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

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.

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. Information on tree species composition was collected using the point centred quarter method, while that on food preference was collected using visual observation, identification and 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, while *Bosqueia angolensis* was the least dominant species with IVI of 0.99. Tree species with diameter of breast height class of 41cm and above were absent in Eziudo and Obo communities. *Dacryodes edulis*, *Elaeis guinensis*, *Magnifera indica* and *Musa balbisiana* were the most consumed plant species. The mean troop sizes were 3.21±0.68 for the dry season and 2.78±0.55 for the wet season, with troop density for both seasons as 0.03±0.01.

Conclusion: The findings presents the relationship between the Sclater's monkeys 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.

Key Words: 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 monkey have been sighted in some locations in Ebonyi, Enugu, Akwa Ibom, Anambra and Imo States. In four of the states mentioned, the population 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].

Habitat is key to the sustenance of wildlife particular. Monkey's habitat 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 where in that ecosystem, as well as estimates of 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 and provides the monkeys the option of selecting which species to prefer, reject or tolerated. Most tree species produce fruits which is the major diet of monkeys, and alterations to the composition of these trees means alterations to the diets of these monkeys, hence impacting negatively on the health status as well as population estimates of the monkeys [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 carried out 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 which covers approximately one hundred and eighty five square kilometers (185km^2), lies 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

Gnentum agricana, commonly known as Okazi and other leafy vegetables. The community's population is traced to the existence of the Slater's monkey among them.

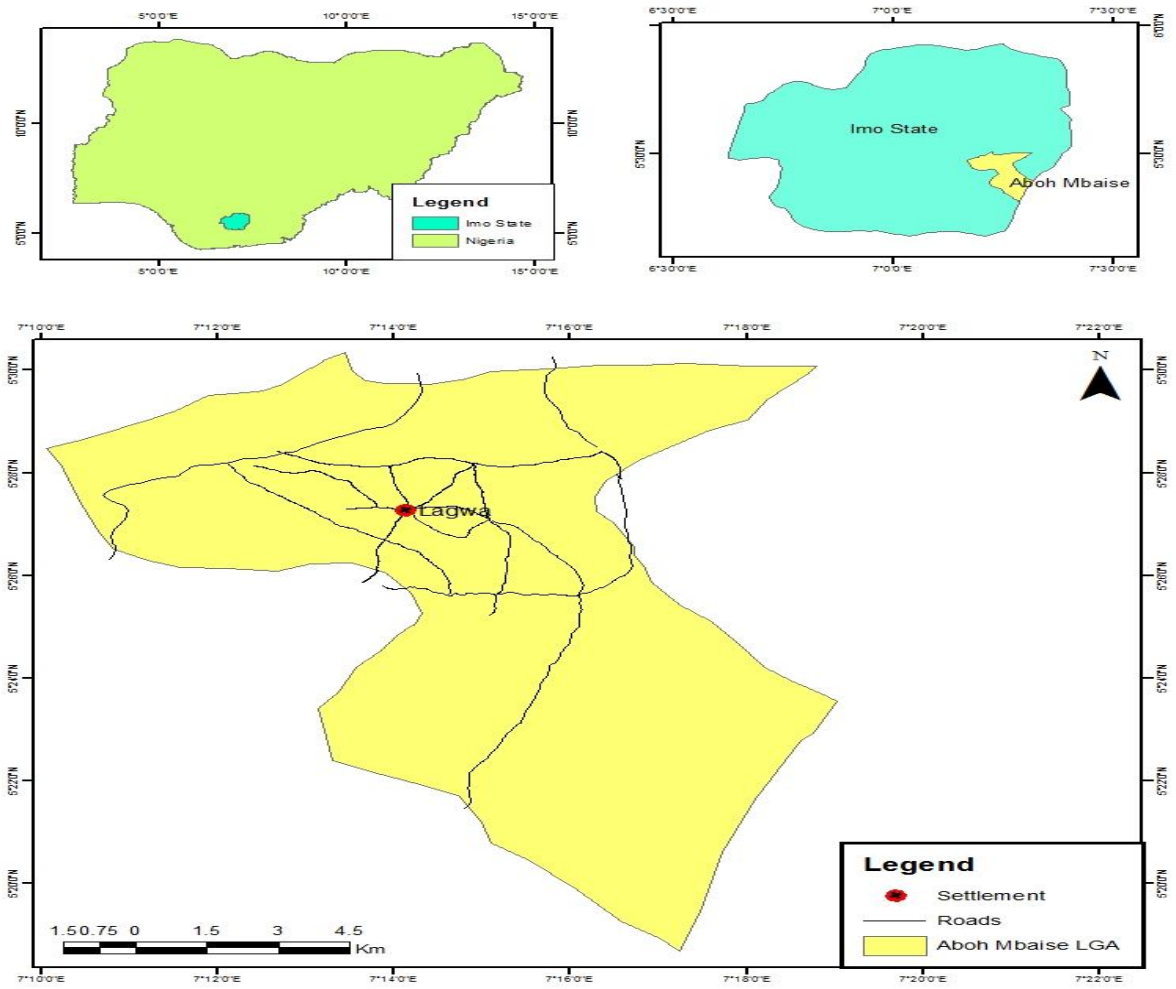

*Figure 1: Map of Aboh-Mbaise showing Council Wards (**Source**: Imo State Forestry Commission (Owerri)*

