



Effect of Tree Species Composition and Food Selectivity on the Population Density of Sclater's Guenon (*Cercopithecus sclateri* Pocock 1904) in Forest Patches of Lagwa, Aboh-Mbaise, Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Effect of tree species composition and food selectivity on the population density of the Sclater's guenon was carried out to determine how habitat composition and food preferences affect population density of the Sclater's monkeys in the study area.

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Place and Duration of Study: The study was carried out in forest patches of Lagwa community in Aboh-Mbaise Local Government Area, Imo State (December 2019-November 2021).

Study Design: The point centered quarter method was used to collect data on trees species, while the visual observation and line transect methods was used to collect data on food preference and population density of the monkeys.

Methodology: The research was carried out within the wet and dry season. Faecal examination was used for collecting information on plant and fruit species consumed.

Results: The most dominant tree species were *Khaya ivorensis* and *Treculia africana* with important value index (IVI) of 35.13 and 26.73 respectively, while *Bosqueia angolensis* was the least dominant species with IVI of 0.99. Tree species with diameter at breast height class of 41cm and above were absent in Eziudo, Obo and Umunekere communities. *Dacryodes edulis*, *Elaeis guinensis*, *Mangifera indica* and *Musa balbisiana* were the most consumed plant species. The mean troop sizes were 3.21 ± 1.42 for the dry season and 2.78 ± 1.25 for the wet season, with troop density for both seasons as 0.03 ± 0.02 .

Conclusion: The findings presents the relationship between the Sclater's monkey's diet and their habitat, and how habitat changes can cause changes in the feeding pattern, type of food and meals consumed. Sensitization campaigns and provision of alternative food sources for humans can reduce disturbance of the habitat and further sustain the population of the monkeys.

Keywords: Trees; density; forest; selectivity; monkey.

1. INTRODUCTION

The Sclater's monkey (*Cercopithecus sclateri*) is an important species that is endemic to the South Eastern region of Nigeria [1]. The monkeys have been sighted in some locations in Ebonyi, Enugu, Akwa Ibom, Anambra and Imo States. In four of the states mentioned, the populations of these monkeys have dwindled as a result of human activities, except for Lagwa in Imo state where the species population density is still relatively high due to a local taboo prohibiting the killing and eating of the monkeys [2]. The presence of monkeys in any given habitat or ecosystem represents the quality and health of that ecosystem, and the sclater's monkey is no exception. But the monkey's population is threatened due to habitat disturbance and other human activities [3].

Monkey's habitats comprises of trees, shrubs, herbs and vine tangles, and serve as cover food and protection against predators and other vagaries of weather. The composition of trees in any given ecosystem measures the level of degradation, as well as estimate the population of animal's species occupying that ecosystem [4]. The role of trees in monkey's habitat range from provision of fruits, nuts, berries and seeds. Most tree species produce fruits which are the major diet of monkeys, and alterations in the composition of these trees means alterations to the diets of these monkeys, hence impacting negatively on the health status as well as their population [5]. Distortions in habitats and tree

composition will imply that the monkeys will have to navigate between patches of forest for food cover and shelter, which will further predispose the species to other environmental hazards. Absence of preferred animal food in required amount can cause species population to shrink, thereby affecting the quality and health of the ecosystem [6].

This study therefore evaluates the effects of tree species composition and food selectivity on the population density of Sclater's guenon in forest patches of Lagwa, Aboh-Mbaise, Imo State, Nigeria so as to provide information on conservation approaches to be adopted in the management of the species [7].

2. METHODOLOGY

2.1 Study Area

This study was conducted in the eight communities (Umunokwu, Umalabazu, Umunoke, Umunokere, Eziudo, Obo, Okwuato, Umuosi) of Lagwa ward in Imo State (Fig. 1). The land area of Aboh-Mbaise covers approximately one hundred and eighty-five square kilometers (185km^2), lying within longitude $7^0 10^1$ and $7^0 20^1$ E and latitude $5^0 20^1$ and $5^0 40^1$ N. The area with an annual rainfall of about 2,297mm have a population of 195,652 (National Bureau of statistics, [8]). The occupants of Lagwa are predominantly traders and farmers of leafy vegetables such as *Gnetum africanum*, commonly known as Okazi and other leafy

vegetables. Dry season in the study area is between December to March, while wet season is between April to November.

