



ISSN 2635-3296

Journal of Forest Science Environment.
Volume 7 (2022): 97 – 103

Estimates of Primates Population Density and
Distribution in Kainji Lake National Park,
Nigeria

Modu M ● Akosim C ● Yaduma Z B



© Forestry and Wildlife Department, University of
Maiduguri, Nigeria

Website: www.jfseunimaid.com.ng



ESTIMATES OF PRIMATES POPULATION DENSITY AND DISTRIBUTION IN KAINJI LAKE NATIONAL PARK, NIGERIA

MODU M ^{a*} • AKOSIM C ^b • YADUMA Z B ^b

^a Department of Forestry and Wildlife, University of Maiduguri

^b Department of Forestry and Wildlife Management, Modibbo Adama University of Technology, Yola

*Corresponding Author's email: malamodu50@unimaid.edu.ng

ABSTRACT: Population information of wildlife species is crucial to the management of National parks. This study investigated the abundance and distribution of primate species in Kainji Lake National Park. The line transect method was used to survey primate abundance for both wet and dry seasons. Computer software (*DISTANCE*) was used for estimates the primates' densities and the mean encounter (MERs). The results revealed that Olive baboon (*Papio anubis*), Patas (*Erythrocebus patas*), Tantalus (*Chlorocebus tantalus*), Mona (*Cercopithecus mona*), Green (*Cercopithecus aethiops*) and Colobus (*Colobus vellerosus*) monkeys were sighted in the park. The densities of the primate species were baboon (54.94km⁻²), Patas (47.14km⁻²), Tantalus (3.58km⁻²), Mona (4.56km⁻²), Green (4.56km⁻²) and Colobus monkeys (0.34km⁻²). The MERs and densities of baboons were 16.26km⁻¹ and 32.58 km⁻² for morning and 1.18km⁻¹ and 22.36km⁻² for evening surveys. More individuals (5140) of all the six species were sighted in the wet season than in the dry season (2228). The population densities and structure of baboon, Patas and Tantalus monkeys were estimated, in view of the species expanding population the park management should without delay implement a definite programme on primate species population management in the park. The aim should be to ensure that the primates do not exceed the carrying capacity of the ranges.

Keywords: Primate, abundance, distribution, Population, National Park

1. INTRODUCTION

Primate abundance and distribution are variable in time, especially in regions where the monkeys track feeding resources over large areas (Pablo, 2001). The limited baseline data in the study area (KLNP) makes monitoring impossible because there will be no bases for determining increase or decline in primate population. Food abundance and distribution have played a central role in the conceptual theory of primate socio-ecology (Pablo,

2001). This theory predicts that agonistic (contest) competition should occur when food is distributed in discrete, defensible patches; in contrast, when food sources are distributed uniformly or randomly, nonagonistic (scramble) competition is expected (Erin and Janson, 2011). The primary goal of ecologists is to understand the ecological factors that determine species distribution and abundance patterns (Westem, 2001). The use of space has thus become a central theme in primate studies with conservationists relying on patterns of

habitat use and minimum resource requirements for the effective conservation and management of various primate populations (Arrowood, *et al.*, 2003). This is particularly true for those inhabiting small, isolated and fragmented habitats (Robbin, 2003).

Nocturnal primates can be challenging to survey and, especially for many species that live in dense forest habitats, limited information is available on their densities and distributions. Primate distribution and abundance, as well as their spatial and temporal population trends, are important data to collect in the aim of gaining knowledge on ecosystem functioning, but can also form the basis for management decisions and offer a means by which to evaluate the effectiveness of different conservation strategies. However, estimates of species distribution, population size, and trends may vary considerably in quality depending on the choice of survey design and the methods used. In this study, details were provided on the different steps involved in the planning of a primate survey, and three case studies were used to illustrate the variety of options available according to study species and survey objectives. When carefully designed, a primate survey can yield precise and accurate estimates of population distribution, abundance and trends, and thus provide an information source which supports researchers, wildlife managers and government in decision-making processes Geneviene *et al.*, 2016).

