FOOD AND FEEDING HABITS OF WHITE-THROATED MONKEY (*Cercopithecus erythrogaster.L*) IN OKOMU NATIONAL PARK, EDO STATE, NIGERIA

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DEDICATION

This project work is dedicated to Almighty God for His infinite mercies, love, care and protection on me during this programme. My dedication also goes to my parents, Mr and Mrs. Rolland Obasogie Evbomwan for their kindness.

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ABSTRACT

The study examined the relative abundance, feeding habits and nutrient quality of the food of white-throated monkeys. (Cercopithecus crythrogastèr (L) in Okomu National Park. The rainy season study was conducted between the months of May to October 2005 and November to February 2006, to determine the effects of seasonality of the food and feeding behaviour of white-throated monkeys in the park. Data were collected between the hours of 7.00 11.30 and 14.00 – 19.00 along the natural trails which were used as transects in each of the four ranges in the park. Plant species and their parts eaten by white-throated monkeys were identified through direct observations with the aid of binoculars. Food items eaten by white-throated monkys in the park were identified to include young leaves, matured leaves, fruits and flowers. These identified parts of plants were collected fresh in plastic bags and oven dried at 40''C for 24 hours to estimate the dry matter content. Each dried food sample was milled to powdered form to determine the proximate contents. The results revealed that White-throated monkeys feeds mainly on fruits. Elacis guineensis, Atlanblanckia floribunda and Myrianthus arborcus recorded the highezxt percentage of food consumptionm with 13.3%, 13.3$% and 12.3% respectively, in the rainy season. While Irvingia smithii, Zylopia aethiopica and Juglan nigran recorded the highest percentage frequency of food consumption in the dry season with 17.3%, 14.4% and 13.8% respectively. It was generally concluded that the present vegetation of Okomu National Park could sustain the existing population of white-throated monkeys and other wild animal species in the park provided various illegal human activities in the park areas are effectively controlled. Obasogie (2005)

CHAPTER ONE

INTRODUCTION

1.0 Wildlife Nutrition

Wildlife nutrition is a combination of processes by which wild animals receives and utilize food materials necessary for the maintenance of its functions and for the growth and renewal of its body tissues (Olomu, 1979). Wild animals require different classes of food such as protein, carbohydrates and fats for energy. The size of animal largely predetermines the animal's primary food sources, because small animals expose a relatively large surface area than big ones, they have to burn proportionally more fuel to maintain a constant body temperature. However, monkeys consumes mostly young leaves, buds, shoots and fruit pods to enhance their nutritional requirement. Wild animals require animal supplements to supply the much needed protein and energy than in plants tissue, but primates cannot locate and capture enough of such small animals as food items, so have to rely on less nourishing vegetable foods to sustain their nutritional requirements (Olomu, 1979).

1.1 Food and Feeding Habits of Monkeys

Food is an important requirement of wild animals and it must be present at a sustainable quantity and quality at all times (Adeyoju, 1988). The potential carrying capacity of any given rang depend largely on the abundance and distribution of preferred food within the range. However, variation occurs in the feeding behaviour of monkey, especially during food scarcity, this has lead to competition over food. Food selection within a given species has influenced greatly on the feeding pattern of different species of primates (Aremu et al, 2002).

1.2 Importance of Wildlife Resources

In Africa, cropped wildlife species make a considerable contribution to human welfare in the form of food for rural people, Food and Agricultural Organization (FAO, 1989). In Nigeria game constitute about 20% of the mean annual meat consumption, FAO (1989). Also a large

numbers of wildlife species are utilized in the preparation of traditional medicine to cure several illness in Nigeria. Tourism industry earned Uganda about US $ 90 million from about 193,000 tourists. Also Zimbabwe realized about US $ 130 million and US $ 200 million from tourism in 1995 and 1996 respectively. World Tourism Organization reported that the wildlife based tourism accounts for at least 6% of the World Gross Domestic Product (GDP) and employs about 127 million people and that tourism will represent 11.5% of the World GDP by the year 2010 at US $ 7.1 trillion and will then employ over 500 million people.

1.3 Monkeys Time Pattern Activities

The activities of monkeys include feeding, playing and grooming. The way in which monkeys use their time is an important aspects of behavioural ecology. The frequency of interactions among species of monkeys are directly related to food availability and distribution. Changes in food availability of monkeys also affects their daily time pattern activities, therefore feeding becomes the most time-consuming activity. However, some species spent most of the hours searching for food during food scarcity (Freese et al 1988).

