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PRELIMINARY STUDY ON SOME ASPECT OF THE ECOLOGY OF *Cercopithecus erythrogaster pococki* (Grubb, Lernould and Oates, 2000) IN OKOMU NATIONAL PARK, EDO STATE, NIGERIA

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ABSTRACT

The is a preliminary study on some aspect of the ecology of Cercopithecus erythrogaster pococki, the Nigerian white throated monkey. The study area was divided into three partitions; the forest reserve, the agro-forest and the oil palm / rubber plantation which are the three distinct habitat types in the area for adequate accessibility and count. Using partition count, the distribution and abundance of the Cercopithecus erythrogaster pococki were examined in 2019 with reference to the vegetation types in the Okomu National Park and environs (boundary). Using one-way analysis, Duncan at 95% confident interval, the distribution of C. erythrogaster pococki between the three partition was significantly different from each other and the number within each group. The homogeneity of variation shows that the distribution of C. erythrogaster within the forest compartment has a significant difference (p<0.05), while within the plantation showed no significant difference of distribution. It was observed that C. e. pococki do not have a specific migratory route but move in troops in association with Mona monkeys (C. mona) and red capped Mangabey monkey (Cercocebustor quatustor quatus) in the direction of fruiting plants.

Keywords: *Cercopithecus erythrogaster pococki, Population Dynamics, Okomu National Park, Monkeys,*

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INTRODUCTION

The Nigerian white-throated monkey (*Cercopithecus erythrogaster pococki)* is a diurnal monkey that lives on trees of southern forest areas of Nigeria and Benin Republic (Oates, 1989). *Cercopithecus erythrogaster pococki* is a little-known primate with a mousy brown coat and a reddish-grey underbelly, a feature which both its common and scientific name refer to; the scientific name of this species, *erythrogaster*, originates from the Greek words '*erythros*' meaning 'red' and '*gaster'* meaning 'belly'. The name 'guenon' comes from the French word for 'fright' and refers to the baring of teeth when these monkeys are excited or distressed (Dwight, 1919). They are medium sized monkeys which live in dense tropical rain forest and farmland in south-western region of Nigeria into the south-eastern part of Benin Republic.

White-throated monkey is usually a frugivore, but insects, leaves and crops are also in its diet. The white-throated monkey also known as red-bellied guenon feeds predominantly on fruit and seeds. It is one of the species that live in the Guinean forest of the West Africa biodiversity hotspot. Although the breeding biology of this species is not fully understood, it is likely to be similar to that of other guenon species, which typically mate during July to September and give birth to single young after a gestation period of around six months (Oates, 1996).

There are two subspecies of white-throated monkeys Red-Bellied Guenon (*Cercopithecus*

erythrogaster erythrogaster) and Nigerian White-throated Guenon (*Cercopithecus erythrogaster pococki*), which has a greyer abdomen than *C. e. erythrogaster* (Oates, 1982; Sinsin, *et al.,* 2002). The red-bellied guenon occurs in a number of forest reserves, including the Okomu National Park in Edo State Nigeria, which is an area of around 1,082 square kilometres designed specifically to protect the red-bellied guenon by preventing poaching and deforestation in the area (Oates and Anadu, 1989).

The red- bellied guenon is classified as Vulnerable (VU) on the IUCN (International Union of Conservators of Nature) Red List (1) and listed on the Appendix II of CITIES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). Red bellied-monkey (*Cercopithecus erythrogaster erythrogaster*) is classified as Endangered (EN) and the Nigerian white-throated guenon *Cercopithecus erythrogaster pococki* is classified as Vulnerable on the IUCN Red List (2000). A similar analysis also elevated the status of *C. e. pococki* to Endangered (EN), and at the species level, the threatened category of *C. erythrogaster* was also elevated to EN (Ikemeh *et al*., 2017; Matsuda, *et al*., 2017). This calls for the prospect of the conservation of this endangered subspecies of *C. erythrogaster*, but unfortunately, it does not look bright.

