

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

Daniel. I. Edet<sup>1\*</sup>, Samuel Ajayi<sup>2</sup> and Ovat. I. Ovat<sup>2</sup>

<sup>1</sup>Department of Forestry and Wildlife Technology, Federal University of Technology, Owerri, Nigeria.

<sup>2</sup>Department of Forestry and Wildlife Management, Cross River University of Technology, Obubra Campus, Cross River State, Nigeria

Accepted 15 May, 2014

---

## 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  $18.50 \pm 1.23$ ,  $18.50 \pm 0.25$ ,  $3.00 \pm 0.50$  and  $2.00 \pm 0.00$  for the Northern, Central, Eastern and Southern Blocks respectively. Population estimate from the two study periods was  $42 \pm 1.50$  individuals with a low density of  $0.40 \pm 0.02$  gorillas/km<sup>2</sup>. Number of bands was  $4.50 \pm 0.25$  while an average band size of  $9.38 \pm 0.19$  individuals/band and band density of  $0.04 \pm (2.00 \times 10^{-3})$  band/km<sup>2</sup> 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.

---

\*Corresponding author. E-mail: daniffer2003@yahoo.com.

---

## 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 might 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 km<sup>2</sup> 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 unsustainable 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 biphidensis*, *Pterocarpus osun*, *Albizia zygia*, *Parkia bicolor*, *Pycnanthus angolensis*, *Triplochiton scleroxylon*, *Mitragyna stipulosa*, *Ceiba pentandra* and *Xylopia 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 vellerosus*) and drill (*Mandrillus leucophaeus*). The red-eared guenon (*Cercopithecus erythrotis*) 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 (*Picarthetes oreas*) 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 Nwufoh (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), Iruan 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

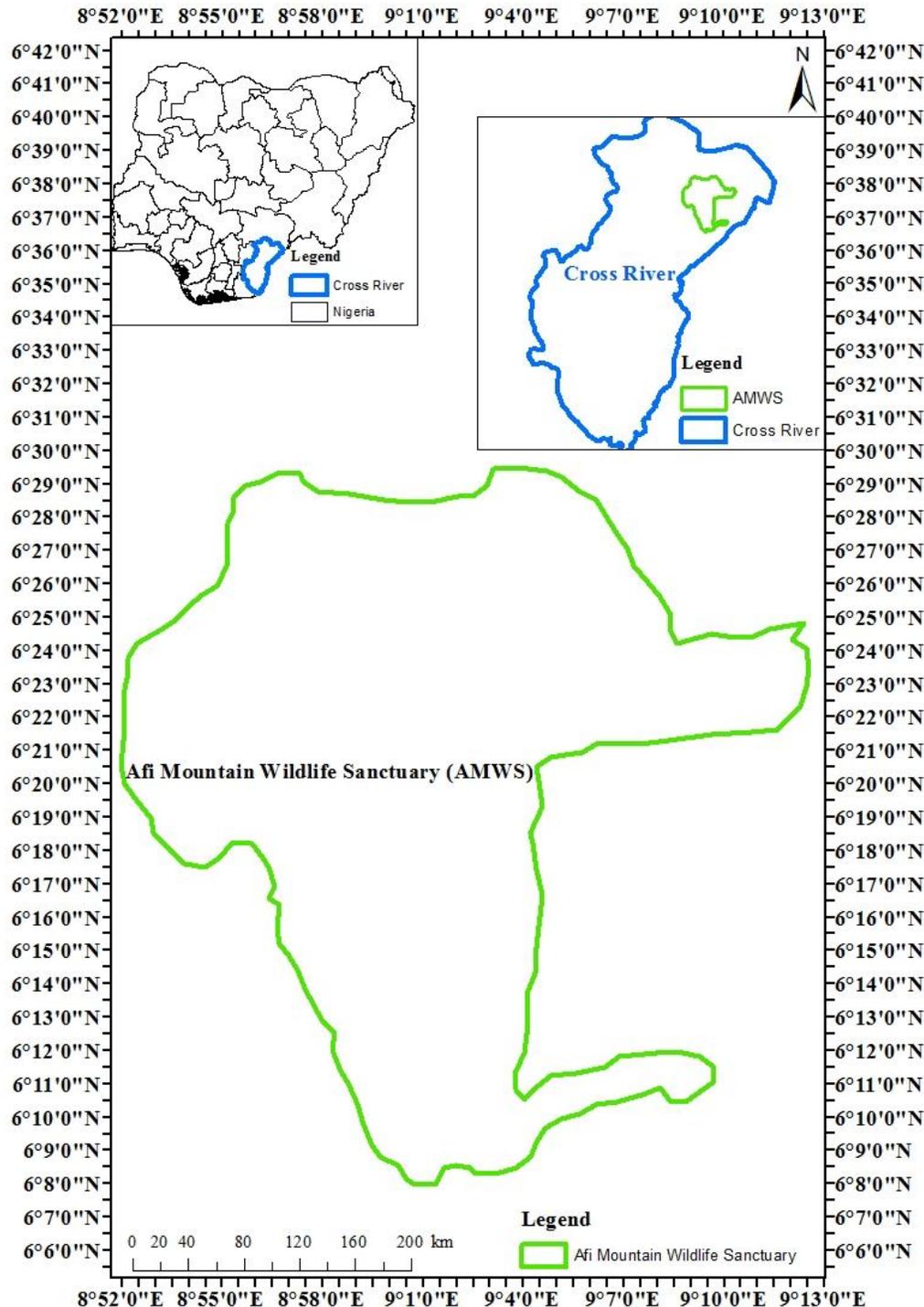


Figure 1. Map of the study area.

