Nigerian Journal of Wildlife Management

Wildlife for Sustainable Development

Nig. J. of Wildl. Mgt., 2021, 5(2): 8 - 19

https://wildlifesocietyng.org/ojs/index.php/wildlifesocietyng-journal/index ISSN 2735-9298 (PRINT) ISSN 2735-928x (ONLINE)

Population and Feeding Ecology of Mona Monkey (*Cercopithecus mona* Schreber 1774) in Finima Nature Park, Bonny Island, Rivers State, Nigeria

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ABSTRACT

Mona monkeys feeding and population ecology were studied in FNP. Data were collected using field observation and review of literatures. Eleven purposely selected pre-existing trails of 2km each served as transects. Data were analyzed using descriptive statistic. A total of 117 species in 57 families were found in FNP with 18 tree species in 15 families were utilized for feeding. *Elaeis guineesis* (31.00%) was the most utilized species. A total of 432 individual Mona monkeys were sighted and the resource center/residential area (3) and access road (3) had the highest number of colonies. Similarly, the highest relative abundance and density was recorded in the resource centre/residential area (22.45%; 48.5/km^2) and the airstrip (1.62%; 3.5/km^2) recorded the least. Highest time budget was expended on locomotion (33.17%) while agonistic behavior (1.25%) consumed the least. The need to prioritize and protect plant species utilized and areas with higher abundance is important.

Keywords: Guenons, time budget, feeding ecology, population, Finima Nature Park

INTRODUCTION

Mona monkey (*Cercopithecus mona* Schreber 1774) is one of the twelve non-human primates in the world that are endemic to tropical forests of the West Africa Region (Groves, 2005; Starr, 2018). They are the most common gregarious guenons found in Africa, living in a troop up to thirty-five (Groves, 2005; Oates, 2011; Starr, 2018). Although the species is majorly a forest inhabitant, it has also been observed to adequately adapt to heavily degraded forest, gallery forest, mangrove forest, and urban forest areas (Okekedunu *et al.*, 2014; Oshita, 2016). Mona monkeys play important role in vegetation growth through seed dispersal. Despite, their high adaptability and little or

no predators in the wild, their population has dwindled due to poaching and anthropogenic activities which have induced changes in ecological balance (Bukie *et al.,* 2016; Owolabi *et al*., 2019).

Mona monkey is one of the most endangered species of non-human primates in the tropics despite the International Union for Conservation of Nature (IUCN) listing it as Near Threatened (Ogunyebi *et al*., 2018; IUCN, 2019). In Nigeria, it is a protected species under the Nigeria Endangered Species Decree Number 11 of 1985 nevertheless; the population is rapidly declining due to hunting pressure, increasing wildlife trade, and habitat loss (Tooze and Baker, 2008; Okekedunu *et al.,* 2014; Bukie *et al.,* 2016). The species is mostly conserved and protected only in protected areas and few communities with the traditional conservation method (TCM).

Food and feeding habits are an important component of wildlife biology, population dynamics, reproduction, survival, habitat selection, and social behaviour (Owolabi *et al*., 2019). The food selection pattern of primates is essential to understanding their behavioral pattern and spatial distribution. Understanding the feeding ecology of an organism in an area so as to gather information for environmental quality and monitory is scientifically necessary and important to conservation (Nwosu and Iwu, 2011). Olaleru *et al.* (2020) had opined that primates living in private reserves may have nutritional challenges with long-term survival implications. Consequently, it is pertinent to study *Cercopithecus mona* in such reserves.

Available data on *Cercopithecus mona* population and feeding ecology in West Africa is relatively scanty especially in the southern part of Nigeria, more specifically at Finima Nature Park (FNP). This study examine the plant-feeding materials of *Cercopithecus mona*, determine the spatial distribution of the species, estimate the relative abundance of the species, and assess the time budget of the species in the study area. The result of the study will form a baseline survey for other similar surveys and help prioritize Mona monkey's conservation efforts.