Afolayan *et al*. (2004) noted that about 75% of the original wildlife habitat in Nigeria had been lost. This has affected wildlife resources within these ecological systems leaving only remnant populations of wildlife resources in protected areas including the National Parks. Several workers have done studies in different aspect and fauna of Okomu National Park (Olaleru, *et al*. (2020) on diet of mona monkeys; Omoregie and Oboh, (2019) on forest elephants; Tanshi, *et al*., (2019) on bat diversity; Omogbeme & Oke, (2018) on rodents and insectivores; Amusa, *et al*., (2017) on population status and distribution of forest elephants (*Loxodonta cyclotis* Matschie, (1900); Orimaye, & Ogunjemite, (2017) on Conservation Attitudes and Challenges, Akinsorotan, *et al*. (2011), diversity of large mammals of Arakhuan Range), none has looked at the ecology of *Cercopithecus erythrogaster pococki* and how it can give us an insight into the conservation status and future of biodiversity of monkeys in the protected area and indeed the dynamics of biodiversity in Okomu. Apart from the current need to assess the biodiversity status of our forest due to man's anthropogenic activities, it has become necessary to carry out preliminary study on some aspect of the ecology of *Cercopithecus erythrogaster pococki* in Okomu National Park and how it will affect the population of the protected area in the future.

MATERIALS AND METHODS

Study Area

Okomu National Park covers a total of 181km^2 of land which is only 15% of the 1,200km^2 area covered by the Okomu forest reserve. It is situated between longitude 5°30' east and between latitude 6°10' north park. It was originally gazette as Okomu Wildlife Sanctuary by the Bendel State Government in 1986. It is located in Ovia Southwest Local Government area of Edo State. The park lies 45km west of Benin-city and immediate south of Udo town. It derives its name from River Okomu which flows southwest to join the Osse River. The rainfall in the area is well above 2,500 mm per annum. The area is within 300metres above sea level (Akinsorotan, 2011) Soils are acidic, with nutrients poor sandy loam, pH of 5.0 (Soladoye and Oni, 2000). Vegetation is Guinea-Congo lowland rain forest, including areas of swamp-forest, high forest, secondary forest and open shrub.

Sampling

Primary data was obtained from the field by methods described by Buckland *et al.,* (2010); Plumptre & Cox, (2005) and Kuhl, *et al.* (2008). Okomu National Park and its environs was partitioned into three sections for easy accessibility and count and this was done once every month. The sections include the forest reserve, the agro-forest and the oil palm / rubber plantation as seen in Fig 1. There were three groups of at least two individuals per group in each of the partitions taking censors simultaneously each time the censors were carried out and results were compared. Sometimes members of a particular group split and walk in opposite direction within their partition as they take their censors to avoid counting the same group twice. Also, the condition of the habitat, feeding pattern of the white-throated monkeys, its association, migration route and some behaviours were

observed. The activities were done in the early hours of the morning 0600hrs-1100hrs or 1600hrs-1900hrs when this species is active. Some apparatus used includes binoculars, cameras, cutlasses, and GPS readers. Means of transportation is by foot. At the end of each day's activity notes were taken, questions asked and little analysis was made when they come together at the rangers' camp (Rangers and Student).

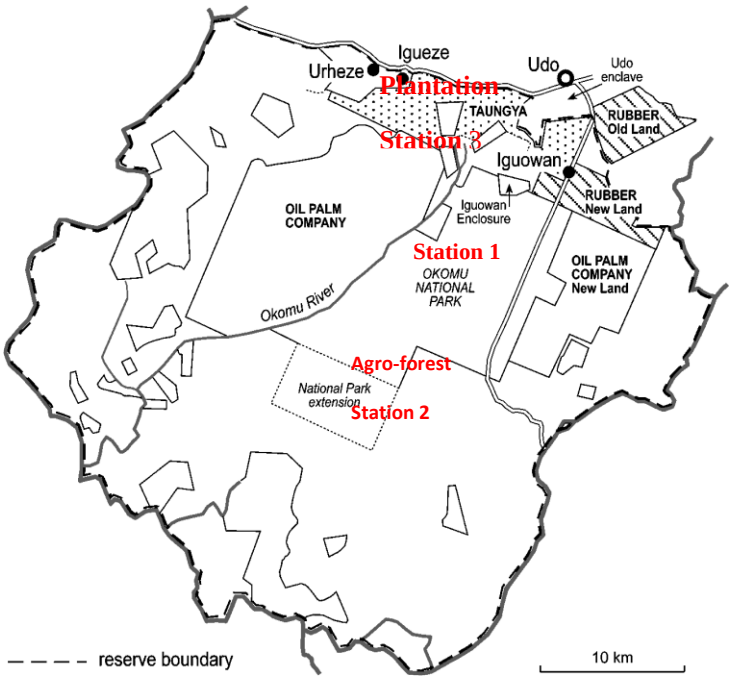

Figure. 1. Map of Study area.