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.

**Table 1.** Record of fresh gorilla nest sites in AMWS at the first study period (March, 2012).

Date of observation	Block	Location of nest site	Number of nests	Remarks
07-03-2012	Northern	06°23.626'N 08°58.127'E	16	6 nests on the ground; 10 nests on trees.
09-03-2012	Central	06°19.290'N 08°58.696'E	19	All nests on the ground.
07-03-2012	Eastern	06°20.193'N 08°58.415'E	2	Nests on the ground
08-03-2012	Southern	06°18.146'N 08°56.121'E	2	Nests on trees.

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

Data generated from nest sites were analysed with mean, standard error and chi-square ( $\chi^2$ ) at 5% level of probability.

## RESULTS AND DISCUSSION

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 ( $18.50 \pm 1.23$ ), Central ( $18.50 \pm 0.25$ ), Eastern ( $3.00 \pm 0.50$ ) and Southern ( $2.00 \pm 0.00$ ) while the pooled estimate for the whole sanctuary is  $42.00 \pm 1.50$  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  $9.38 \pm 0.19$  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  $0.40 \pm 0.02$  individuals/km<sup>2</sup> recorded for the subspecies (Table 4) is far below the 2.50 nesting individuals/km<sup>2</sup> recorded for the proposed Lobeke Forest

Reserve in Cameroon (Usongo, 1998) and 1.52 individuals/km<sup>2</sup> recorded for Sangha Reserve, Central African Republic (Remis, 2000). However, the result from the present study slightly follows that of 0.44 individuals/km<sup>2</sup> recorded in Gabon (Williamson and Usongo, 1996), 0.70 individuals/km<sup>2</sup> recorded for Rio Muni Island in Equatorial Guinea (Fa et al., 1995) and higher than 0.20 individuals/km<sup>2</sup> 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  $0.04 \pm (2.00 \times 10^{-3})$  troops/km<sup>2</sup>.

## CONCLUSION AND RECOMMENDATION

The population density of gorillas in Afi Mountain Wildlife Sanctuary is low, and this is in 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 ethno-medicinal 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).

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

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

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

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

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

**Table 4.** Estimated parameters from the two study periods.

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

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 ( $p < 0.05$ ). Source: Field Survey (2012).

gorillas and other wildlife species is detrimental to wildlife conservation in Afi 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.

## ACKNOWLEDGEMENT

Our profound appreciation goes to the management and staff of the Cross River State Forestry Commission (CRSFC) for providing us with some of the logistics for the survey.