MATERIALS AND METHODS

Study Area

The study was conducted at Finima Nature Park (FNP) Bonny Island, Rivers State Nigeria, an area covering approximately 1000ha (Akani and Luiselli, 2010; Finima Nature Park Biodiversity Assessment (FNPBA), 2019). The Nature Park lies between latitude 4° 23′7″ N to 4°24′ 7″ N and longitude 7° 8′ 5″ E to 7°11′ 30″ E (Figure 1) (FNPBA, 2019). The park was established by Nigeria Liquefied Natural Gas (NLNG) in 1999 to protect the mangrove vegetation and its rich fauna population (FNPBA, 2019). FNP is characterized by an equatorial climate, with May to October wet season and November to April dry season. It has an average temperature of 26ºC - 32ºC (Akani and Luiselli, 2010). Every year, the park experiences an average rainfall of 3200 mm and the climax of rains is between July and September. The relative humidity of FNP is 65% during the dry season and 98% during the wet season (Akani and Luiselli, 2010).

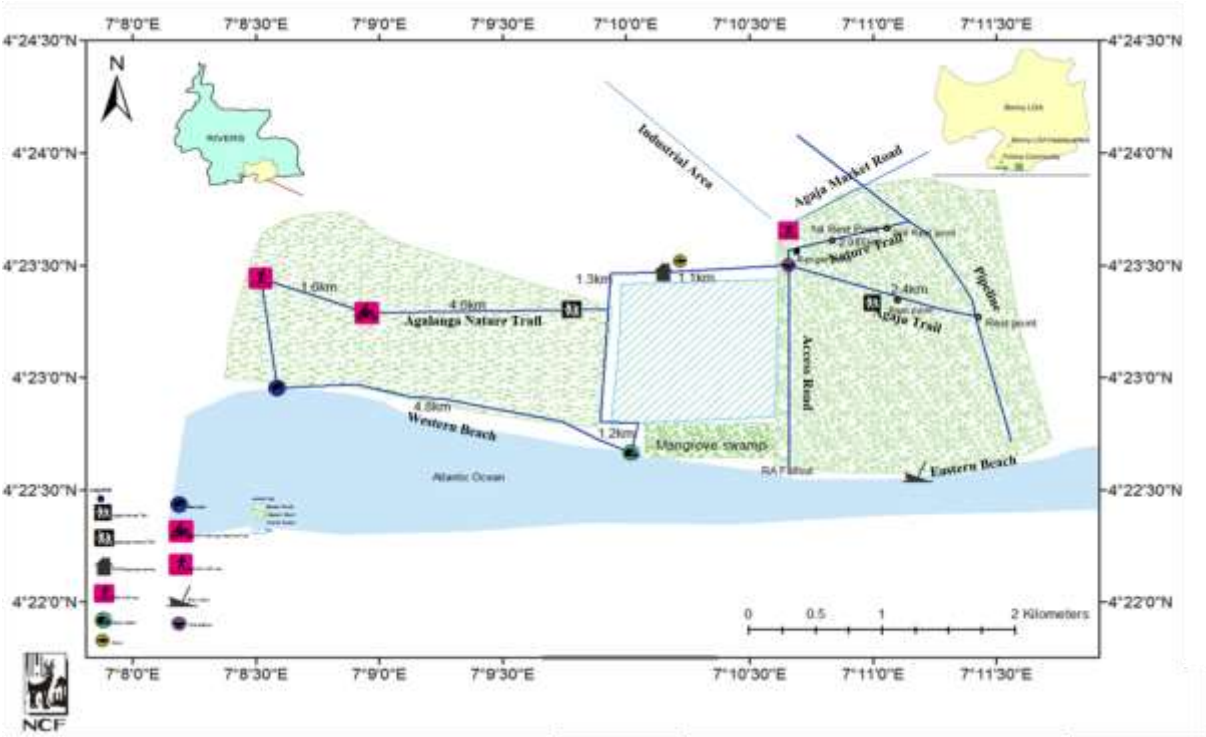

Figure 1: Map of Finima Nature Park
Source: Finima Nature Park, 2019.