1.4 Wildlife Utilization

The utilization of wildlife resources is as old as man's existence, it has found various uses in the past and present era of civilization. Evidence shows that man was able to maintain himself successfully (Health-Wise) for ages by hunting wildlife for food. He ate flesh of all animals that surrounded him. Wildlife resources are used in traditional medicine, bio-chemical research, education, recreation etc. According to (Eltringham, 1984) wildlife resources are used in three major ways: firstly as edible products (food and medicine) secondly as non edible products (trophies) and thirdly as sport hunting (tourism). However, wildlife utilization has been classified into consumptive and non consumptive utilization (Eltringham, 1984).

1.5 Wildlife Conservation

Wildlife conservation is very important to the economy of any Nation. It implies getting the maximum use of the greatest diversity of available natural resources that are valuable to the greatest possible number of people for the longest period of time (Christopher, 1988).

1.6 Justification of the Study

Okomu National Park is endowed with both flora and fauna resources which has been greatly influenced by man through uncontrolled exploitation of wildlife resources. Okomu National Park contains different species of wildlife resources which are threatened with extinction. The intensity and extent of forest exploitation within and around Okomu National Park has increased greatly due to increase in human population in adjourning communities around the park; Obasogie, (2005).Increase in population pressure, coupled with wildlife habitat destruction by farmers, hunters and industrial expansion, has contributed greatly to the continuous degradation of wildlife habitats resource within Okomu National Park. However, as a result of the continuous wildlife habitats destruction, the survival of animals are threatened by game poaching, uncontrolled bush burning, illegal felling of economic trees and illegal settlement which can degenerate to the food security problems in the park.. If this is allowed to continue, it will greatly lower wild animals productivity and perpetuation in the reserves areas. There is therefore the need to study the relative abundance, food preference and feeding habits of white-throated monkeys for effective habitat enrichment techniques by introducing preferred food species of white-throated monkeys so as to achieve a sustained yield of the resources.

Objectives of the study

The objectives of the study are to:

i determine the species abundance and troop size of white-throated monkeys (*Cercopithecus erythrogaster)* in Okomu National Park

ii identify foods of white-throated monkey *(Cercopithecus erythrogaster)* in Okomu National Park

iii observe the effect of seasonality on the foods and feeding habits of white-throated monkey *(Cercopithecus erythrogaster)* in Okomu National Park. As well as to:

iv determine the nutrient quality of the foods of white-throated monkeys in Okomu National Park

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Classification of Primates

The order primate belongs to the class mammalia and has sub-orders; that are *Prosimii* and *Anthropoida*. Each of these sub-orders consists of six families. The six families of the *prosimians* include, *Tupaiidae, emuridae, Indriidae, Daubentoniidae, Lorinsidae* and *Tarsiidae*. While the anthropoideans that include *Cellitrichidae, cebidae, Cercopithecidae, Hylobatridae, Pongidae* and *Haminidae* have monkeys as primary members. This means that the monkeys do not form one natural taxonomic group. Two of the above families are found in South and Central America that is, the Callitrichidae and the Cebidae and for this reason are often called the "New World monkeys". The third family, the cercopithecidae is found only in Asia and Africa and as a result are sometimes called the "Old World Monkeys". This is the largest of the families in terms of number of species and distribution. It is further sub-divided into two sub-families, Cercopithecinae and colobinae. According to Raven and Johnson (1989) White-throated monkey can be classified as follows.

*KINGDOM*_____*Animalia*

*PHYLUM*_____*Chordata*

*CLASS*_____*Mammalia*

*ORDER*_____*Primate*

*SUB-ORDER*_____*Anthropoidae*

*FAMILY*_____*Cercopithecidae*

*SUB-FAMILY*_____*Cercopithecinae*

*GENUS*_____*Cercopithecus*

*SPECIES*_____*erythrogaster*

White-throated monkey *(Cercopithecus erythrogaster)* is a medium sized animal with short hair, dark brown to black in general colour, underpart is dirty white. Both fore and hind limbs are equally black brown to black and it extend to the tail. It possess white colouration around the throat like bead. This is where it derived its name white-throated monkey. When resting or seating, it looks like an old man with bead hence many communities do not hunt or eat it and this gives it natural protection.(Haruna, 2004).