RESULTS

Distribution and Abundance

Okomu National Park and environs was partitioned into three sections for easy accessibility and counting. The sections include the Forest Reserve (RF), Agro-forest (AF), and Plantation (P). *Cercopithecus erythrogaster pococki* were found more in the Forest Reserve, compared to the Afro forest and the palm plantation (Table 1). The mean number of observed *Cercopithecus erythrogaster pococki* was 17.429 for Forest Reserve partition, 3.571 for Agro-forest and 10.714.

Table 1: Distribution of *Cercopithecus erythrogaster pococki* in Okomu forest

Time	Forest Reserve	Agro forest	Palm Plantation
April	-	-	-
May	4	2	8
June	12	20	3
July	7	29	-
August	8	6	-
September	53	-	-
November	23	-	5
December	15	11	-

The homogeneity of variation shows that the distribution of *C. erythrogaster* within the forest compartment has a significant difference ($p<0.05$), while within the plantation showed no significant difference of distribution. White throated monkeys within the park are always found in the fruiting areas of the forest and the surrounding farmland. Although white throated monkeys do not have a specific migratory route around the forest, but it was noticed that they were only sighted at a particular part of the forest at a particular time scattered in small groups and most times in mixed groups with Mona monkeys.

The plant species at the park are scattered all over the reserve with a few exotic species found in

clusters as if it is a mini plantation or a ‘’nursery gone wild’’ within the park. Such exotic species include guava trees (*Psidium guajava*), palm kennel trees (*Elais guineensis*) which is actually a developed plantation and mango trees (*Mangifera indica*).

Diurnal Activities

The Nigerian white-throated monkeys usually sleep on trees close to water bodies (streams or lakes within the park). They descend for a drink at first light at about 0600hrs, spend some time around the stream and head for the closest fruiting part of the forest of desired seeds and plant species which is mostly detected the previous day. When they get to the desired fruiting trees, the females feed their young and the males position themselves for security as they feed. The females on the other hand after feeding themselves and their young simultaneously, fill their pouches in their inner jaws with food and browse through the forest gradually as they move deep inside the forest; at the detection of any intruder, they run away. They move to lager trees before about 1100hrs that will provide shade for them and spread themselves out and become less active from about 1100hrs during which time they tend their young, mate (rarely sighted) and also attend to any injured member of the group and rest until late afternoon about 1600hrs, when they turn around and go on same route, they came from back to the previous place they slept, if the fruit is abundant or head towards another direction in search of another fruiting area.

Migratory route

White throated monkeys do not have a specific migratory route but move to the part of the forest that is fruiting at each point in time. They have a good relationship with Mona, and Mangabey monkey too. They move in mixed up troops from time to time. The white throated monkeys are a shy species unlike their Mona cousins which are bold and more social especially with humans. They have a special ecological relationship which starts from the canopy top down to the floor. The white horn-bill bird at the peak of the canopy sights fruiting plants from a distance and move towards it making a unique sound or call as it goes, the monkeys in turn follow the sound of the bird and feed on same fruits.

The white- throated and Mona monkeys stay at the middle part of the forest beneath the top canopy but not on the ground and the Mangabeys love the peak of the forest, but larger members and baboons (especially during the day when they feed), stay very close to the ground or even on the ground and feed from the food that their smaller members drop from the top. The duikers (deer) feed on the remnants and left over from the primates, squirrels also are seen in this group. Sometimes the duikers (deer) in turn provide security for the monkeys and birds from ground predators or invaders such as man.

Monkeys do not like rain or wet conditions; although good swimmers. When it is raining, they hide themselves almost motionless under thickets, covers and caves formed by climbers. White-throated monkeys also gather food in its inner jaws inside its mouth before going to sleep after sunset and possibly wake up at night to feed. They usually sleep close to a fruiting area in the forest. They breast feed their young first thing in the morning and last thing in the evening, they also drink water in the morning before climbing back up to start feeding. They are most active in the mornings and evenings. Breast feeding mothers only eat a fruit locally called “GBOSA” in Bini language (*Xylopia aethiopica*) also known as spice tree. This plant fruit and seeds are also known to be consumed locally by humans (women) who just gave birth.