Data Collection

The study area was stratified into 5 major habitats types on the bases of vegetation and land use; mangrove forest, freshwater swamp, coastal area, industrial layout, and residential area. Data were collected using onset field observation and literatures on plant diversity in FNP. Line transects method was used to collect data because it's the most efficient in terms of data collection per unit effort (FNPBA, 2019). The survey involved walking a total of 11 selected pre-existing trails with each transect measuring approximately 2km with a pair of Celestron 8 X 42 Binoculars. The line transects represent 5 major habitat types; mangrove forest, freshwater swamp, coastal area, industrial layout, and residential area. All Mona monkeys sighted directly and indirectly were recorded. The sampling covered 5 days in the wet season (September 2-6, 2019). Each individual sighted was assigned 2mins to avoid wrong readings due to eye-catching behavior. Sighting locations (coordinates) of the species were recorded using a Garmin eTrex 30X GPS. A review of the park data and publication on plant diversity of the FNP was done to complement data obtained through the field survey.

Data Analysis

Data collected were analyzed on the Statistical Package for Social Sciences (SPSS version 22) using descriptive statistics with results presented in a pie chart, bar chart, and frequency tables.

Species relative abundance =

$$\frac{\text{Species abundance X 100}}{\textit{Total abundance}}$$

Density = number of individuals/ transects' distance

The spatial distribution was determined by the GPS coordinate of each colony.

RESULTS

Plant Species Checklist and Parts Utilized by Mona Monkey in the Study Area

The results of the plant species checklist, parts utilized, and the percentage of utilization in the study area is presented in Table 1 and Figure 2. Table 1 shows a total of 117 species of plants belonging to 57 families are found in the study area and 18 tree species belonging to 15 families were observed to be utilized for feeding by Mona monkey in the study area. The plant parts utilized for feeding vary from leaves to fruits. Figure 2 shows *Elaeis guineesis was* the most utilized species (31.00%) followed by *Crysoballanus Icacao* (14.00%) and *Cantium vulgaris* (13.00%) and the least utilized species were *Cleistopholis patens* (1.00%), *Chrysobalanus icaco* (1.00%), *Klainedoxa gabonensis* (1.00%), *Mangifera indica* (1.00%), *Terminalia catappa* (1.00%), *Dacryodes edulis* (1.00%).

Table 1: Plants species and parts utilized by mona monkey in the study area

S/N	Family	Plant species	Common Names	Parts Utilized	Plant Form
1	Acanthaceae	*Asystasia gigantic*			
2	Agavaceae	*Dracaena arborea*			
3	"	*Dracaena sp.*			
4	Amaranthaceae	*Alternanthera sessilis*			
5	Anacardiaceae	**Anacardium occidentale*	Cashew	Fruits	Trees
6	"	**Mangifera indica*	Mango	Fruits	Trees
7	Annonaceae	**Cleistopholis patens*	Cleistopholis	Leaves	Trees
8	"	*Monodora myristica*			
9	"	**Xylophia aethiopia*	Negro Pepper	Fruits	Trees
10	Apiaceae	*Cleome asiatica*			
11	Apocynaceae	*Alstonia boonei*			
12	"	*Funtumia Africana*			
13	"	*Landolphia dulcis*			
14	"	*Landolphia owariensis*			
15	"	*Rauvolfia caffra*			
16	"	*Rauvolfia vomitoria*			
17	"	*Strophanthus preussii*			
18	Araceae	*Aglaonema sp*			
19	"	*Colocasia bicolor*			
20	"	*Colocasia esculenta*			
21	"	*Culcasia scandens*			
22	"	*Cyrtosperma senegalense*			
23	Arecaceae	*Calamus deeratus*			
24	"	**Elaeis guineensis*	Palm Tree	Fruits	Trees
25	"	*Laccosperma secundiflorum*			
26	"	*Oncocalamus mannii*			
27	"	*Raphia hookeri*			
28	Asclepiadaceae	*Secamone afzelii*			
29	Asteraceae	*Chromolaena odorata*			