Plate 1 – White–throated Monkey –*Cercopithecus erythrogaster*

Plate 1. White-throated Monkey – *Cercopithecus erythrogaster* roosting on top of Barteria nigritiana tree

2.2 Food and Feeding Habits of Monkeys

Differences in home range of monkeys in term of size and utilization may not only be affected by factors such as food resources availability but also by Water source, and cover for protection and breeding space. Field and Blankenship (1983) stated that apart from changing the feeding habits of monkeys with changes in season and availability of food resources, monkeys are accustomed to the location of those plant species producing their favourite fruits at a particular season, for instance monkeys consumes *Myrianthus arboreus, Piper guineensis, Garcina kola, Irvingia gabonensis, and Elaeis guineensis* at various ranges and at different seasons of the year. Monkeys consumes less of fibrous part but consume more of succulent and nutritious parts of plants such as fruits, flowers, young leaves. (Field and Blankenship 1983). During feeding or resting, the females with their young ones are always at the middle, while adult males stays at the periphery with the group soldier guard at the top of the tallest tree around so that it can alert the troop when there is danger (Haruna, 2004).

2.3 Abundance and Social Interaction of Primates

Primate habitats are very crucial in their various social organizations. The various habitats determines their group size, home range area, population density, sex ratio and feeding behaviour. Different species of primates have evolved as a result of different selection pressures operating in different habitats. (IUCN,1979). In different and independent studies on primates living in different habitats such as forests and open savanna, the food types, such as insects, fruits and grasses is also a part of their social interaction. Eisenberg *et al* (1988) found that species living in similar habitat with the same diet also tend to have certain features such as group size, number of males per group and the relative body size. He further stated that white-throated monkeys are seen in troops of between 15-25 individuals and stays almost within tree canopy. They are very clever and shy, they are very secretive in performing their mating behaviour and they take good care of their young ones by carrying them on their black and on their chests.

2.4 Feeding Behaviour of Primate.

The abundance and distribution of food in different habitats, and the intensity of predation and the availability of safe sleeping environment is very crucial to the feeding habitat of primates. Competition for food in primate habitats is very paramount for their survival in any given area, (Gartlan, 1972), carried out a survey on five forest living monkey species in the same locality in Uganda for food competition in their various habitats, these species included; black and white colobus *(Colobus guereza)* and *(Colobus badius)*, the red tailed monkey *(Colubus mitis)* and white-checked managbey *Cercocebus albigena)*. He found that *Colobus mitis* was able to compete for food with ko*lobus boduis* in times of food scarcity in their habitat. He also worked with three *Cercopithecus* genera, from the tropical rainforest in Cameroon. These include *Cercocebus, torquatus Cercopithecus mona and Cercopithecus nictitan.* However, it was also noted that competition between the last two species seemed reduced by their different ranging pattern.

2.5 Tropical Rainforest and Deforestation

The Nigeria rainforest Zone which extends in a discontinuous belt between latitude 4^0 15^1 and 7^0 north of the equator exhibit ecosystems which are intimately bound with the welfare of the immediate communities. These forests covering an area of about 95,563 km^2, are the sources of varied forms of food, drugs, building timber, fuelwood, fibre, spices, resins and other countless forest products that currently supporting the Nigeria economy, Soladaye (1996). This natural vegetation formation is also the main repository of the genetic diversity of both flora and fauna of the country, while it protects the Nigerian environment against drought and erosion. The structure of the Nigerian rainforest vegetation is rapidly changing as a result of human activities. These changes have caused the loss of some plant and animal species and a decline in its biodiversity and environmental quality. Collections of different types of plants from the Nigerian forests, which started in the 1950's gave birth to the forests, Herbarium, Ibadan (FHI) and the production of the Nigeria vegetation Map. (Keay 1999).

The socio- cultural factors that prevailed among the forest communities at the forest reserve created drastical changes. Among these factors have been population and economic values. The demand for forestlands and forest products has increased tremendously (Kio and Abu, 1993).

With deforestation, many plant species of economic, nutritional and medicinal values and which are only sparcely distributed in the wild forests are disappearing even before they are studied, domesticated and improved upon. (Oguntala, 1971).

2.6 Tourism and Foreign Exchange

Wildlife reserves have been one of the world's greatest attractions for tourists. Nigeria as a country with potential resources can earn hundred of millions of naira from game viewing and tourism like Kenya and Tanzania (Afolayan, 1987). However, Sodipe, (1986), further stated that wildlife has made charming contributions to medical research the world over. Life animals (rats, Primate) have been used in many medical research laboratories spread over the world. Primates are widely used by virtue of their close relationship to man. The Rhesus factor was first discovered in Rhesus monkey before it was applied to man (Ajayi 1979). The clawed toad, Zenopus is used in pregnancy test. Also, the common toad is used in countless undergraduates practical to demonstrate nerve muscle action (Eltringham, 1984).