## REFERENCES

- Ajayi S, Edet DI, Bukie JO, 2011. Population density of the white throated monkey (*Cercopithecus erythrogaster*) in Okomu National Park, Edo State, Nigeria. *J Agric For Soc Sci*, 9(2):175-182.
- Blom A, 2001. Ecological and Economic Impacts of gorilla-based tourism in Dzanga-Sangha, Central African Republic. PhD Thesis, Wageningen University and Research Centre. Pp 165.
- Boulos N, 2013. Visiting the Jungle VIPs: Mingling with Mountain gorillas in Uganda's Remote South. Associated Newspaper Ltd (downloaded 19-03-2014). <http://www.dailymail.co.uk>.
- Bowen-Jones E, Pendry S, 1999. The threat to primates and other mammals from the bushmeat trade in Africa, and how this threat could be diminished. *Oryx*, 33:235.
- Conservation International (CI), 2005. Biodiversity Hotspots. CI Facts. Internet Communication (downloaded 07-05-2012). Available from URL: <http://www.fao.org/docrep/XO451E/XO45/el/htm>.
- Doran DM, McNeillage A, 1997. Gorilla ecology and behavior. *Evol Anthro*, 6(1):120-31.
- Edet DI, 2011. Biodiversity Utilization Pattern in Afi Mountain Wildlife Sanctuary, Cross River State, Nigeria. Ph.D. Thesis, University of Ibadan, Ibadan, Nigeria.
- Edet DI, Ayodele IA, Akinyemi AF, 2005. Threats to wildlife and their utilizable products in the Cross River rainforest, Nigeria. *J Agric For Soc Sci*, 3(1):61-68.
- Edet DI, Ijeomah HM, Ogogo AU, 2012. Preliminary survey of tree species diversity in Afi Mountain Wildlife Sanctuary, Southern Nigeria. *Agric Biol J North Am*, 3(12):486-492.
- Fa JB, Juste J, Del Val JP, Castroviejo J, 1995. Impact of market hunting on mammal species in Equatorial Guinea. *Cons Biol*, 9:1107-1115.
- Imong IS, Dunn A, 2005. Report of Afi Mountain Wildlife Sanctuary Gorilla Census. March 2005. NCF-WCS Biodiversity Research Programme, Calabar, Cross River State, Nigeria. Pp. 19.
- International Union for Conservation of Nature and Natural Resources (IUCN), 2013. Red List of Threatened Species. Version 2013.1. (downloaded 21-08-2013). <http://www.iucnredlist.org>
- Krebs CJ, 1999. *Ecological Methodology*. Second edition. Addison-Wesley Publishers, Menlo Park, California.
- Leca J, Gunst N, Rompis A, Soma G, Putra IGAA, Wandia IA, 2013. Population density and abundance of ebony leaf monkeys (*Trachypithecus auratus*) in West Bali National Park, Indonesia. *Primate Cons*, 26(1):133-144.
- McFarland K, 1999. Afi Mountain Wildlife Sanctuary Field Guide. Pp. 3.
- Mehlam PT, Doran DM, 2002. Influencing western gorilla nest construction at Mondika Research Centre. *Int J Primatol*, 23(6):1257-1285.
- Mittermeier RA, Wallis J, Rylands AB, Ganzhorn JU, Oates JF, Williamson EA, Palacios E, Heymann EW, Kierulff MCM, Yongcheng L, Supriatna J, Roos C, Walker S, Cortés-Ortiz L, Schwitzer C, eds, 2009. *Primates in Peril: The World's 25 Most Endangered Primates 2008–2010* (PDF). Illustrated by S.D. Nash. Arlington, Virginia: IUCN/SSC Primate Specialist Group (PSG), International Primatological Society (IPS), and Conservation International (CI). Pp. 1–92.
- Nwufoh E, 2003. Report on the Joint Gorilla Monitoring Exercise, Mbe Mountains. November 2003. NCF – WCS Biodiversity Research Programme Calabar, Cross River State, Nigeria. Pp. 14.
- Oates JF, Bergl RA, Sunderland-Groves J, Dunn A, 2008. Gorilla gorilla ssp. diehli. In IUCN 2013.
- Ogogo AU, Eniang EA, Etta US, 2013. Habitat utilization and conservation of the Cross River gorilla (*Gorilla gorilla diehli*) in Afi Mountain Wildlife Sanctuary of Cross River State, Nigeria. *Int J Biol Chem Sci*, 7(4):1579-1585.
- Plumptre AJ, Cox D, 2006. Counting primates for conservation: primate surveys in Uganda. *Primates*, 47:65–73.
- Ransom CM, 2004. Afi Mountain Wildlife Sanctuary: Gorilla Survey, May, 2004. NCF - WCS Biodiversity Research Programme, Calabar, Cross River State, Nigeria. Pp 15.
- Remis MJ, 2000. Preliminary assessment of the impacts of human activities on gorillas *Gorilla gorilla* and other wildlife at Dzanga-Sangha Reserve, Central African Republic. *Oryx*, 34:59.
- Robbins MM, 2001. Variation in the social system of mountain gorillas: the male perspective. In: Robbins M. M., Sicotte, P., & Stewart, K. J., (eds). *Mountain gorillas: three decades of research at Karisoke*. Cambridge (England): Cambridge Univ. Press. Pp 29-58.
- Sam U, 2005. Prospects of Gorilla habituation in Afi Mountain Wildlife Sanctuary of Cross River State, Nigeria. A Biannual News Letter for Afi Mountain Wildlife Sanctuary, Boki Local Government Area, CRS, Vol. 1 No. 2, 2005. Pp 73.
- Sarmiento EE, Oates JF, 1999. Cross River Gorillas - a neglected subspecies. *Gorilla Journal*, December 1999 (downloaded 19-03-2014). Available from URL: <http://www.berggorilla.de>.
- Usongo L, 1998. Conservation status of primates in the proposed Lobeke Forest Reserve, Southeast Cameroon. *Primate Cons*, 18:66.
- Watts DP, 1996. Comparative socio-ecology of gorillas. In: McGrew WC, Marchant LF, Nishida T, editors. *Great Ape Societies*. Cambridge (England): Cambridge Univ. Press. Pp 16-28.
- Williamson EA, Usongo L, 1996. Survey of gorillas *Gorilla gorilla* and chimpanzees *Pan troglodytes* in the Reserve de Faune du Dja, Cameroon. *Afr Prim*, 2:67.
- Yamagiwa J, Kahekwa J, Kanyunyi BA, 2003. Intra-specific variation in social organization of gorillas: implications for their social evolution. *Primates*, 44:359-369.