan Axis Camp (Northern Block), Odoja Lower Cave Camp (Western Block), Olum Base Camp (Eastern Block) and Katabang Axis Base Camp (Southern Block). Overlap of teams was avoided by the use of flagging tapes to mark the extent of the five blocks according to easily recognisable features such as trails, peaks and streams. Each block was intensively searched for gorilla nests (which were
determined by the presence of distinctive fresh tri-lobed dung); using old hunting trails, transects and by making new trails. The searches were carried out simultaneously around each of the camp, with the teams moving in a different direction each day. The primary focus of the survey was to locate fresh nest sites, but any trails, feeding evidence or dung encountered were also noted. Trails were followed to the nest sites. Close contact with the animals was avoided so as not to influence their movement and behaviour. Nest site observation commenced the following morning immediately the animals abandoned their nests. Whenever a nest site was located, data were collected on number of nests. Global Position System (GPS) was used to record the nest site location. All nest sites encountered were labeled with flagging tapes to avoid multiple counting. The survey which was conducted in March 2012 was repeated six months later (September 2012) to produce an estimate (with confidence limits) of population size.
The quantitative data generated from the sweep survey of gorillas in this study in the first census revealed a total of thirty-nine (39) fresh nests (individuals) as shown in Table 1. The Northern and Central Blocks recorded sixteen (16) and nineteen (19) fresh nests respectively while the Eastern and Southern Blocks recorded two (2) fresh nests each. In the second study period, a total of forty-five (45) fresh nests were recorded (Table 2). Twenty-one (21), four (4) and two (2) nests were recorded for the Northern, Eastern and Southern Blocks respectively. The Central Block recorded two nest sites with fifteen (15) and three (3) nests respectively. The number of individuals per band ranges between 2 and 21 (Tables 1 and 2). These results are in line with the findings of Yamagiwa et al. (2003) that the minimum group size for all subspecies of gorilla is two individuals while the maximum group size can exceed twenty individuals.

As indicated in Table 3, the mean population estimates for the various blocks are Northern (18.50 ± 1.23), Central (18.50 ± 0.25), Eastern (3.00 ± 0.50) and Southern (2.00 ± 0.00) while the pooled estimate for the whole sanctuary is 42.00 ± 1.50 individuals. There is no significant difference among estimated population parameters and between the two censuses (p < 0.05) as shown in Table 4. The average of about 9.38 ± 0.19 individuals per band recorded for the subspecies, as shown in Table 4 slightly follows the report of 9.2 individuals recorded by Watts (1996), Doran and McNeilage (1997) as well as Robbins (2001).

The density of 0.40 ± 0.02 individuals/km² recorded for the subspecies (Table 4) is far below the 2.50 nesting individuals/km² recorded for the proposed Lobeke Forest Reserve in Cameroon (Usongo, 1998) and 1.52 individuals/km² recorded for Sangha Reserve, Central African Republic (Remis, 2000). However, the result from the present study slightly follows that of 0.44 individuals/km² recorded in Gabon (Williamson and Usongo, 1996), 0.70 individuals/km² recorded for Rio Muni Island in Equatorial Guinea (Fa et al., 1995) and higher than 0.20 individuals/km² reported by Bowens-Jones and Pendry (1999) in Motaba Region of the Republic of Congo. As shown in Table 4, band density for the subspecies in AMWS was 0.04 ± (2.00 × 10⁻³) troops/km².

### RESULTS AND DISCUSSION

The population density of gorillas in Afi Mountain Wildlife Sanctuary is low, and this is line with previous studies (Ransom, 2004; Imong and Dunn, 2005). The study has been conducted using counts of fresh nests. The possibility of remote sensing application should be exploited in subsequent study. This will further ascertain if gorillas do not actually inhabit the Western Block of the Sanctuary as indicated in this study.

Poaching for bushmeat utilization and social status as well as unsustainable agriculture are among the factors responsible for the decline in abundance of wildlife species including the gorillas in Afi Mountain Wildlife Sanctuary and environs. According to Edet et al. (2005) primates including gorillas are among the mostly preferred wildlife species for bushmeat and ethnomedicinal purposes by indigenous people of the Cross River rainforest. Despite several campaigns for the conservation of the Cross River gorilla (Ogogo et al., 2013; Sarmiento and Oates, 1999) the sub-species is heavily poached because of the social status being accorded hunters with numerous gorilla skulls to display during festive periods and war dances (Edet, 2011). Intensive poaching which is typified by low density of
Table 2. Record of fresh gorilla nest sites in AMWS at the second study period (September, 2012).