2.7 Problems of Wildlife Conservation

Poaching, illegal grazing of livestock in conservation areas and indiscriminate bush burning are the major social and ecological problems confronting wildlife conservation in Nigeria today. (Afolayan,1987). The problems were further compounded by the destruction of habitats for industrial expansions, development of infrastructure, illegal settlement and pollution.

Afolayan (1987) further highlighted that other constraints to effective conservation of the wild animal resources in Nigeria include, inadequate man power, inadequate funding, and absence of a national focus along defined theme. Further constraint to wildlife conservation in Nigeria is the inadequacy of the information database. There are also very few inventories of the

vegetation and animal's habitat over most of the wildlife conservation areas, and without species checklist, it is difficult to know what species are disappearing or increasing. There are no studies of the ecology neither of the individual animal species nor of the total ecosystem on which sound management can be based.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

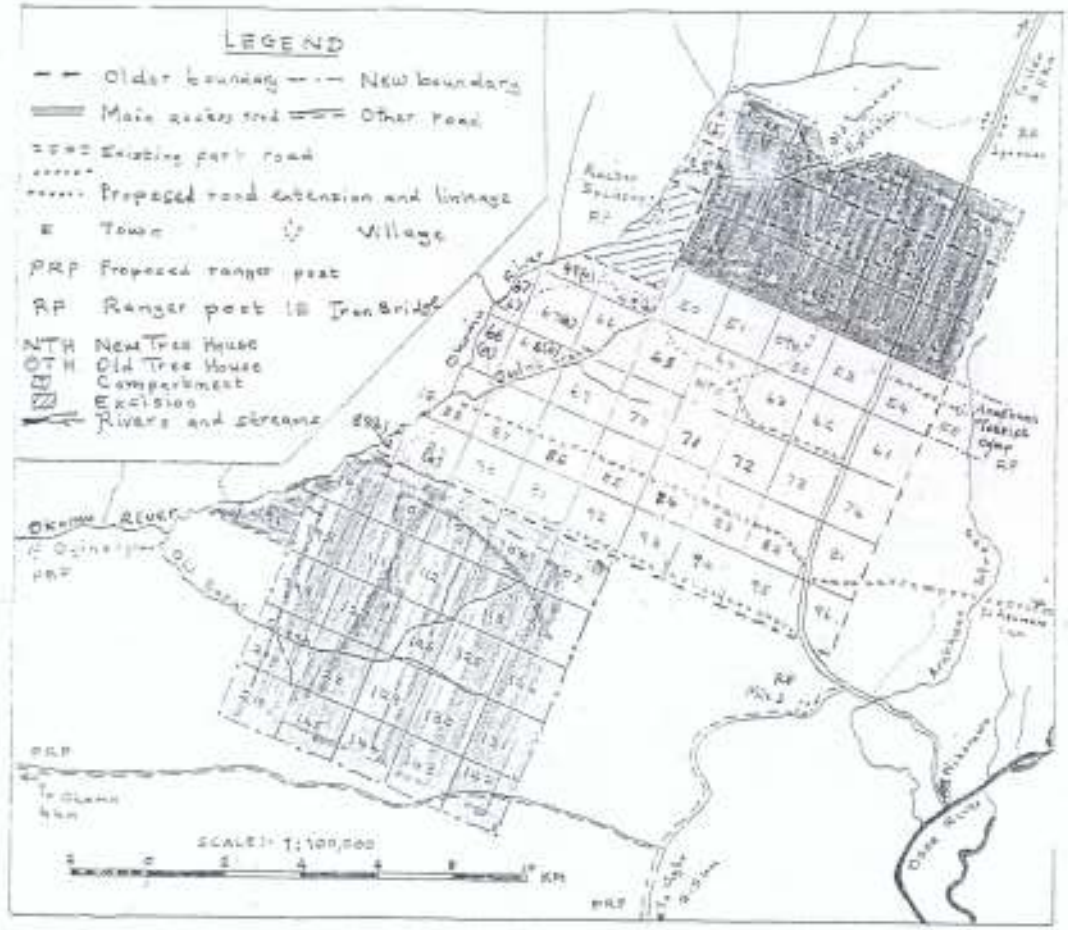
Okomu National Park was originally gazetted as a wildlife sanctuary in 1986 through legal notice N0 198 of 1986. The park is located in Ovia South-West Local Government Area of Edo State. This conservation enclave became a full fledged national park in 1999 through the provisions of decree 46 of 1999. The park lies 45km west of Benin City and immediate South of Udo town. The park derives its name from river Okomu which has its sources in the North-East of Okomu forest and flows South-West to join the Osse River. The National park covers a total area of 212.48 sq.km, which constitute four different ranges, the ranges are Iguowan range (38.40 sq.km), Arakhuan range (66.56 sq.km), Baibui creek range (66.56 sq.km) and Julius creek range (40.96 sq.km). The park is situated in the rainforest ecosystem in the South-West of Nigeria and it is endowed with rich flora and fauna resources, which include *Afzelia africana, Baphia nitidas, Allanblackia floribunda, Raphia veniifera, Khaya ivorensis, Lovoa trichiloides, Elaeis guineensis, Xylopia aethiopica* e.t.c. while the fauna resources of the park includes *Cephalophus maxwelli, Loxondonta africana, Panthera pardus* Python *regius, Crocodylus niloticus, Artherurus africanus* and the *endangered Cercopithcus erythrogaster*, among others. (See Appendix I and II for details).