2.2 Sampling Units/Data Collection Procedure

The study was carried out between November 2019 and October 2021. As described by [9], the point centred quarter method was used to estimate plant density of tree species in the study area. Transects laid in each of the communities were gridded 2500m in length with distance between each point on the transect measuring 160m. Points were selected randomly on the transects using ballot placement with the first sampling point indicated by the smallest random number [10]. Each sampling point was divided into four quarters of equal sizes with an imaginary line drawn perpendicular to the transect. Trees nearest to points in each quarter

and with diameter not less than 4cm were identified. Enumeration, identification and measurement of diameter at breast height (dbh) ≥ 10 cm using diameter tape were recorded.

2.3 Determination of Food Preferences by the Sclater's Monkey

In determining which food species the monkeys preferred, rejected or tolerated, visual observation method was employed. In each of the communities where transects were laid, the animals were observed during feeding between 3- 4 hours especially morning and evening hours. The remains of different plant parts (seeds, leaves, fruits) consumed were collected and identified [11] were collected and observed under a light microscope. This was done so as to cover seeds, leaves and fruits partly digested and identified.

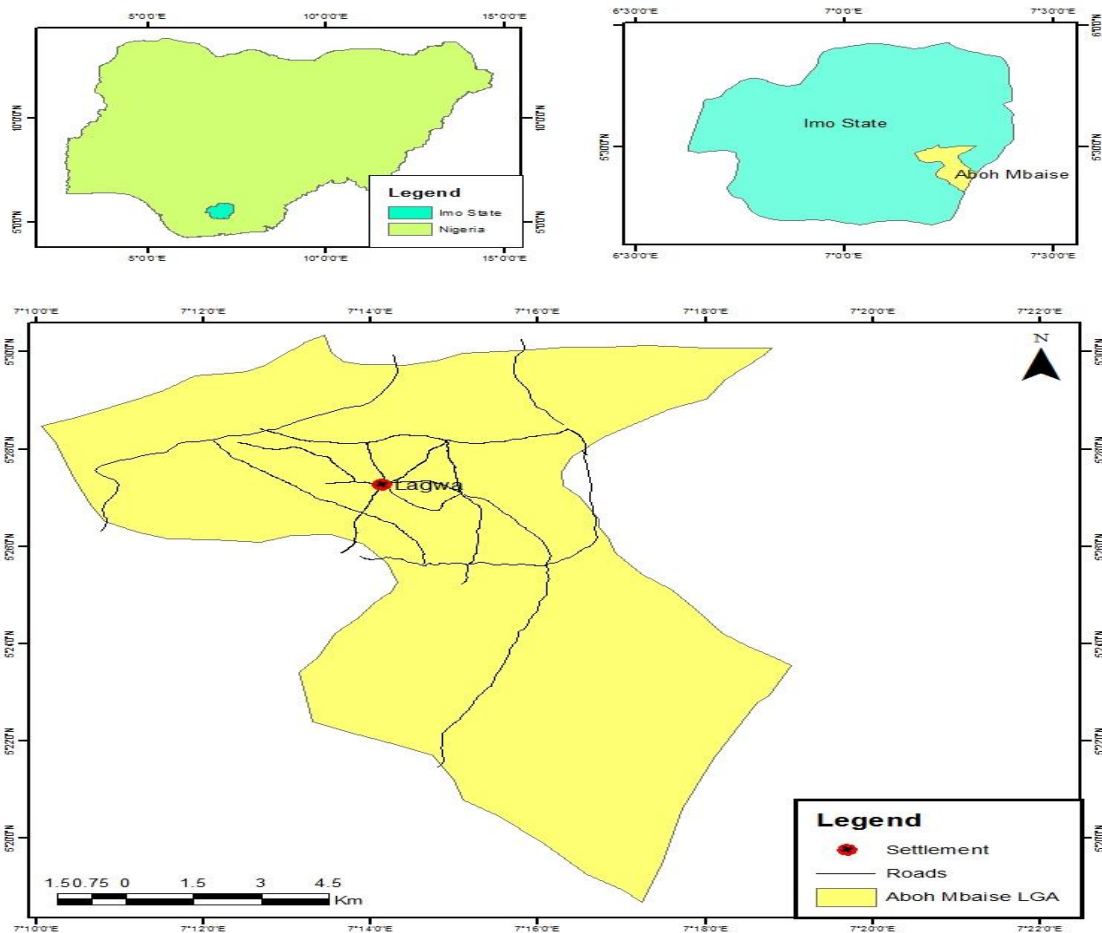


Fig. 1. Map of Aboh-Mbaise showing Council Wards
Source: Imo State Forestry Commission (Owerri)