Primates are highly intelligent animals that live in family groups in a number of habitats throughout the world. Chimps live in forest, woodland and savannah habitats in family groups that are predominantly female. In the wild, the males separate from the group in adolescence. Chimps in the wild also make adaptations to their group size called "fission and fusion" in response to the availability of food and social situations within their troop (Lawton, 2015). Mandrills live in harems with one male and five to 10 females plus up to 10 youngsters. The females use tree habitats while males patrol on the ground. Mandrill home ranges are up to 50 square kilometers and are some of the largest of the baboon species. Across a wide variety of organisms, taxa whose individuals live at high local densities (abundance) often, even usually, have relatively large geographical ranges (distributions) (Lawton, 2015).

2. METHODS

2.1. Study Area

Kainji Lake National Park (KLNP) is geographically located between Latitudes 9° 40' and 10° 20' N, and Longitude 3° 40' and 5°10'E. The study area (KLNP) which has a savannah climate has a total area of 5,340.82 sq km and is located in the North West central part of

Nigeria between Niger and Kwara States. The area has two distinctive sectors known as the Borgu and Zugerma Sectors (Marguba, 2002). Kainji Lake National Park was established as Premier Park in Nigeria on 29th July 1979 by the amalgamation of the two existing Game Reserves, Borgu and Zugerma sectors under decree 46 of 1976 replaced by decree 36 of 1991. Zugerma Sector covers an area of 1370.89km² and it is situated in Mashegu Local Government Area of Niger State while Borgu sector is located in Borgu Local Government Area of Niger State in Kaiama and Barutten Local Government Areas of Kwara state. It covers an area of 3970.02sqkm. Both sectors (Zugerma and Borgu) are separated by the Kainji Lake, a lake impounded on the river Niger for hydroelectric power generation (Eleazor, 2002) as shown in Figure 1.

2.2. Study Design, Sampling and Data Collection

Data collection covered both wet and dry seasons. Wet season data collection was done from August to October and the dry season data was collected from February to April. Line transect was the main method that was used for surveying diurnal primates' abundance. Sampling sites were selected based on presence of forest patches occupied by primates and possibility of experiencing human-nonhuman primate conflict. Villages adjacent to the park boundaries both in Borgu and Zugerma Sectors of the park were selected for the study.

In this study, the eight administrative ranges in Kainji National Park (Doro range, Oli range, Kuble range and Kali range in Borgu sector; Kemanji range, Worumakoto range, Ibbi range and Kulho range in Zugerma sector) were randomly selected. In each of these administrative ranges, two established trails were randomly selected and used as line transects for the survey as described by Chapman and Lambert (2000). Each transect was 4km length were measured and to assist the enumerators in judging distances along the transect, each transect was calibrated using flagging tapes on the trees at every 100m as described by Buckland *et al.* (2001). Research assistants were drawn from members of staff of Kainji Lake National Park, who were further trained for data collection in the field.

Survey for direct observation of primates was done in the morning and evening. Daytime census walk began at 06:00 hours and ends at 10:45hours at an average speed of about 1 km h⁻¹, including a pause at every 100 meters looking from side to side and recording all sightings of primates (White and Ward, 2010). Additional evening walk censuses were done between 16:00 hours to 19:45 hours. At the start of each transect walk information on observers' names, name of transect, coordinate was recorded at the top of the data sheet. When sightings were

made, the following observations were recorded in the data sheet: number in troop, troop composition (age and sex), activity at sighting, altitude, sighting distance (m), angle at sighting, time of sighting, location on the transect and habitat type. A pair of binoculars 10x 40

was used to enhance sighting during the survey. The estimated distance location on transects were obtained by referring to numbered tags placed every 100 meters along the transect. Perpendicular distances were determined by direct measurement using meter tape.