3.2 Climatic Condition of Okomu National Park

Okomu National park is bounded in the West by river siluko and in the East by river Osse. The park lies between longitude 5^0 30^1 East and latitude 6^0 10^{11} North and 5'' 30" South North with an altitude of 25m. The mean annual rainfall is 1500mm to 2100mm with most of the rain falling between March and November each year. The driest months are December, January and February, while the relative humidity is about 65%. The mean temperature is 30.2^0C and the soils are sandy-loams derived from deep loose coastal sediments, with a P.H. of 5.0 which is

Markedly acidic. The vegetation of the park is semi-deciduous and belong to the humid lowland rainforest with fresh water swamps occurring along the river. (Soladoye and Oni, 1996)

OKOMU NATIONAL PARK, NIGERIA



BABUI RANGE JULIUS CREEK RANGE IGLIOWAN RANGE
ARAKHUAN RANGE

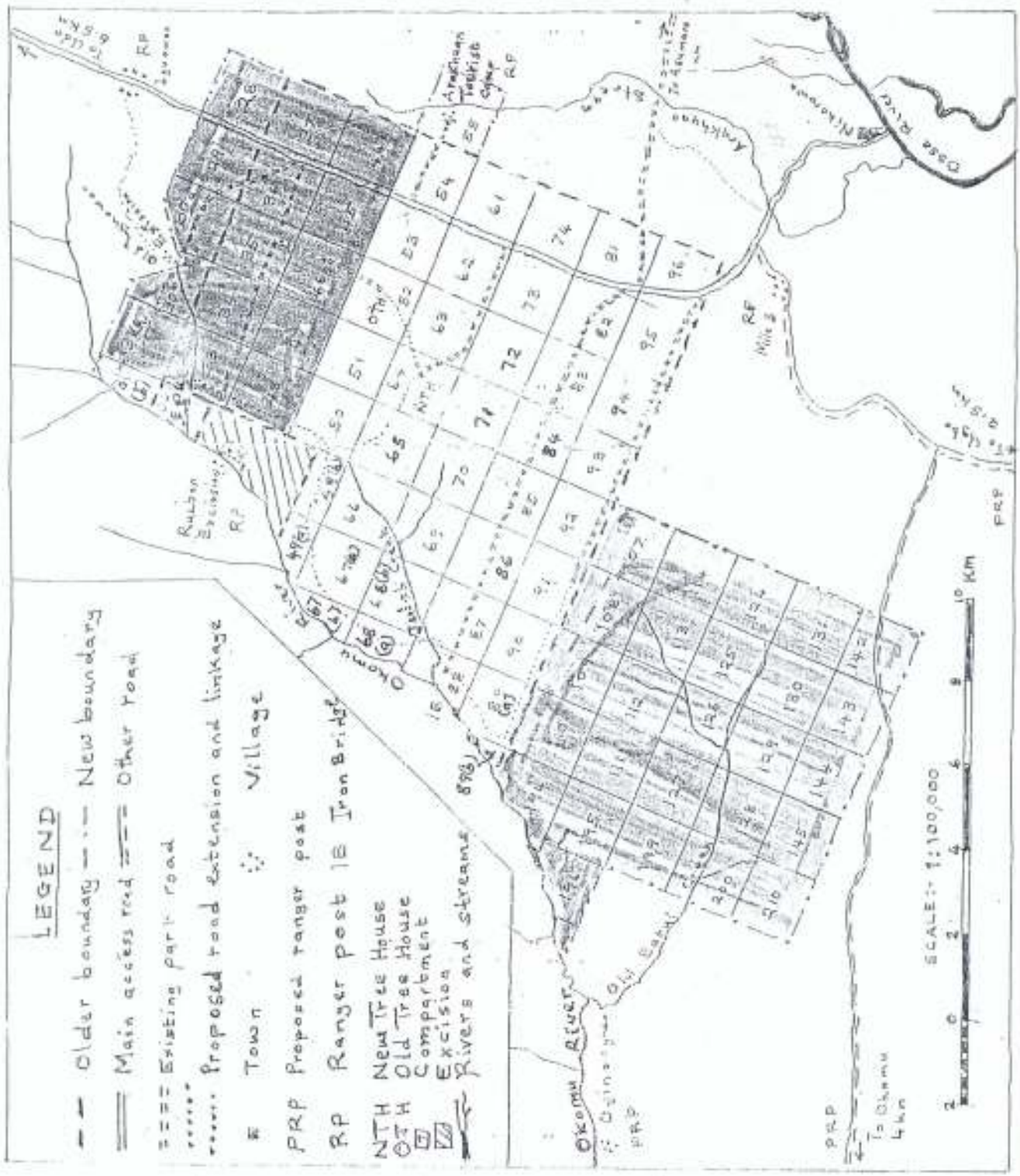


Fig. 1 Map of Okomu National Park

Source: Oguntala and Soladoye (2000)

3.3 Protection Structure of Okomu National Park

The park is divided into four smaller protection management units called ranges. Each range is placed under the leadership, control and responsibility of an officer known as Range officer. The range officer is assisted and represented by a relatively senior ranger known as Range Assistant. Each range has an operational-base called the field station, where the range officer, his rangers and other staff are officially resident. The national park being a secondary forest, it was compartmentalized by early exploiters of the forest, primarily due to logging activities. The size of each compartment is usually 1mile square. Today various compartment in the park now serves as protection unit to different ranges

and beat within the park.

3.4 Methodology