2.4 Population Density of the Sclater’s Monkey

The line transect method was used in conducting the survey of *Cercopithecus sclateri* in the area of study. They were observed at different points (160m apart) on each transect measuring 2500m in length [12]. The survey was conducted once every month for twelve months in each of the communities with the help of trained field assistants. The parameters recorded for the species included the number of group sighted, feeding habit/sign, mating and interaction with other wildlife species. The census was conducted between 9.00am and 4:00pm using G.P.S and binoculars.

2.5 Data Analysis

Population density was estimated using the formula:

$$PD = \frac{nlw}{a}$$

Where PD = population density, n = number of individuals, l = length of the transect (m), w = width of the transect (m), and a = area of the transect in km² [13]. The relative dominance, frequency, relative density and importance value index were determined using the formula:

$$IVI = RF + RD + RDo \text{ (Jacob et al. [6,13])}$$

Where IVI = Importance value index, RF = Relative frequency, RD = Relative density and RDO = Relative dominance.

$$RDo = \frac{Tba \text{ of a species}}{Tba \text{ of all species}} \times 100 \text{ (Where; Tba = Total basal area)}$$

3. RESULTS AND DISCUSSION

3.1 Tree Species Composition

The tree species that were most dominant in the study area were *Khaya ivorensis* (IVI=35.13), *Treculia africana* (IVI=26.73), and *Nauclea diderrichii* (IVI = 24.76), while IVI of 0.92 was observed in *Napoleona vogelli*, making it the least dominant species as contained in Table 5 in [14]. This implies that though the habitat was dominated by exotic species like *Tectona grandis* and *Gmelina arborea*, indigenous tree species such as *Khaya ivorensis*, *Cola nitida*, *Nauclea diderrichii*, *Triplochiton scleroxylon* and *Ceiba pentandra* still enjoy some form of conservation and protection in the form of sacred groves and shrines. These views are in line with those of [4] who opined that indigenous conservation by local people contributes to the conservation of indigenous tree species.

Majority of the tree species were within the diameter at breast height (dbh) classes of 21 cm and 30 cm (Table 1). DBH is a measure of anthropogenic activities. In Eziudo, Obo and Umonokere communities, trees with dbh classes of 41cm and above were absent, which is an indication that serious logging and deforestation activities were going on in the habitats within these communities as was stated by [15]. This condition may have been responsible for the low population density of the sclater’s monkey recorded in these communities in both dry and wet seasons. These views are also in line with those of [16], that habitat disturbance can lead to migration of species to and from one location or habitat to another.

Table 1. DBH class distribution of trees in the study area

Communities	% DBH Class (cm)				Total
	41 & above	31 ≥ 40	21 ≥ 30	10 ≥ 20	
Umunokwu	25.00	37.50	25.00	12.50	100
Umuabazu	12.50	22.50	45.00	20.00	100
Umunoke	7.50	37.50	35.00	20.00	100
Umunokere	0.00	15.00	70.00	15.00	100
Eziudo	0.00	22.50	62.50	15.00	100
Obo	0.00	35.00	45.00	20.00	100
Okwuato	32.00	12.50	45.00	10.00	100
Umuosi	22.50	12.50	32.50	32.50	100
Total	12.50	24.38	45.00	18.13	100

Source: Field Survey (2019-2021)

3.2 Food Selectivity Pattern of the Sclater's Monkey in the Study Area

The most consumed plant species during the dry season were *Dacryodes edulis*, *Elaeis guineensis*, *Mangifera indica* and *Musa balbisiana*, while *Pterocarpus erinaceus*, *Dacryodes edulis* and *Treulia africana* were the most utilized during the wet season (Table 2). Fruits seeds and leaves were utilized more during both seasons (Table 3). More seeds were consumed during the wet season, while fruits were consumed more during the dry season (Fig. 2). This feeding pattern conforms to the fact

that the monkeys live with the people within these communities, thus consuming virtually what humans consume [17]. The consumption of more seeds during the wet season may be due to the fact that seeds were more available to the monkeys during the period. Majority of the food the monkeys consumed were fruits, hence confirming their frugivorous nature. This feeding pattern is the reason for the conflict that exists between the monkeys and humans, and these views confirm those of [18]. The food types were confirmed in the faecal samples examined in the laboratory.