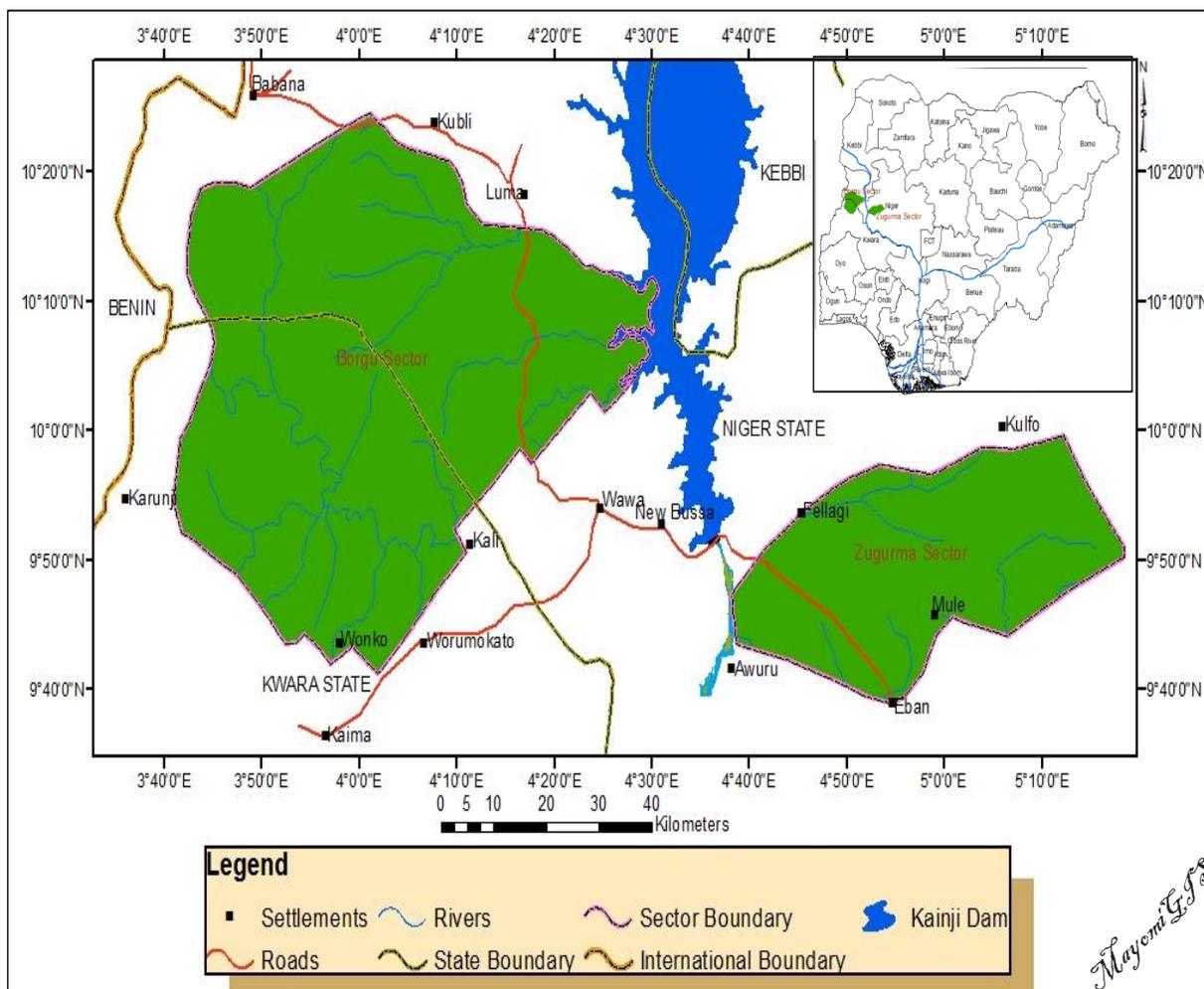


Figure 1: Map of Kainji Lake National Park. Source: Digitized from Google Earth Pro (May, 2018): GIS Laboratory, Dept. of Geography, University of Maiduguri

2.3. Study Design, Sampling and Data Collection

Data collection covered both wet and dry seasons. Wet season data collection was done from August to October and the dry season data was collected from February to April. Line transect was the main method that was used for surveying diurnal primates' abundance. Sampling sites were selected based on presence of forest patches occupied by primates and possibility of experiencing human-nonhuman primate conflict. Villages adjacent to

the park boundaries both in Borgu and Zugerma Sectors of the park were selected for the study.

In this study, the eight administrative ranges in Kainji National Park (Doro range, Oli range, Kuble range and Kali range in Borgu sector; Kemanji range, Worumakoto range, Ibbi range and Kulho range in Zugerma sector were randomly selected. In each of these administrative ranges, two established trails were randomly selected and used as line transects for the survey as described by Chapman and Lambert (2000). Each transect was 4km

length were measured and to assist the enumerators in judging distances along the transect, each transect was calibrated using flagging tapes on the trees at every 100m as described by Buckland *et al.* (2001). Research assistants were drawn from members of staff of Kainji Lake National Park, who were further trained for data collection in the field.