Existing nature trails in various ranges of the park were used as transects between the months of May 2005 to February 2006. The study was conducted thrice weekly between the hours of 9.00am – 11.30am and 2.00pm–5.00pm with an average walking speed of 1km/hour. Period of walking were interspersed with period of "Silent" "Watch" and "Wait" censusing in order to increase the possibility of detecting animals that might hide or flee upon the approach or movement of the observers. The counts of individual per group was made conservatively by only including individual seen. Binocular (Zeisis Dialyt l0x40) were used to observed and detect presence of white-throated monkeys while feeding. Population structure and troop size as well as season sighted were also recorded, so as to determine the effects of seasonal variation on the feeding habits of white-throated monkey.

Cercopithecus erythrogaster sighted were identified as outline and described by jean and Pierre (1970). Collected faecal samples were dried and broken and then examined to identify undigested food samples. Cultured samples of the faeces were also buried in a sterilized soil and the records of food samples eaten were taken, plants eaten and parts preferred were recorded, frequency of consumption were also recorded. Information collected on any group of white-

throated monkey sighted include time sighted, range sighted, troop size and plant species eaten. Plant species eaten by white-throated monkey were collected for plant identification. Plant proximate composition was determined using Weend's analysis through Kjeldahin procedure as described by Association of Official Analytical Chemist (AOAC, 1990). Groups of white-throated monkeys sighted in various ranges were closely monitored in both wet and dry seasons to determined their daily feeding patterns and activities.

3.5 Statistical Analysis

Estimate index of plant diversity and frequency using Shannon-Weiner Function (H1) according to (Maguran, 1987) as follows:

Plant frequency (Fk) = [Yi/nx 100

Where Fk is the frequency species k, I is the incidence (presence) of species K in site I, n is the number sampled.

Plant diversity index (H1) = [PiLogi

Where Pi is number of plant species, log is the natural log.