30	"	*Eclipta prostrate*			
31	"	*Emilia sonchifolia*			
32	"	*Vernonia amygdalina*			
33	Athyriaceae	*Diplazium sammatii*			
34	Avicenniaceae	*Avicennia germinans*			
35	Bignoniaceae	*Newbouldia laevis*			
36	Burseraceae	**Dacryodes edulis*	Bush Pear	Fruits	Trees
37	Cannabaceae	*Trema orientalis*			
38	Chrysobalanceae	**Chrysobalanus icaco*	Coco Plum	Fruits	Trees
39	Clusiaceae	*Symphonia globulifera.*			
40	Combretaceae	**Terminalia catappa*	Almond	Fruits	Trees
41	Commelinaceae	*Commelina difussa*			
42	"	*Palisota hirsute*			
43	"	*Vernonia conferta*			
44	Costaceae	*Costus afer*			
45	Cucurbitaceae	*Momordica charantia*			
46	Dilleniaceae	*Tetracera alnifolia*			
47	Euphorbiaceae	*Alchornea cordifolia*			
48	"	**Anthostema aubryanum*	Baill	Leaves	Trees
49	"	*Macaranga barterii*			
50	"	*Manihot esculenta*			
51	"	*Phyllanthus niruri*			
52	"	*Phyllantus amarus*			
53	"	*Spondianthus preussii*			
54	"	*Uapaca spp.*			
55	Fabaceae	*Baphia nitida*			
56	"	*Canavalia rosea*			
57	"	*Carthormion altissimum*			
58	"	*Crotalaria retusa*			
59	"	**Erythrophleum ivorense*	Sasswood	Leaves	Trees
60	"	*Lonchocarpus cyanescens*			
61	"	*Pentaclethra macrophylla*			
62	"	*Stylosanthes spp.*			
63	Gentianaceae	*Anthocleista vogelii*			
64	Guttiferae	*Pentadesma butyraceae*			
65	Humiriaceae	*Sacoglottis gabonensis*			
66	Hypericaceae	*Harungana madagascariensis*			
67	Icacinaceae	*Lasienthera Africana*			
68	Irvingiaceae	**Irvingia gabonensis*	Dika Nut		
69	"	**Irvingia grandifolia*	Bitter Mango	Fruits	Trees
70	"	**Klainedoxa gabonensis*	Bush Mango	Seeds	Trees
71	Lamiaceae	**Catnip vulgaris*		Fruits	Trees
72	"	*Ocimum cannon*			

73	"	*Ocimum gratissimum*			
74	"	*Solenostemon monostachyus*			
75	"	*Gmelina arborea*			
76	"	**Tectonia grandis*	Teak		
77	Loranthaceae	*Tapinanthus spp.*			
78	Lycopodiaceae	*Lycopodium spp.*			
79	Malvaceae	*Cola pachycarpa*			
80	"	*Urena lobata*			
81	Marantaceae	*Marantochloa purpurea*			
82	Melastomataceae	*Dissotis erecta*			
83	"	*Dissotis rotundifolia*			
84	Moraceae	**Ficus spp*	Fig	Fruits	Trees
85	Myristicaceae	*Pycnanthus angolensis*			
86	Nephrolepidaceae	*Nephrolepis biserrata*			
87	"	*Nephrolepis exaltata*			
88	Nephthytideae	*Anchomanious difformis*			
89	Ochnaceae	**Lophira alata*	Ironwood Tree	Seeds	Trees
90	"	*Ouratea callophylla*			
91	"	*Ouratea spp.*			
92	Pandanaceae	*Pandanus candelabrum*			
93	Passifloraceae	**Barteria nigritana*		Leaves	Trees
94	Phytolaccaceae	*Petiveria Alliaceae*			
95	Piperaceae	*Piper guineensis*			
96	Polygalaceae	*Carpolobia spp.*			
97	Primulaceae	*Ardisia spp.*			
98	Rubiaceae	*Borreria verticillate*			
99	"	*Diodia scandens*			
100	"	*Hallea ledermannii*			
101	"	*Massularia acuminate*			
102	"	*Mitragyna ciliate*			
103	"	*Mitragyna inermis*			
104	"	**Nauclea didderichii*	Opepe	Leaves	Trees
105	"	*Pauridiantha floribunda*			
106	"	*Psydrax subcordata*			
107	"	*Rothmannia whitfieldii*			
108	Selaginellaceae	*Selaginella spp.*			
109	Simaroubaceae	*Pierrreodendron africanum*			
110	Smilacaceae	*Smilax klaussiana*			
111	"	*Smilax spp.*			
112	Sterculiaceae	*Sterculia tragacantha*			
113	Thelypteridaceae	*Cyclosorus afer*			
114	Urticaceae	*Laportea spp*			
115	"	**Musanga cecropioides*	Umbrella Tree	Fruits	Trees

116	Verbenaceae	*Vitex grandifolia*
117	Zingiberaceae	*Aframomum melegueta*

*Plants that are utilized by Mona monkey at FNP
Source: Field Survey, 2019.