Survey for direct observation of primates was done in the morning and evening. Daytime census walk began at 06:00 hours and ends at 10:45 hours at an average speed of about 1 km h⁻¹, including a pause at every 100 meters looking from side to side and recording all sightings of primates (White and Ward, 2010). Additional evening walk censuses were done between 16:00 hours to 19:45 hours. At the start of each transect walk information on observers' names, name of transect, coordinate was recorded at the top of the data sheet. When sightings were made, the following observations were recorded in the data sheet: number in troop, troop composition (age and sex), activity at sighting, altitude, sighting distance (m), angle at sighting, time of sighting, location on the transect and habitat type. A pair of binoculars 10x 40 was used to enhance sighting during the survey. The estimated distance location on transects were obtained by referring to numbered tags placed every 100 meters along the transect. Perpendicular distances were determined by direct measurement using meter tape.

2.4. Data Analysis

Estimates of Abundance and Distribution of primates in the study area

The conventional sampling computer software package called *DISTANCE* version 6.0 was used to achieve the abundance and distribution of primates. The software facilitates all the computations and plotting needed in the analysis. Analysis phase involves exploratory phase that takes care of preparation of histograms of the distance data under several groupings to assess presence of heaping and the occasional gross error (Rebecca and Brigida, 2004).

For the first category of analyses, data from all the ranges were pooled to obtain estimates of density, abundance and the mean encounter rate for the primates in Kainji National Park. In the second category, the data was post-stratified and the estimates of densities, abundance and mean encounter rates (MER) were computed for morning and evening surveys. The third category of analysis involved post-stratification of the data using season as covariate in modeling detection probability, and the estimates of density, abundance as well as the encounter rate for each of the two seasons.

3. RESULTS

After survey efforts of 256 km, a total of 7368 individuals of six primate species were sighted in the study area. Table 1 presents the estimates of densities and abundance for the six primate species in the study area. The species most-sighted in the area was olive baboon having mean encounter rate (MER) and density of 13.73 km⁻¹ and 54.94 km⁻², respectively.

Table 1: Estimates of densities and distribution of six primate species in the study area

Species	N	%	MER	D/km ⁻²	CI	AIC
Olive Baboon	3516	47.7	13.73	54.94	7.5-55.0	2536
Colobus monkey	22	0.3	0.09	0.34	0.1-0.6	912
Green monkey	292	4.0	1.14	4.56	2.3-5.0	1240
Mona monkey	292	4.0	1.14	4.56	2.3-5.0	989
Patas monkey	3017	40.9	11.79	47.14	33.4-48.6	7169
Tantalus monkey	229	3.1	0.89	3.58	2.2-4.1	2934
Total	7368	100	4.8	19.9		

Source: Field survey (2019)

n = number of animals sighted; MER = mean encounter rate (nkm⁻¹); D = density; CI = confidence interval; AIC = Akaike information criterion

3.1. Densities of primates species Sighted during morning and evening surveys

The results of morning and evening surveys of the primates species are presented in Table 2. In general, more individuals across all the species were sighted during the morning than at evening. For diurnal survey,

Baboon were most-sighted with a MER and density of 16.26/ km¹ and 32.58 km⁻², respectively, while the MER and density were 11.18 km⁻¹ and 22.36 km⁻², respectively for evening survey.

3.2. Densities of the primate species Sighted during dry and rainy season

Table 3 presents the distribution of primate species encountered in dry and rainy seasons. The result revealed that more individuals of all the species were sighted in the rainy season than in the dry season. For instance, Baboon, Green, Mona, Patas and Tantalus monkeys were

sighted in the rainy season than in the dry season with MERs of 4.49, 0.34, 0.45, 3.10 and 0.33 km⁻¹, respectively with no individual of Colobus monkey sighted in the dry season. Figure 2 shows the proportion of each of the six primate species sighted during dry and rainy season in the study area.

Table 2: Densities of the six primate species sighted during morning and evening surveys.