Data collected where subjected to Analysis of Variance using completely randomized design as a recommended by Alika (2006) as follows: Yij = /j+t1+eij

Where

Yij = the effect of the jth observation in the ith treatment

Ji = general mean of the population

Ti = the effect of the jth treatment where I = 1,2-----1

Eij = random error associated with the jth observation in the jth treatment.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

4.2 Relative Abundance and Distribution of *Cercopithecus erythrogaster* in Okomu National Park

A total of 33 groups of *Cercopithecus erythrogaster* representing 155 individuals was sighted in both wet and dry seasons in all the ranges of the park. Iguowan and Arakhuan ranges recorded the highest relative abundance and distribution of *Cercopithecus erythrogaster* in wet seasons, representing 0.3571 and 0.2857 respectively (Table 4.1) while Arakhuan and Julius Greek ranges recorded the highest relative abundance and distribution of *Cercopithecus erythrogaster* in the dry season, representing 0.3158 and 0.2632 respectively. (Table 4.2)

Table 4.1: Troop size and Distribution of *Cercopithecus erythrogaster* in Wet Season in Okomu National Park

nge/Habitat	Troop size	Individual	%Group Size	Relative abundance
owan Range	5	25	35.71	0.3571
khuan range	4	14	28.57	0.2857
is creek range	3	16	21.43	0.2143
bui creek range	2	8	14.29	0.1429
tal	**14**	**63**	**100**	**1.0**

Source: Field data survey

Table 4.2: Troop size and Distribution of *Cercopithecus erythrogaster* in dry season in Okomu National Park

Range/Habitat	Troop size	Individual	%Group Size	Relative abundance
Iguowan range	6	28	31.58	0.3158
Arakhuan range	4	19	21.05	0.2105
Julius Creek range	5	21	26.32	0.2632
Baibui Creek range	4	24	21.05	0.2105
Total	**19**	**92**	**100**	**1.0**

4.3: Population Structure of *Cercopithecus erythrogaster* in Okomu National Park.

The Adults recorded the highest population of *Cercopithecus erythrogaster* in the park in both seasons, representing a total of 50 and 27 individuals respectively. This was closely followed by Subadults and Juveniles females with a total population of 22 and 19 individuals respectively.

Table 4.3: Population Structure of *Cercopithecus erythrogaster* in Wet Season in Okomu National Park

Range/Habitat	Adult	Subadult	Juvenile	n
Iguowan range	10	7	5	22
Arakhuan range	5	5	3	13
Julius Creek range	7	4	3	14
Baibui Creek range	5	3	2	10
TOTAL	**27**	**19**	**13**	**59**
Mean	**6.75**	**4.75**	**3.25**	
Percentage	**45.76**	**32.20**	**22.03**	

Table 4.4: Population Structure of *Cercopithecus erythrogaster* in Dry season in Okomu National Park

Range/Habitat	Adult	Subadult	Juvenile	n
Iguowan range	15	7	8	30
Arakhuan range	12	5	6	23
Julius Creek range	10	6	4	20
Baibui Creek range	13	4	6	23
Total	**50**	**22**	**24**	**96**
Mean	**12.5**	**5.5**	**6.0**	
Percentage	**52.08**	**22.92**	**25.0**	

Survey:Field data survey

4.4: Daily Feeding Activities of *Cercopithecus erythrogaster* in Okomu National Park

Cercopithecus erythrogaster in Okomu National Park are arboreal and diurnal primate species, their behaviour is tied to the lowland tropical rainforest. *Cercopithecus erythrogaster* are usually very active between 7.00am – 11.30am in the morning and 2.00pm – 7.00pm in the evening. Their resting period is between 12.00 noon – 4.00 pm in the afternoon. However, *Cercopithecus erythrogaster* spent most of their time on top of trees jumping, playing, grooming and feeding. Occasionally, they are found on the forest floor at the river banks (Table 4.5).

Table 4.5: Daily time pattern and Activities of *Cercopithecus erythrogaster* in Okomu National Park

Local Time (Hours)		Feeding Activities
7.00am – 8.30am	→	Early morning traveling and food search
9.0am – 11.00 noon	→	Early morning feeding and drinking
12.00noon – 4.00 pm	→	Resting on top of trees
2.00pm – 5.00 pm	→	Evening feeding and drinking
6.00pm – 7.00pm	→	Traveling back to resting site

Source:Field data survey

4.5 Effects of season on food of white-throated monkey

Seasonal variation affects the fruiting season and availability of food of white-throated monkeys in the park. Varieties of plant species were identified in both wet and dry season as being eaten by white-throated monkeys in the park. They include *Myrianthus arboreus, Irvmgia smithii, Elaeis guineensis, Juglan nigran, Xylopia aethiopica, Piper guineensis, Allanblackia floribunda* among others (Table 4.6 and 4.7)