Habitat

At the park itself the vegetation is healthy (a dense secondary tropical rain forest of numerous tree species) but highly fragmented as jeep tracks and nature trails for access into the park. (Although most of these roads are in very poor conditions and in the heart of raining season it becomes inaccessible). The diverse plant species are growing on a rich fertile soil with small lakes / streams running through the park. Although the park is shrinking with the expanding multimillion oil palm and rubber plantations and from local farmers who are encroaching into the park from all directions. Some of the plant/tree species which the white throated monkeys feed and live on includes; *Mangifera indica* (mango tree), *Xylopia aethropica* (spice tree), *Psidium guajava* (guava tree) and *Musanga cercropiodes* (umbrella tree).

Feeding Behaviour and Diet

White- throated monkeys feed on various fruits, seeds and leaves in and around the forest as shown in Table 2, but they have a special liking for the umbrella tree (*Musanga cercropiodes*) because in my opinion its fruits (small and soft and easy to consume) brightly coloured flowers and its overall size which serve as both shelter during rain and shade during sun. The white-throated monkeys are found on this tree even in non-fruiting seasons and this on the other hand might be due to the fact that this plant species is evenly distributed all over the Reserve.

The Nigerian white throated monkeys are highly frugivorous but leaves, seeds and black ants on *Barteria nigritana* are part of its diet. The white throated monkeys have pouches in their inner jaw where they store food. The foods they eat mostly include: the following in the table below.

Table 2: Commonly consumed food by *Cercopithecus erythrogaster pococki*

Plant Species	Common Name	Local Name	Plant Parts used as food.
Dacryodes edulis	Native pear	Owon	Fruits and seeds
Garcina kola	Bitter kola	Ėduń	Fruits
Psidium guajava	Guava	Ēĝuėva	Fruits, seeds and leaves.
Xylopia aethiopica	Spice tree	-	Fruits and seeds.
Elais guineensis	Palm tree	Iǩpédiń	Fruits and nuts(seeds).
Musanga cercropiodes	Umbrella tree	-	Fruits and seeds
Mangifera indica	Mango tree	Ėmāėgó	Fruits.
Diallium guineensis	Velvet tamarind	-	-
Barteria nigritana	Bacteria tree	-	Fruits and black ants that lives on it.
Irvingia gabonensis	Bush mango	Ógúėih.	Fruits
Macaranga barteri	-	-	Fruits
Myranthus arboreus	Bush pineapple	Iĥiėgĥē	Fruits and seeds
Cleistopholis patens	-	Ōtu	Seeds
Ficus mucuso	-	Amēmē	Seeds.
Ficus exaspirata	-	Amēmē	-
Gana obeche	Obeche/masonia	Ōkpėhmasonia	-
Spondias mombin	-	Ōghekhe.	-
Staudtia stipitata	-	Umaza	-

Table 3: Activities of *Cercopithecus erythrogaster pococki* in Okomu National Park.

Date	Time	Sighting	Species	Location	Distance	Comments
17/4/19	1600-1830	Nil	Nil	-	-	-
12/5/19	1100-1700	4	WTM	OOP	20M	Playing
		12wtm/8mona	Mixed group	OOP	15m	Playing/ resting
13/5/19	1000-1640	7-5 Wtm/mona	Mixed group	Plantain plantation	30m	Feeding
18/6/19	0600-1150	3-5	Wtm/mona mixed group	Comp.2	10m	Running away.
			,,			
	1600-1800	15-20		,,	20m	Rapid movement
19/6/19	0600-1130	5mona.3wtm	Mixed group	Comp.4.	40m	Running away.
22/7/19	0630-1200	Nil	Mona	Comp.2.	-	Calls, leaf litter.
	1530-1800	Nil	Mona	,,	-	
10/8/19	0800-1100	Nil	Wtm	Comp.3	-	Calls
	1500-1740	Nil	Mona	Comp.1	-	Calls
19/10/19	1849	70-100 or more	Wtm,mona, mangabey&baboon	From comp. 2 to 4.	35m	Rapid movement in a highly mixed group. An unusual experience
15/11/19	0640-1215	-	Wtm	Comp.2.	-	Calls, foot Impression. Faeces.
5/12/19	1300	8-12	Mona /wtm	Comp.2.	15m	Feeding, resting.