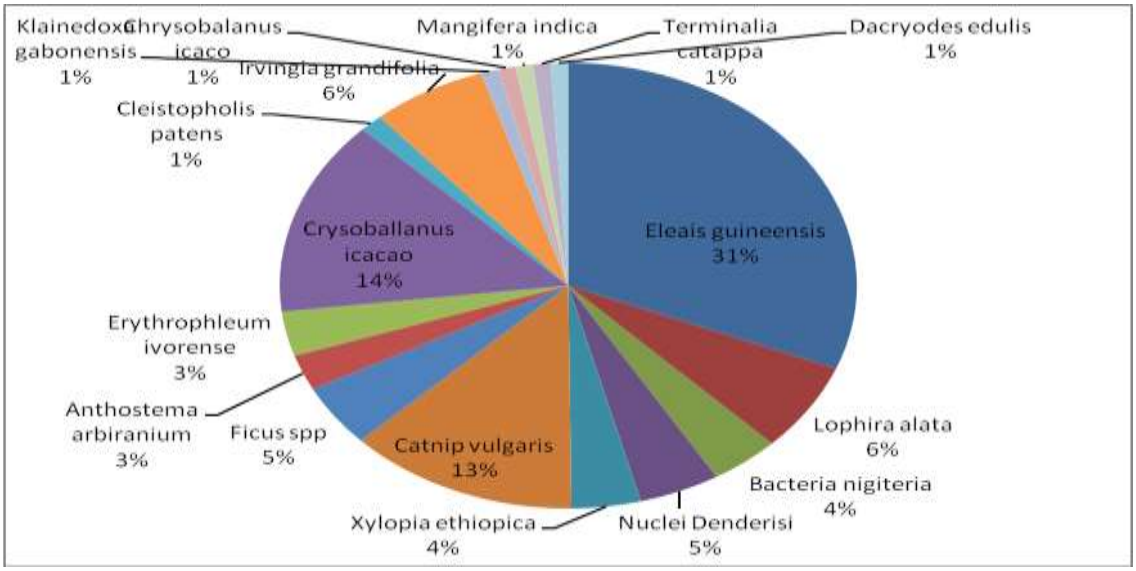

Figure 2: Percentage of Utilization of the Various Tree Species.
Source: Field Survey, 2019.

The Spatial Distribution of *Cercopithecus mona* in the Study Area

The results of the spatial distribution of Mona monkeys in the study area are presented in Figure 3. The figure shows that the resource centre/residential area transect (3) and access road (3) had the highest number of colonies sighted, and the least was found in the airstrip transect (1), while the western coastline (0) and eastern coastline (0) had no colonies of mona monkeys.