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. The 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, while recording distances from the tree trunk to the sampling point. Enumeration, identification and measurement of diameter at breast height (dbh) $\geq$ 10cm using diameter tape were the procedure for data collection.

2.3 Determination of food preferences by the Sclater's monkey

In determining which food species the monkeys preferred, rejected or tolerated, the visual observation method was employed. In each of the communities where transects were laid, the animals were observed during feeding hours especially morning and evening, with remains of the different plant parts (seeds, leaves, fruits) consumed collected and identified [11]. Also faecal samples of the monkey from locations where they excreted were collected and observed under a light microscope in the laboratory. This was done so as to recover seeds, leaves and fruits since faecal matter of some animals contain partly digested materials which may be recovered and identified.

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. The C. sclateri 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 that were recorded for the species included number of group sighted, feeding habit/sign, mating and interaction with other wildlife species. The census which was conducted between the hours of 9.00am and 4:00pm used G.P.S and binoculars as magnification of the species.

2.5 Techniques for data analysis

Population density was estimated using the formula

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

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 km^2 [13]. The frequency, relative frequency, relative density and importance value index were determined using the formula;

$$IVI = RF + RD + RDo$$

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

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

3.0 Result 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), while the least IVI of 0.99 was observed in *Bossqueia angolensis*, making it the least dominant species (Table 1). This implies that though the habitat was dominated by exotic species like *Tectona grandis* and *Gmelina arborea*, indigenous tree species such as Mahogany, Kolanut, Opepe, Obeche and Silk cotton 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.

Table 1: composition of tree species in the study area.

Species	Freq.	Trees/ha	RDo (%)	RD (%)	RF (%)	IVI
Irvingia wombulu	1	8	0.3239	0.5437	0.3289	1.1965
khaya ivorensis	39	296	12.5765	9.7231	12.8289	35.1285
Magnifera indica	24	182	6.1051	7.5642	7.8947	21.564
Milicia excels	3	23	3.545	0.7673	0.9868	5.2991
Musanga cercopoides	5	38	0.8116	1.4413	1.6447	3.8976
Dacryodes edulis	12	91	2.4987	3.8341	3.9474	10.2802
Elaeis guinensis	13	99	1.7665	3.9672	4.2763	10.01
Gmelina arborea	27	205	6.7615	7.4402	8.8816	23.0833
Heinsa crinata	3	23	0.7522	0.7673	0.9868	2.5063
Irvingia gabonensis	3	23	1.0892	0.7673	0.9868	2.8433
Terminalia ivorensis	12	91	3.3687	2.7641	3.9474	10.0802
Terminalia superba	3	23	1.1982	0.7673	0.9868	2.9523
Treculia Africana	26	198	10.8005	7.3764	8.5526	26.7295
Tripochiton scleroxylon	10	76	3.2499	3.7363	3.2895	10.2757
Tetrapleura tetraptera	3	23	1.3864	0.7673	0.9868	3.1405

Afzelia Africana	11	84	3.9069	3.3416	3.6184	10.8669
Bombax buonopozense	5	38	1.0799	1.4413	1.6447	4.1659
Bosqueia angolensis	1	8	0.1134	0.5437	0.3289	0.986
Brachystegia eurycoma	9	68	4.5993	2.7781	2.9605	10.3379
Carpolobia lutea	1	8	0.1278	0.5437	0.3289	1.0004
Myrianthus arboreus	2	15	1.1418	0.2647	0.6579	2.0644
Napoleona vogelli	1	8	0.0441	0.5437	0.3289	0.9167
Nauclea diderrichi	26	198	8.8261	7.3764	8.5526	24.7551
Parkia biglobosa	2	15	0.4163	0.6579	0.6579	1.7321
Pterocarpus mildbraedii	1	8	0.1978	0.5437	0.3289	1.0704
Citrus sinensis	7	53	1.786	2.4215	2.3026	6.5101
Cola gigantean	8	61	6.0015	2.6514	2.6316	11.2845
Cola nitida	11	84	7.3744	3.3416	3.6184	14.3344
Pycnathus angolensis	3	23	1.573	0.7673	0.9868	3.3271
Randia longiflora	4	30	1.3659	1.3158	1.3158	3.9975
Sterculia oblonga	1	8	0.2305	0.5437	0.3289	1.1031
Sterculia tragacantha	2	15	0.8877	0.2647	0.6579	1.8103
Tectona grandis	24	182	3.8492	7.5642	7.8947	19.3081
Pterocarpus osun	1	8	0.2447	0.5437	0.3289	1.1173
	304	**2310.4**	**100.0002**	**99.7516**	**99.9992**	**299.7510**