Time: *(+1 GMT). Distance: in meters.*

Location: *Compartments. (Comp.). Sightings: number of individuals. Mixed groups: Group comprising more than one species.*

Ranging
White throated monkeys have a large range and have been sighted for over 10km outside the National Park, most likely sourcing for food (Table 3). Their range is largely influenced by food distribution at each given time. When food source is abundant in an area like in plantations they tend to remain in that area. The scarcer food is the larger their range

Predators
White throated monkeys are not known to have a natural predator in the area but man who hunts it for food and the forest resources for livelihood.

Poly specific association
Nigerian white throated monkeys (wtm) always move about with Mona monkeys, browsing through the forest for food and other daily activities. The Mona monkeys are social and more used to humans than the white throated monkeys. In one instance, a large mixture of a group of *C. mona*, *C. e. pococki*, baboons and red capped Mangabey (which is very rare at the park) was sighted. They possess this behaviour to defend against predators especially when they are moving through an area where human activity is high or other predators. Polyspecific association is centred on two major factors;

1. Foraging Efficiency Advantages: Reduced scramble competition, Increased detection of resources, Access to otherwise unavailable resources, Increased prey capture rate, Increased competitive ability.
2. Anti-Predator Advantages: Increased predator detection, Increased predator confusion, decreased chances of "being the victims", Increased ability to defend against predators.

DISCUSSION
The distribution and abundance are affected by fruiting areas of the Wildlife Park. The analysis shows that there was a significant difference ($p<0.05$) in the number and distribution of *Cercopithecus erythrogaster pococki* observed within the forest on different days of observation. Again, when compared to the Agro-forest in distribution show a similar trend in the other partition. There was a significant difference ($p\pm0.05$) between the members of *C. erythrogaster* in the forest and on different days and between the forest and plantation. In this study it was observed that the majority of the green monkeys were found in the riparian vegetation. This trend was also noticed by several researchers, Meduna, 1988, Marina 1999 and its was attributed to the species preference for availabilities of adequate food and coverage. This is in line with the reports of previous workers (Meduna, 1988; Ajibade, *et al.,* 2011). The attributes of such habitats included availabilities of adequate food and coverage for Cercopithecus species. This also explains the fact that there are no migratory routes.

Cercopithecus erythrogaster pococki was found in a dense secondary tropical rain forest of numerous tree species. Other researchers have also reported this trend for other monkey species. Barbara *et al.,* (1987) reported that more than 90% of world primate species occur in the tropical forests. Wolfheim (1983) reported that most monkeys inhabit the forest of West and Central Africa. He further stated that habitat preferences vary both within and between forest species. Some species are restricted to particular forest while others occur in two on more kinds of habitats. Statistical analysis confirmed that there is a weak or insignificant correlation between the diameter at breast height and the relative frequencies of the different tree species in the habitats of green monkey in this park.

The diet is are more of fruits, though the percentage to fruits, seeds and nuts may be different from time to time as a result of availability of different diets. This research also followed the same pattern, for the diet of the mona monkey, *Cercopithecus mona*, which were made up of fruits, which constituted the largest proportion of ingested plant parts (64%), followed by seeds (28%), and nuts (8%), according to Olaleru, *et al.* (2020). The researchers also observed that Mona monkeys obtained 79% of their diets within and 21% outside the park, which was also the finding in this research. This was also noticed by Brugiere, *et al.,* 2002, monkey preference for fruits.

The major reason for the declining population of green monkeys a different species at the park was attributed to habitat destruction. According to Barbara *et al* (1987), as forest disappear so too the animals that depend on them for survival. Agbelusi (1995) also reported that there is inter-relationship between primates'

population and deforestation. Russel *et al*. (1987) further suggested that it was the price to pay for forest destruction caused by the human population explosion, which is greater in the poor under-developed countries of the tropics. Another threat to primates' conservation includes hunting and live capture for export or local trade or poaching.

CONCLUSION

This was a preliminary study was to investigate the population dynamics of *Cercopithecus erythrogaster pococki*, the Nigeria White-throated Monkey since its documentation in 2000 in Okomu National Park. Our study revealed the sub species was more common in the reserved forest, mostly feeds on fruits and seeds and are not known to have natural predators apart from man that hunt them for food. More studies on this subspecies are needed to fully understand the evolutionary position of the primate.

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