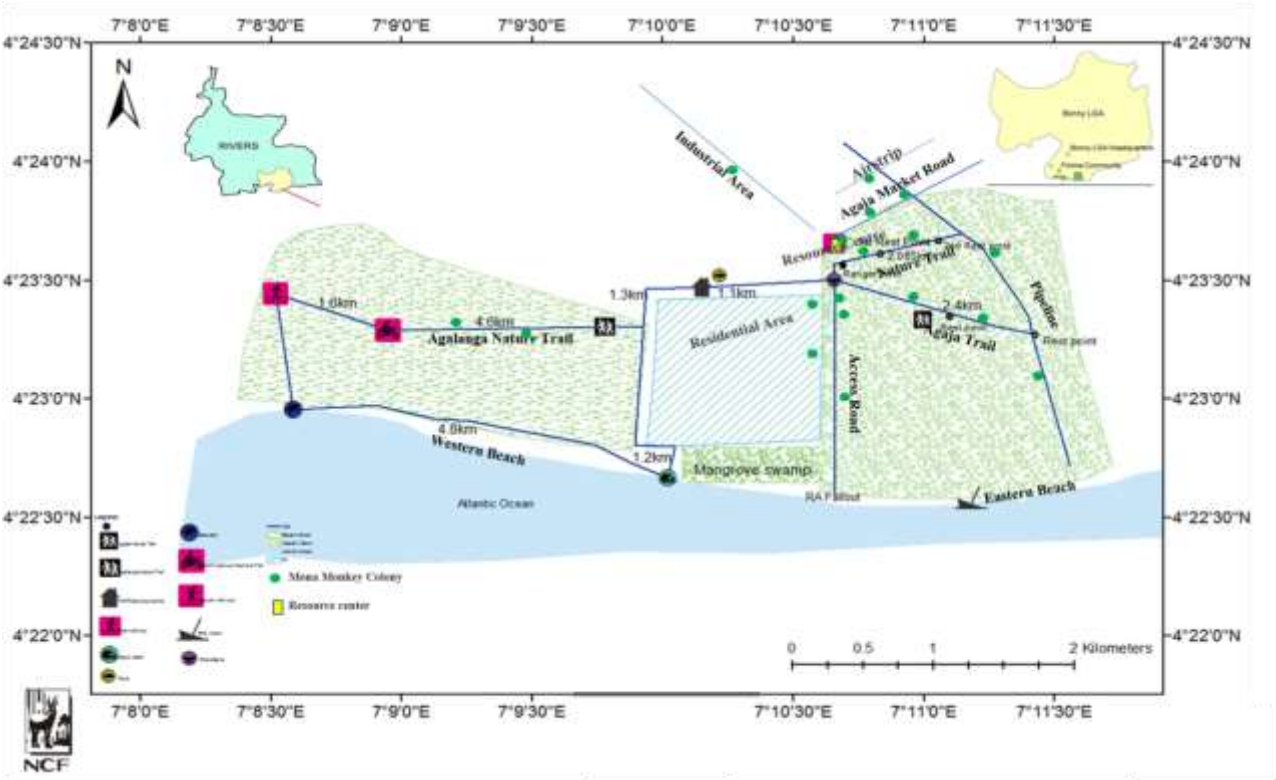

Figure 3: Spatial distribution of *Cercopithecus mona* in the Study Area
Source: Field Survey, 2019.

Relative Abundance and density of *Cercopithecus mona* in the Study Area

The results on the relative abundance and density of the species in the study area are shown in Table 2. The table 2 shows total of 432 individuals were observed and the highest relative abundance was recorded in the resource centre/residential area transect (22.45%) as shown in Table 2, followed by access road (21.30%), and nature trail (17.36%), while the airstrip transects (1.62%) recorded the least relative abundance. In addition, western (0.00%) and eastern coastal areas (0.00%) had no record of Mona monkeys. More also, the table shows resource centre/residential area transect (48.5/km^2) had the highest Mona monkey density and the two coastal area transects had none.

Table 2: Relative abundance and density of mona monkey in FNP

s/n	Transects	Colonies	No Individuals	Relative Abundance	Percentage %	Density/km^2
1	Resource Centre/Residential area	4	97	0.22	22.45	48.5
2	Nature Trail	3	75	0.17	17.36	37.5
3	Agalanga Nature Trail	2	52	0.12	12.04	26
4	Western Coastal Area	0	0	0.00	0.00	0
5	Eastern Coastal Area	0	0	0.00	0.00	0
6	Pipeline OGGT	1	29	0.07	6.71	14.5
7	Agaja Nature Trail	2	42	0.10	9.72	21
8	Airstrip	0	7	0.02	1.62	3.5
9	Agaja Market Transect	1	22	0.05	5.09	11
10	Industrial Area	1	16	0.04	3.70	8
11	Access Road	4	92	0.21	21.30	46
	Total	18	432			216

Source: Field Survey, 2019.

Time Budget of Mona Monkeys in the Study Area

The results of the time budget of the species in the study are presented in Table 3. The table shows 7 activities which include; locomotion, feeding, resting, grooming, playing, agonistic behavior, and vocalization were recorded. The highest period was expended on locomotion (33.13%), followed by feeding (26.88%), while agonistic behavior (1.25%) consumed the least of the time spent by the species.