Table 2. Seasonal Utilized Plant Species for cover and food by the Sclater's Guenon in the Study Area

Family	Species	D	F	%	W	F	%
Myristicaceae	<i>Pycnanthus angolensis</i>	+	1	0.98	-	4	3.42
Myrtaceae	<i>Psidium guajava</i>	+	-	0.00	-	1	0.85
Poaceae	<i>Zea mays</i>	-	3	2.94	+	7	5.98
Rubiaceae	<i>Nauclea diderrichii</i>	-	-	0.00	+	-	0.00
Rutaceae	<i>Citrus sinensis</i>	+	1	0.98	-	1	0.85
Sapotaceae	<i>Chrysophyllum albidium</i>	+	-	0.00	-	2	1.71
Sterculiaceae	<i>Cola nitida</i>	-	3	2.94	+	-	0.00
Anacardiaceae	<i>Mangifera indica</i>	+	13	12.75	+	8	6.84
Arecaceae	<i>Elaeis guineensis</i>	+	16	15.69	+	9	7.69
Burseraceae	<i>Dacryodes edulis</i>	-	21	20.59	+	13	11.11
Bromeliaceae	<i>Ananas comosus</i>	+	3	2.94	-	-	0.00
Caricaceae	<i>Carica papaya</i>	+	7	6.86	+	11	9.40
Combretaceae	<i>Terminalia catappa</i>	+	-	0.00	-	-	0.00
Fabaceae	<i>Azelia africana</i>	-	2	1.96	+	-	0.00
	<i>Arachis hypogea</i>	-	6	5.88	+	-	0.00
	<i>Pentacletra macrophylla</i>	-	-	0.00	+	-	0.00
	<i>Pterocarpus erinaceus</i>	+	3	2.94	-	17	14.53
	<i>Pterocarpus mildbraedii</i>	+	1	0.98	-	-	0.00
	<i>Tetrapleura tetraptera</i>	-	1	0.98	+	8	6.84
Gnetaceae	<i>Gnetum african</i>	+	4	3.92	+	5	4.27
Irvingiaceae	<i>Irvingia wombolu</i>	+	1	0.98	-	-	0.00
Lauraceae	<i>Persea americana</i>	+	-	0.00	-	-	0.00
Fabaceae	<i>Brachystegia eurycoma</i>	+	-	0.00	-	-	0.00
Malvaceae	<i>Bombax buonopozense</i>	+	-	0.00	-	9	7.69
Moraceae	<i>Treulia africana</i>	-	1	0.98	+	13	11.11
Musaceae	<i>Musa acuminata</i>	+	5	4.90	-	-	0.00
	<i>Musa balbisiana</i>	+	10	9.80	+	9	7.69
Total			102	100.00		117	100.00

+ = utilized during the season, - = not utilized during the season, D = dry season, W = wet season, F = freq.

Table 3. Utilized Plant Species Parts for food by the Sclater’s Guenon in the Study Area

Family	Species	PAU	WS	DS
Gnetaceae	<i>Gnetum africana</i>	Leaves	**	*
Irvingiaceae	<i>Irvingia wombolu</i>	Fruit	*	**
Lauraceae	<i>Persea americana</i>	Fruit	*	**
Fabaceae	<i>Brachystegia eurycoma</i>	Seed	*	**
Moraceae	<i>Treulia africana</i>	Seed	**	*
Musaceae	<i>Musa acuminata</i>	Fruit	*	**
	<i>Musa balbisiana</i>	Fruit	*	**
Myrtaceae	<i>Psidium guajava</i>	Fruit	*	**
Poaceae	<i>Zea mays</i>	Seed	**	*
Rutaceae	<i>Citrus sinensis</i>	Fruit	*	**
Sapotaceae	<i>Chrysophyllum albidum</i>	Fruit	*	**
Anacardiaceae	<i>Mangifera indica</i>	Fruit	*	**
Arecaceae	<i>Elaeis guineensis</i>	Fruit	*	**
Burseraceae	<i>Dacryodes edulis</i>	Fruit	**	*
Caricaceae	<i>Carica papaya</i>	Fruit	**	*
Combretaceae	<i>Terminalia catappa</i>	Seed	**	*
Fabaceae	<i>Azelia africana</i>	Seed	**	*
	<i>Arachis hypogea</i>	Seed	**	*
	<i>Penraclethra macrophylla</i>	Seed	*	**
	<i>Pterocarpus erinaceus</i>	Leaves	**	**
	<i>Pterocarpus mildbraedii</i>	Leaves	**	**
	<i>Tetrapleura tetraptera</i>	Fruit	*	**