RD (Relative Density, RDo(Relative Dominance, RF (Relative Frequency), IVI (Importance Value Index)

Majority of the tree species were within the diameter at breast height (dbh) classes of 21cm and 30cm (Table 2). DBH is a measure of anthropogenic activities. In Eziudo and Obo 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 [14]. This condition may have been responsible for the low population density of the sclater's monkey that was recorded in these communities in both dry and wet seasons. These views are also in line with those of [15], that habitat disturbance can lead to migration of species to from one location or habitat to another.

Table 2: DBH class distribution of trees in the study area.

	% DBH Class (cm)				
Communities	**41 & above**	**31 ≥ 40**	**21 ≥ 30**	**10 ≥ 20**	**Total**
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*, *Magnifera indica* and *Musa balbisiana*, while *Pterocarpus erinaceous*, *Dacryodes educlis* and *Treculia africana* were the most utilized during the wet season (table 3). Fruits seeds and leaves were utilized more during both seasons (Table 4). 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 [16]. 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 exist between the monkeys and humans, and these views conform with those of [17]. The food types were confirmed in the faecal samples examined in the laboratory.

Table 3: Seasonal Utilized Plant Species for cover and food by the Sclater's Guenon in the Study Area.

Family	**Species**	**D**	**F**	**%**	**W**	**F**	**%**
Myristicaceae	*Pycnantus angolensis*	+	1	0.98	-	4	3.42
Myrtaceae	*Psidium guajava*	+	-	0.00	-	1	0.85
Poaceae	*Zea mays*	-	3	2.94	+	7	5.98

Rubiaceae	*Nuclea diderrichi*	-	-	0.00	+	-	0.00
Rutaceae	*Citrus sinensis*	+	1	0.98	-	1	0.85
Sapotaceae	*Chrysophyllum albidium*	+	-	0.00	-	2	1.71
Sterculiaceae	*Cola nitida*	-	3	2.94	+	-	0.00
Anacardiaceae	*Magnifera indica*	+	13	12.75	+	8	6.84
Arecaceae	*Elaeis guineensis*	+	16	15.69	+	9	7.69
Burseraceae	*Dacryodes edulis*	-	21	20.59	+	13	11.11
Bromeliaceae	*Ananas comosus*	+	3	2.94	-	-	0.00
Caricaceae	*Carica papaya*	+	7	6.86	+	11	9.40
Combretaceae	*Terminalia catappa*	+	-	0.00	-	-	0.00
Fabaceae	*Afzelia Africana*	-	2	1.96	+	-	0.00
	Arachis hypogea	-	6	5.88	+	-	0.00
	Pentracletra mycrophylla	-	-	0.00	+	-	0.00
	Pterocarpus erinaceous	+	3	2.94	-	17	14.53
	Pterocarpus mildbradii	+	1	0.98	-	-	0.00
	Tetrapleura tetraptera	-	1	0.98	+	8	6.84
Gnetaceae	*Gnetum african*	+	4	3.92	+	5	4.27
Irvingiaceae	*Irvingea wombulu*	+	1	0.98	-	-	0.00
Lauraceae	*Persea americana*	+	-	0.00	-	-	0.00
Leguminosae	*Brachyztegia eurycoma*	+	-	0.00	-	-	0.00
Malvaceae	*Bombax buonopozense*	+	-	0.00	-	9	7.69
Moraceae	*Treculia africana*	-	1	0.98	+	13	11.11
Musaceae	*Musa acuminate*	+	5	4.90	-	-	0.00
	Musa balbisiana	+	10	9.80	+	9	7.69
Total	**27**		**102**	**100.00**		**117**	**100.00**

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

Table 4: Utilized Plant Species Parts for food by the Sclater's Guenon in the Study Area