Table 3: Mona monkeys' activities and average duration expended per day in FNP

S/N	Activities	Period Expended (hr)	Period Expended (%)
1	Locomotion	5.3	33.13
2	Feeding	4.3	26.88
3	Resting	3.2	20.00
4	Playing	1.6	10.00
5	Grooming	1.1	6.88
6	Agonistic	0.2	1.25
7	Vocalization	0.3	1.88

Source: Field Survey, 2019.

DISCUSSION

The fruit pulp has been described as an excellent carbohydrate source for primates according to the survey of Lambert (2017). Our survey recorded fruits as the most frequent plant parts utilized for feeding by *Cercopithecus mona* in FNP this result is similar to Olareru *et al.* (2020) which recorded fruits and seeds as the main diet of Mona monkeys in a strict private nature reserve. Four species of trees (*Elaeis guineensis, Xylopia aethiopia, Ficus ingens,*

and *Chrysobalanus icaco*) identified in this study has been previously recorded Olareru *et al.* (2020). *Elaeis guineensis* was the most utilized species in the park and this may be connected to the fact that most of the plant materials fed on have fruiting seasonality while some such as palm trees are available all year round as indicated in the study by Ejidike and Salawu (2009).

The distribution of *Cercopithecus mona* in the park is mainly driven by food sources such as fruit trees and areas with human habituation had the highest abundance which correlates with availability of leftover food this result is similar to the findings of Matsuda (2007). The transects close to the residential areas recorded more species, while on the contrary, the western and eastern coastlines recorded zero sightings which may be attributed to the lack of fruit trees and adequate vegetation cover.

Cercopithecus mona was recorded to be more in the eastern part of the park which had more fruit trees and more importantly *Elaeis guineensis* was more abundant in the eastern part and this species has been recorded to be the most utilized species of the guenon in the park. Troops were also observed to be overlapping, which might be as a result of the clustered nature of their home ranges and the clustered nature of their food source. Troops were observed to roost not far from their feeding points as well. The relative abundance of the species is closely related to its distribution and areas with a higher number of sighted individuals had a higher relative abundance. The resource centre/residential area transect had the highest relative abundance and the coastline and industrial areas recorded the least relative abundance, this is as a result of the abundance of fruit trees close to the resource centre and residential area.

Among the recorded activities, locomotion was obtained to take the highest period of the day for the guenon while vocalization and agonistic behavior consumed the least time. Similar records were obtained in the study carried out by Okekedun *et al.* (2014) this is as a result of the arboreal nature of the species which rely on fruit trees for most of their food source. As an arboreal species, acquiring food required movement on treetops thereby increasing the need for locomotion agonistic behavior and vocalization were minimal during the study, and no mating was observed.

CONCLUSION

The species *Elaeis guineensis* was utilized more than the other recorded species in the park due to its year-round availability. On observation, the troops tend not to roost far from their foraging points due to the clustered nature of fruit trees, and the population was more of juveniles which indicate an increase in population over the next couple of years. This can be attributed to the lack of predators within the park. The species were abundantly distributed around the residential areas which had more fruit trees and this also implies that the species have adapted to the noise from human activities and are now accustomed to tourist sightings. However, the fast-changing coastal topography and the anthropogenic activities have resulted in the unavailability of the species along with the coastal areas. The species have a similar time budget as its counterparts in other populations in West Africa and although they boast a large juvenile population vocalization is still minimal. A longer period of observation is recommended to achieve robust data of the feeding as per seasonality. Afforestation of fruit species around the park is recommended to ensure a more even distribution of the species in the park. Further study on the

species sexual dimorphism would help in determining the population structure of the troops.

ACKNOWLEDGEMENTS

We are grateful to the management of the Nigeria Conservation Foundation (NCF) for the research permit and boat logistics support. Special thanks to the FNP Director Mr. Dagogo Brown, Shittu, U. A., and forest rangers (Mr. Ugbana Clement Uwubong and Mrs. Rose Idongisit) for their support, hospitality, and field assistance, also to Dr. B. A. Oyebade the Head of the Department of Forestry and Wildlife Management University of Port Harcourt for initiating the research request permit.

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