Species	Morning			Evening		
	N	MER (nkm ⁻¹)	D/km ⁻²	N	MER (nkm ⁻¹)	D/km ⁻²
Olive baboon	2085	16.29	32.58	1431	11.18	22.36
Colobus monkey	15	0.12	0.23	7	0.05	0.11
Green monkey	188	1.47	2.94	104	0.81	1.63
Mona monkey	197	1.54	3.08	95	0.74	1.48
Patas monkey	1925	15.04	30.08	1092	8.53	17.06
Tantalus monkey	148	1.16	2.31	81	0.63	1.27

Field survey (2019).

n = number of animals sighted; MER = mean encounter rate (nkm⁻¹); D = density

Table 3: Densities of primate species sighted during dry and rainy seasons

Species	Dry			Rainy		
	N	MER (nkm ⁻¹)	Dkm ⁻²	N	MER (nkm ⁻¹)	Dkm ⁻²
Olive baboon	1149	4.49	17.95	2367	9.25	36.98
Colobus monkey	Ns	-	-	22	0.09	0.34
Green monkey	86	0.34	1.34	206	0.80	3.22
Mona monkey	116	0.45	1.81	176	0.69	2.75
Patas monkey	793	3.10	12.39	2224	8.69	34.75
Tantalus monkey	84	0.33	1.31	145	0.57	2.27

Field survey (2019).

n = number of animals sighted; MER = mean encounter rate (nkm⁻¹); D = density

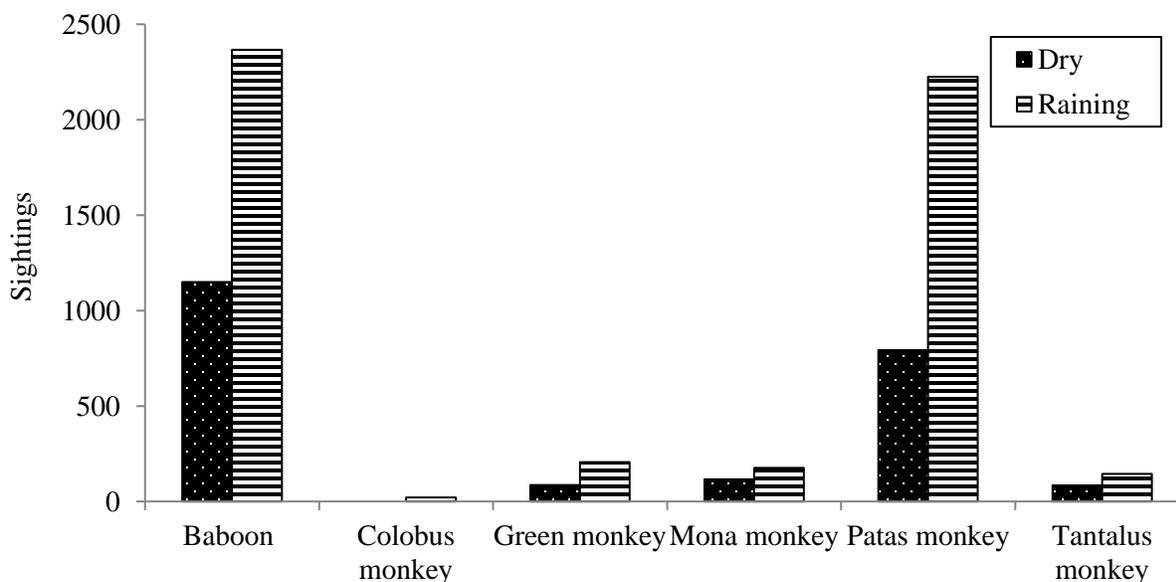


Figure 2: Proportion of primate species in dry and rainy seasons (Field survey, 2019)

4. DISCUSSION

The densities of six primate species were estimated in this study. The estimated aggregate population densities of Baboon, Colobus monkey, Green monkey, Mona monkey, Red Patas monkey and Tantalus monkey were 54.94, 0.34, 4.56, 4.56, 47.14 and 3.58 individuals km^{-2} respectively. The overall group density for Baboon was slightly more than that of Red Patas monkey, and almost fifteenth times that of Tantalus monkey. The mean encounter rate per kilometer (km^{-1}) walked for the six primate species sighted in the study area were approximately 13, 0, 1, 1, 12, and 1 for Baboon, Colobus monkey, Green monkey, Mona monkey, Red Patas monkey and Tantalus monkey respectively. The highest densities were estimated for Baboon and Patas monkey in all the ranges, however, variation in densities was recorded for all the primates in all the ranges. The density of Colobus monkeys was relatively lower than other monkeys and was never sighted in seven ranges. In a similar study by Gabriel *et al.*, (2018) in the Mono Trans-boundary Reserve (MTBR) in Togo (West Africa) the densities of Tantalus monkey (4.10km^{-2}), Patas monkey (13.96km^{-2}) and Olive baboon (0.81km^{-2}) were found to be at variance with the findings of this study.