* = Not related to the season, ** = Related to the season, PAU = parts utilized, WS = wet season, DS = dry season

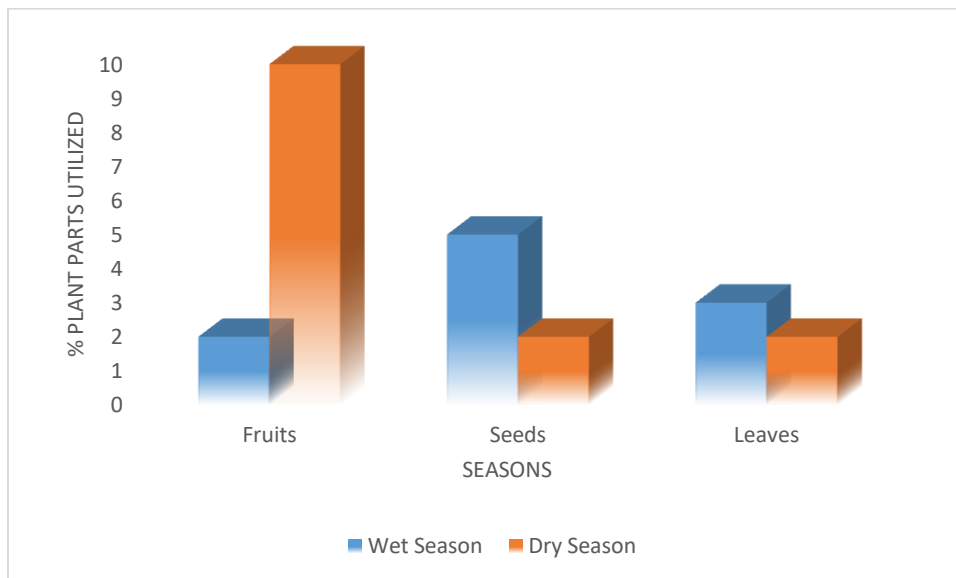


Fig. 2. Percentage Plant species utilized for food during the dry and wet seasons in the study area

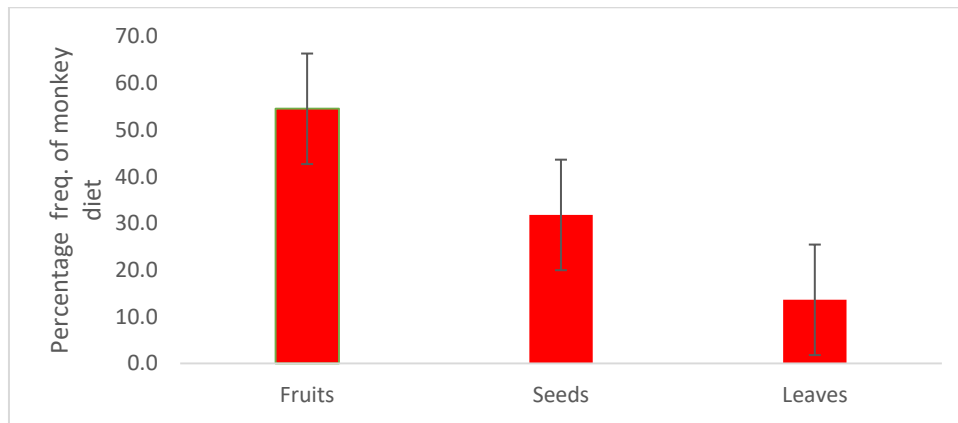


Fig. 3. Food selection frequency by the Sclater's guenon at Lagwa

Table 4. Mean seasonal troop size and density comparison of Sclater's monkeys in the study area