<table>
<thead>
<tr>
<th>Date of observation</th>
<th>Block</th>
<th>Location of nest sites</th>
<th>Number of nests</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-09-2012</td>
<td>Northern</td>
<td>06°23.559’N 08°59.620’E</td>
<td>21</td>
<td>3 nests on the ground; 18 nests on trees.</td>
</tr>
<tr>
<td>12-09-2012</td>
<td>Central</td>
<td>06°19.424’N 08°58.381’E</td>
<td>15</td>
<td>8 nests on the ground; 7 nests on trees.</td>
</tr>
<tr>
<td>13-09-2012</td>
<td>Central</td>
<td>06°19.272’N 08°58.454’E</td>
<td>3</td>
<td>All nests on the ground.</td>
</tr>
<tr>
<td>13-09-2012</td>
<td>Eastern</td>
<td>06°20.232’N 08°58.419’E</td>
<td>4</td>
<td>Nests on the ground.</td>
</tr>
<tr>
<td>15-09-2012</td>
<td>Southern</td>
<td>06°18.149’N 08°54.621’E</td>
<td>2</td>
<td>Nests on trees.</td>
</tr>
</tbody>
</table>

Note: Gorilla presence was not recorded in the Western Block. Source: Field Survey (2012).

Table 3. Record of gorilla nests per block in AMWS.

<table>
<thead>
<tr>
<th>Block</th>
<th>1st census</th>
<th>2nd census</th>
<th>Mean ± S.E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>16 (1)</td>
<td>21 (1)</td>
<td>18.50 ± 1.23</td>
</tr>
<tr>
<td>Central</td>
<td>19 (1)</td>
<td>18 (2)</td>
<td>18.50 ± 0.25</td>
</tr>
<tr>
<td>Eastern</td>
<td>2 (1)</td>
<td>4 (1)</td>
<td>3.00 ± 0.50</td>
</tr>
<tr>
<td>Southern</td>
<td>2 (1)</td>
<td>2 (1)</td>
<td>2.00 ± 0.00</td>
</tr>
<tr>
<td>Total</td>
<td>39 (4)</td>
<td>45 (5)</td>
<td>42.00 ± 1.50</td>
</tr>
</tbody>
</table>

Figures in parentheses () are number of nest sites = number of bands. Source: Field Survey (2012).

Table 4. Estimated parameters from the two study periods.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1st census</th>
<th>2nd census</th>
<th>Mean ± S.E</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population estimate</td>
<td>39 (39.65)</td>
<td>45 (44.35)</td>
<td>42.00 ± 2.12</td>
<td>0.40 ± 0.02 individual/km²</td>
</tr>
<tr>
<td>Number of bands (troops)</td>
<td>4 (4.25)</td>
<td>5 (4.75)</td>
<td>4.50 ± 0.25</td>
<td>0.04 ± (2.00 × 10⁻³) band/km²</td>
</tr>
<tr>
<td>Band size</td>
<td>9.75 (8.85)</td>
<td>9.00 (9.90)</td>
<td>9.38 ± 0.19</td>
<td>-</td>
</tr>
</tbody>
</table>

Figures in parentheses () are chi-square ($\chi^2$) expected values, $\chi^2_{cal} = 0.2214$, $\chi^2_{tab} = 5.99$ at 2 degrees of freedom (df). There is no significant difference among population parameters and between the two censuses (p<0.005). Source: Field Survey (2012).

gorillas and other wildlife species is detrimental to wildlife conservation in Afir Mountain Wildlife Sanctuary and the surrounding communal forests.

Gorilla conservation in the area of study requires the understanding and goodwill of the local people, which can be achieved through well organized conservation education programme at various levels of the society to get public sympathy and understanding. Public relations activities in the form of radio, jingles, television broadcast, plays and documentary programmes must be institutionalised. These will improve the public awareness of the endangered wildlife species (including the endemic Cross River gorilla) of the sanctuary that may attract educational research, international grant support and other NGOs' interest to support conservation. Continuous ecological monitoring should be carried out to determine the current status of gorilla population and estimate biomass levels of the species as well as their densities.

Well financed anti-poaching patrol units should be put in place to combat the poaching problems of the area. Equipments like four wheel drive vehicles, arms and ammunition, communication (e.g. a VHF radio network to link the sanctuary to Forestry Commission Headquarters and field offices) and camping equipments are needed for effective patrol of the area. It was realized during the study period that despite the creation of the patrol zones,
there is still the need to further check the activities of poachers and this could be achieved through the aid of a mobile patrol squad. The ranger post at the Northern Block of the sanctuary is yet to be built. The construction of ranger posts at strategic locations within the sanctuary is necessary to facilitate wider monitoring and law enforcement within the protected area and the neighbouring human settlements.

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REFERENCES