The density of olive baboon (54.94km^{-2}) Patas monkey (47.14km^{-2}) were higher in this study while that of Tantalus monkey (3.58km^{-2}) was slightly lower than that found in MTBR. The higher population densities of some of the primate species recorded in this study may not be unconnected with high values of standing crops, number of standing crops raided and proximity of the farms to the park boundary. The pattern of primate species densities for morning and evening survey compared indicated a significant variation. The result revealed more activity in the morning for all the six primate species in the study area. The densities of Baboon in the morning and evening counts were 32.58 km^{-2} ($n=2085$) and 22.36km^{-2} ($n=1431$) respectively. Similar pattern of results was obtained for the density estimate of other primate species sighted during morning and evening count, as more individuals across all the six species were sighted during the morning than at evening counts. Colobus monkey during morning and evening surveys were least sighted having 0.12km^{-1} and 0.05^{-1} MER with corresponding densities of 0.23km^{-2} and 0.11km^{-2} respectively. This result is in agreement with the findings of Modu *et al.*, (2016) who observed that more individuals of three primate species were sighted during the morning than evening surveys in Sambisa Game reserve. Modu *et al.*, (2016) reported that the variation in density estimates for morning and evening primate's counts could be caused by the need for more food. In the morning the increased effort for more food leads to movements and consequently more exposure.

A similar pattern occurred at El Tuparro in Colombia where DeFler and Pintor (2013) found that the least active primate, *Alouatta seniculus*, was far more likely to be detected by visual cues than other more active primate species. This difference in detectability might explain why reasonably consistent density estimates were not achieved for both morning and evening counts in this study. The estimates of densities of primates in the two (wet and dry) seasons showed that more primate species were encountered in the rainy season than in the dry season in every range. Individuals of all the six species (Baboon, Green, Mona, Colobus, Patas and Tantalus monkeys) were sighted in the rainy season; however, no individual of Colobus monkey was sighted in the dry season. This result is in line with the findings from a study conducted by Yihune *et al.* (2009) who reported that more primate population was recorded on farmland during the wet season than the dry season. Yihune *et al.* (2009) further observed that temperature, rainfall, and resource availability might have greatly influenced and shaped aspects of primate feeding and behaviour. The result of this study is however, at variance with the findings of Adedoyin *et al.*, (2018) from a Preliminary survey of primates in old Oyo national park buffer zone, Nigeria, which indicated that the total number of primate species recorded in wet season was lower than that reported in the dry season.

Many primate species show behavioural and physiological adaptations to environmental seasonality, including changes to their diets and activities. Ganzhorn *et al.*, (2003) observed that in times of low resource abundance, primates switch diets, increase their ranging, or attempt to save energy by reducing their overall activity. Most primates reduced their travel distance and center their activities around remaining water sources in hotter temperatures (Campos and Fedigan 2009). Diriba *et al.*, (2020) investigated the abundance, diversity, and distribution of primates on Welel Mountain Oromia Region, collected data from different parts of Welel Mountain during wet and dry seasons of the year and analysed using t-test for abundance and distribution of primates in wet and dry season of the year. They identified four primate species: *Chlorocebus aethiops*, *Cercopithecus mitis*, *Papio anubis*, and *Colobus guereza*. Their study showed that more individuals of the primate species were observed in wet season than in dry season, and the number of young individuals was more than that of adults. They further concluded that relatively more primate population were recorded in the wet season because of availability of more food resources on the farmland during the wet season.

5. CONCLUSIONS

From this study, the following conclusion were made.