Family	Species	PAU	WS	DS
Gnetaceae	*Gnetum african*	Leaves	**	*
Irvingiaceae	*Irvingea wombulu*	Fruit	*	**
Lauraceae	*Persea americana*	Fruit	*	**
Leguminosae	*Brachyztegia eurycoma*	Seed	*	**
Moraceae	*Treculia africana*	Seed	**	*
Musaceae	*Musa acuminate*	Fruit	*	**
	Musa balbisiana	Fruit	*	**
Myrtaceae	*Psidium guajava*	Fruit	*	**
Poaceae	*Zea mays*	Seed	**	*
Rutaceae	*Citrus sinensis*	Fruit	*	**
Sapotaceae	*Chrysophyllum albidium*	Fruit	*	**
Anacardiaceae	*Magnifera indica*	Fruit	*	**
Arecaceae	*Elaeis guineensis*	Fruit	*	**
Burseraceae	*Dacryodes edulis*	Fruit	**	*
Caricaceae	*Carica papaya*	Fruit	**	*

Combretaceae	*Terminalia catappa*	Seed	**	*
Fabaceae	*Afzelia Africana*	Seed	**	*
	Arachis hypogea	Seed	**	*
	Pentracletra mycrophylla	Seed	*	**
	Pterocarpus erinaceous	Leaves	**	**
	Pterocarpus mildbradii	Leaves	**	**
	Tetrapleura tetraptera	Fruit	*	**

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

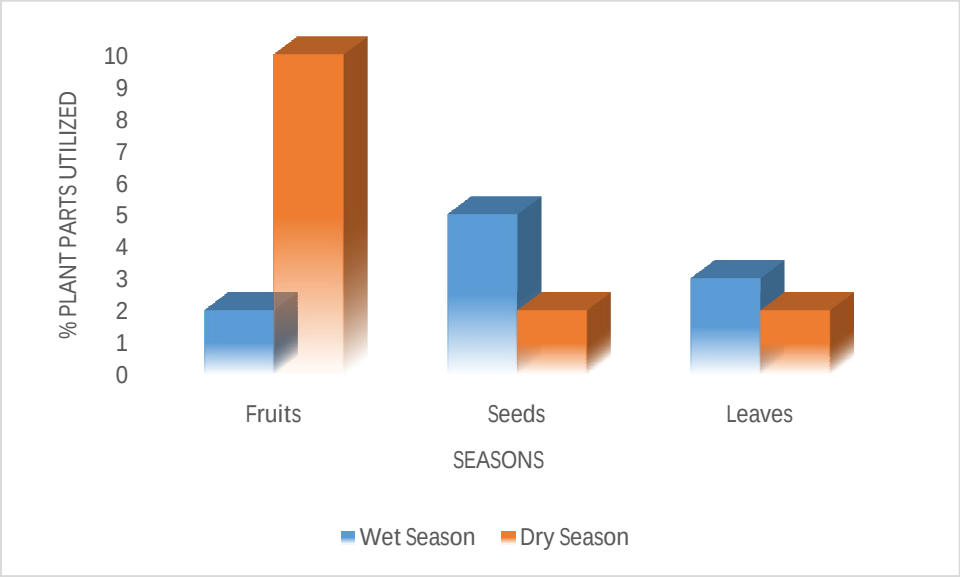

Figure (2): Percentage Plant species utilized for food during the dry and wet seasons in the study area

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 (138,106), followed by Umuabazu community (115,104). No Sclater's monkey was however sighted in Eziudo and Umunokere communities (Table 5). For the dry and wet season, the mean troop size was 3.21±0.68 and 2.78±0.55, 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 be due to the fact that the habitats in the two communities were the most disturbed, especially with the absence of bigger trees, implying further that the animals had migrated to other habitats or areas as a result of this disturbance. This again agrees with the views of [18], as well as [19], that habitats disturbance and destruction can result to migration and extermination of species. The type of food consumed by the Sclater's

monkey depends on the composition of the plants and its availability in forest patches within the study area as opined by [20].

Table 5: Mean seasonal troop size and density comparison of Sclater's monkeys in the study area.

Location	DRY SEASON Troop Size	Density (Troops/km^2)	WET SEASON Troop Size	Density (Troops/km^2)
Umunokwu	5.8	0.06	4.4	0.04
Umuabazu	4.8	0.05	4.4	0.04
Umunoke	1.0	0.01	3.5	0.03
Umunokere	3.7	0.04	0.0	0.00
Eziudo	0.0	0.00	3.1	0.03
Obo	2.7	0.03	1.1	0.01
Okwuato	3.8	0.04	3.2	0.03
Umuosi	3.9	0.04	2.5	0.02
MEAN± S. E	**3.21 ± 0.68**	**0.03 ± 0.01**	**2.78 ± 0.55**	**0.03 ± 0.01**

Source: Field Survey (2019 -2020)

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 composition 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 fruigivores. Considering the importance 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. The need also to declare the area as a conservation area if the present population of the animal must be sustained.

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Appendix

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