Location	Dry Season		Wet Season	
	Troop Size	Density (Troops/km ²)	Troop Size	Density (Troops/km ²)
Umunokwu	5.8±1.92	0.06±0.02	4.4±1.54	0.04±0.01
Umuabazu	4.8±1.74	0.05±0.02	4.4±1.51	0.04±0.01
Umunoke	1.0±1.65	0.01±0.02	3.5±1.39	0.03±0.01
Umunokere	3.7±1.65	0.04±0.02	0.0±1.39	0.00±0.01
Eziudo	0.0±1.82	0.00±0.02	3.1±0.97	0.03±0.01
Obo	2.7±0.67	0.04±0.01	1.1±1.07	0.01±0.01
Okwuato	3.8±0.07	0.04±0.00	3.2±0.49	0.03±0.01
Umuosi	3.9±1.83	0.04±0.02	2.5±1.65	0.02±0.02
Mean± SD	3.21 ± 1.42	0.03 ± 0.02	2.78 ± 1.25	0.03 ± 0.01

Source: Field Survey (2019 -2021)

3.3 Sclater's Monkey Population Density in the Study Area

The mean number of Sclater's monkey sighted within the dry and wet seasons was highest in Umunokwu community (5.8, 4.4), followed by Umuabazu community (4.8,4.4). No Sclater's monkey was however sighted in Eziudo and Umunokere communities (Table 4). For the dry and wet season, the mean troop size was 3.21±1.42 and 2.78±1.25, respectively with corresponding mean troop density of 0.03±0.01 for both seasons. The non-detection of Sclater's monkeys in Eziudo and Umunokere communities may have been due to the fact that the habitats in the two communities were the most disturbed, especially with the absence of bigger trees, implying that the animals had migrated to other habitats or areas as a result of this disturbance. This again agrees with the views of [19], as well as [20], that habitats disturbance and destruction can result to migration and extermination of species. The type of food consumed by the Sclater's monkey depended on the composition

of the plants and its availability in forest patches within the study area as opined by [21].

4. CONCLUSION

The forest habitat is home to many species of animals especially monkeys, including Sclater's monkey. The composition of these habitats contributes to the growth and survival of these monkeys and determine as well their migration pattern. Disturbed habitat can influence animal movement as in the case with this study where the monkeys were not detected at all in some locations. Habitat is key to providing food, shelter, water and protection against predators. The compositions of trees in the forest determine the type of food available to the animals and from which to select from. Tree species composition also initiates variable and seasonal feeding patterns. The feeding pattern of the Sclater's monkey varied according to seasonal food availability in the study area. Undisturbed habitats can retain major food and fruit species for the monkeys since monkeys are majorly