1. More Baboon were sighted per unit area in the study area compared to the other primate species in both the dry and wet season.
2. Colobus monkeys has the least number per unit area in the study locations.
3. Primate species were sighted more in abundance in the morning than in the evening

REFERENCES

- Adedoyin, S.O; Aremu, O.T and Emelue G.U (2018) Preliminary survey of primates in old Oyo national park buffer zone, Nigeria *Journal of Research in Forestry, Wildlife and Environment*, 10 (1): March, 201: 2141 – 1778.
- Arrowood B. H. C, Trevest A, and Mathews N. E: (2003). Determinants of day-range length in the black monkey at Lamanai, Belize. *J Trop Ecol*. 19:591-594.
- Buckland, S. T., Anderson D. R., Burnham K.P., Laake J. L. and Thomas L. (2001). Introduction to Distance Sampling: Estimating Abundance of Biological Population. Oxford University Press, New York.
- Campos, F. A., and Fedigan, L. M. (2009). Behavioral adaptations to heat stress and water scarcity in white-faced capuchins (*Cebus capucinus*) in Santa Rosa National Park, Costa Rica. *American Journal of Physical Anthropology*, 138, 101 –111.
- Chapman, C. A. and Lambert J. E. (2000). Habitat alteration and the Conservation of African Primates: Case Study of Kibale National Park, Uganda. *Am. J. Primatol.* 50, 169-185.
- Defler, R. T. and Pintor D. (2013). Censusing Primates by Transect in a Forest of known Primate Density. *J. primatol.*, 6:243-259.
- DiribaFufa, D. Y., Gezahegn D., and Sibhatu G. (2020). Abundance, Diversity, and Distribution of Primates at Welel Mountain, Kellem Wollega Zone, Oromia Region, Ethiopia *Hindawi Scientific World Journal* Article ID 5691324, 7 pages.
- Erin R. V. and Janson C. H. (2011). Quantifying Primate Food Distribution and Abundance for Socioecological Studies: An Objective Consumer-centered Method *International Journal of Primatology*.32: 737–754.
- Gabriel H. S, Komina H. A, Assou D, Abotsi K. E, Akpamou K. G, Giovanni A, Daniele D, (2018). Local distribution and density estimates of primates in the transboundary reserve of the Mono River, Togo (west Africa) *Revue d'Ecologie (Terre et Vie)*, 73 (3), 2018: 363-374.
- Ganzhorn, J. U., Klaus, S., Ortmann, S., & Schmid, J. (2003). Adaptations to seasonality: Some primate and nonprimate examples. In P. M. Kappeler & M. E. Pereira (Eds.), *Primate life histories and socioecology* (pp. 132–144). Chicago: University of Chicago Press.
- Geneviene C Josephine H Jessica J. and K. A. Nekaris (2016): *Primate Abundance and distribution: concepts and methods, An introduction to primate conservation.*
- Eleazor, A. U. (2002). Critical site for biodiversity conservation in Nigeria. NCF, Lagos. Nigeria. pp 39.
- Lawton, J. H. (2015). *Population Dynamic Principles. Extinction Rates* (ed. by J. H. Lawton and R.M. May), pp. 147–163. Published: Oxford University Press,
- Marguba, L. B. (2002). National parks and their benefits to local communities in Nigeria. Nigerian National Park Service, Abuja, 34p.
- Modu, M., A. A. Alarape, J. K. Omifolaji, and A. Aliyu (2016). Primate Diversity and Population Ecology in Sambisa Game Reserve Borno state, Nigeria. *Elixir international Journal of Environment and Forestry*, 91: 38423-38428.
- Pablo R. S, (2001). The relationship between fruit production and primate abundance in Neotropical communities. *Biological Journal of the Linnean Society*, 72: 161–178.
- Rebecca, S. G. and Brigida A. R. (2004). Distance Sampling for Density Estimation. 9th National Convention on Statistics (NCS) EDSA Shangri Hotel.
- Robbins RM, and McNeilage A. (2003). Home range and frugivory patterns of mountain gorillas in Bwindi Impenetrable National Park, Uganda. *Int J Primatol*, 24: 467-491.
- Westem D. (2001), Human-modified ecosystems and future evolution. *P Natl Acad Sci., USA*, 98:5458-5465.
- White, P.C.L. and Ward, A.I., (2010). Interdisciplinary approaches for the management of existing and emerging human-wildlife conflicts. *Wildlife Research*, 37(8), pp.623–629.
- Yihune, M., A. Bekele, and Z. Tefera, (2009). “Human-gelada baboon conflict in and around the Simien mountains national park, Ethiopia,” *African Journal of Ecology*, 47:276–282.