frugivores. Considering the importance of the Sclater's monkey in the study area and Nigeria at large, there is need to discourage habitat decimation through awareness creation to members of the host communities. There is need also to declare the area as a conservation area if the present population of the animal must be sustained.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Harris G, Thirgood S, Hopcraft JGC, Cromsigt JPGM, Berger J. Global decline in aggregated migrations of large terrestrial mammals. *Endangered Species Resources*. 2009;7:55-76.
- Baker L, Tooze Z. Status of the Sclater's Guenon (*Cercopithecus sclateri*) in south eastern Nigeria. *American Journal of Primatology*. 2003;60(1):88-89.
- Lynne R. Baker, Adebowale A. Tanimola, Oluseun S. Olubode. Sacred Populations of *Cercopithecus sclateri*: Analysis of Apparent Population Increases from Census Counts. *American Journal of Primatology*. 2014;76:303-312.
- Agbaeze UU, Daniel EJ. Tree species composition in selected sacred forests in Nigeria. *International Journal of Molecular Ecology and Conservation*. 2015;5(7):1-10.
- Wanyama F, Muhabwe R, Plumptre AJ. Censusing large mammals in Kibale National Park: Evaluation of the intensity of sampling required to determine change. *African Journal of Ecology*. 2010;48:953-61.
- Jacob DE, Eniang EA, Nelson IU, Udoakpan UI. Vegetation Assessment of Sclater's Guenon Habitat in Ikot Uso Akpan Forest, ITU, Southeastern Nigeria. *International Journal of Mol. Ecol. and Conservation*. 2015;5(1):1-7.
- Lynne R. Baker. Links between local folklore and the conservation of Sclater's monkey (*Cercopithecus sclateri*) in Nigeria. *African Primates*. 2013;8: 17-24.
- National Bureau of Statistics. Demographic Statistics Bulletin. Demographic Statistics Bulletin 2017.pdf; 2017.
- Kevin Mitchell. Quantitative Analysis by the Point-Centered Quarter Method. Department of Mathematics and Computer Science Hobart and William Smith Colleges Geneva, NY 14456 XXX@hws.edu; 2007.
- Daniel I. Edet, Samuel Ajayi, Ovat I. Ovat. Population estimate of the Cross River gorilla (*Gorilla gorilla diehli*) using a sweep survey of nests in Afi Mountain Wildlife Sanctuary, Southern Nigeria. *International Journal of Ecology and Ecosolution*. 2014; 1(1):23-28.
- Edet DI, Akinyemi AF, Mbagwu CI. Evaluation of Human-Monkey Conflict in Lagwa villages of Aboh-Mbaise Local Government Area, Imo State, Nigeria. *Nigerian Journal of Forestry*. 2017;46(1): 13- 20.
- Joseph O. Ogutu, Norman Owen-Smith, Hans-Peter Piepho, Mohammed Y. Said, Shem C. Kifugo, Robin S. Reid, Helen Gichohi, Paula Kahumbu, Samule Andanje. Changing Wildlife Populations in Nairobi National Park and Adjoining Athi-Kaputiei Plains: Collapse of the Migratory Wildebeest. *Conservation Biology*. 2013;7: 11-26.
- Jacob DE, Nelson IU. A Survey of Sclater's Guenon in Ikot Uso Akpan Community Forest, Itu, Nigeria. *International Journal of Mol. Ecol. and Conservation*. 2015;5(2): 1-6.
- Ovat IO, Benjamin TT, Orsar TJ. Assessment of Population Abundance, Density and Habitat Preference of Sclater's Guenon (*Cercopithecus sclateri* Pocock 1904) in Aboh-Mbaise Communal Forest, Imo State, Nigeria. *Asian Journal of Research in Agriculture and Forestry*. 2022;8(2):23-33.
- Lynne R. Baker, Adebowale A. Tanimola, Oluseun S. Olubode, David L. Garshelis. Distribution and abundance of sacred monkeys in Igboland, Southern Nigeria. *American Journal of Primatology*. 2009; 71:574-586.
- Peter Grubb, Thomas M. Butynski, John F. Oates, Simon K. Bearder, Todd R. Disotell, Colin P. Groves, Thomas T. Struhsaker. Assessment of the Diversity of African Primates. *International Journal of Primatology*. 2003;24(6):1301-1357.
- Cynthia L. Thompson, Susan H. Williams, Kenneth E. Glander, Mark F. Teaford, Christopher J. Vinyard. Getting humans off monkeys' backs: using primate acclimation as a guide for habitat management efforts.

- Integrated and Comparative Biology. 2020; 60(2):413-424.
18. Lynne R. Baker, Oluseun S. Olubode. Correlates with the distribution and abundance of endangered Sclater's monkeys (*Cercopithecus sclateri*) in southern Nigeria. African. Journal of Ecology. 2007;46:365–373.
 19. Chapman CA, Bonnell TR, Gogarten JF, Lambert JE, Omeja PA. Are primates ecosystem engineers? International Journal of Primatology. 2013;34:1–14.
 20. Daniel Ibiang Edet, Samuel Sunday Odunlami, Ovat Innocent Ovat. Preliminary Studies on Population Status of Mona Monkey (*Cercopithecus Mona*) in Afi Mountain Wildlife Sanctuary, Cross River State, Southern Nigeria. Agriculture, Forestry and Fisheries. 2016;5(4):108-114.
 21. Nakashima Y, Iwata Y, Ando C, NzeNkogue C, Inoue E, Akomo Okoue E, MbehangNguema P, DiopBineni T, NgokBanak L, Takenoshita Y, Ngomanda A, Yamagiwa J. Assessment of landscape-scale distribution of sympatric great apes in African Rainforest Concurrent Use of Nest and camera-Trap surveys. International. Journal of Primatology. 2013; 99:111.

APPENDIX



Plate 1. Scater's guenons faecal samples (dry and wet season)

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