Table 4.6: Plant species eaten by *Cercopithecus erythrogaster* in wet season in Okomu National Park

Plant Species Eaten	Parts Eaten
Myrianthus arboreus	YL, ML, FR, FL
Elaeis guineensis	YL, FR
Cleistophelis patens	YL, FR
Macaranga bateri	FR
Garcina kola	FR
Allanblackia floribunda	YL, ML, FR
Musanga cercopiodes	FR
Detarium senegalensis	YL, FR
Barteria nigritiana	YL, ML, FR
Irvingia gabonensis	FR

YL – Young leaves, ML-Matured leaves, FR – Fruits, FL – Flowers.

Table 4.7: Plant species eaten by *Cercopithecus erythrogaster* in dry season in Okomu National Park

Plant Species Eaten	Parts Eaten
Irvingia smithii	YL, ML, FR, FL
Piper guineensis	ML, FR
Xylopia aethiopica	YL, ML, FR, FL
Kola nitida	FR
Spondia mombin	YL, ML, FR
Chrysophyllum africanum	YL, FR
Juglan nigran	YL, FR, FL
Mangnifera indica	FR

YL – Young leaves, ML – Matured leaves, FR – Fruits, FL – Flowers.

4.6 Frequency of preferred food eaten in wet season

Ten plant species were identified as food utilized by white-throated monkey in the wet season in Okomu National Park. The result revealed that *Allanblackia floribunda, Myrianthus arboreus* and Barteria nigritiana were the most preferred plant species, using Shannon-Weiner function species ranking procedure, while fruits and young leaves were parts mostly utilized, the reason is due to the high concentration of fibre with less digestibility in old leaves (Table 4.8).

Table 4. 8: Plants species Eaten by *Cercopithecus erythrogaster* in the rainy season in Okomu National Park.

Plants species consumed in the rainy season by *Cercopithecus erythrogaster*	Frequency	Percentage(%)	Parts Eaten YL, ML, FR, FL
Barteria nigritiana	32	11.2	X X X –
Detarium senegalenese	25	8.7	X – X –
Cleistopholis patens	18	6.3	X – X -
Elaeis guineensis	38	13.3	- - X –
Irvingia gabonensis	20	6.9	- - X –
Macaranga barteri	25	8.7	- - X –
Allanblackia floribunda	38	13.3	X X X –
Musanga cercopiodes	30	10.6	- - X –
Garcina kola	25	8.7	- - X –
Myrianthus arboreus	35	12.3	X X X X
Total	**286**	**100**	

Key: YL: Young leaves, ML: Matured leaves, FR: Fruits FL: Flowers X: Parts of plants Eaten : Parts of plants Not Eaten

4.7 Food Quality of *Cercopithecus erythrogaster* in wet season

High crude protein content recorded in *Myrianthus arboreus*, *Allanblackia floribunda* and *Elaeis guineensis* account for their high rate of consumption by *Cercopithecus erythrogaster* as showed in (table 4.8) above. However, *Myrianthus arboreus* and *Allanblackia floribunda* recorded the highest percentage crude protein, while the least percentage crude protein was contained in *Cleistopholis patens* and *Irvingis gabonenses* (Table 4.9).

Table 4.9 Proximate Nutrients Composition of food Items Eaten by *Cercopithecus erythrogaster* in the rainy season in Okomu National Park.

Plant Species Eaten (Fruits) in rainy season	%DM	%CP	%Fat	%CF	%Ash	%NFE
Barteria nigritiana	79.78	9.66	35.06	27.11	7.95	20.22
Detarium senegalensis	74.91	10.12	27.00	29.05	8.74	25.09
Cleistopholis patens	60.01	5.40	28.44	26.14	0.03	39.99
Elaeis guineensis	84.94	10.60	45.04	23.25	6.05	15.06
Macaranga barteri	63.57	8.04	27.60	25.13	2.80	36.43
Allanblackia floribunda	68.29	16.13	25.60	18.65	7.91	31.71
Musanga cercopiodes	53.51	9.06	22.17	16.18	6.10	46.49
Garcina Kola	56.92	7.81	20.10	25.41	3.60	43.08
Myrianthus arboreus	65.64	18.75	16.30	24.79	5.80	34.36
Iruingia gabonensis	69.97	6.32	30.10	24.63	8.92	30.03

% DM: percentage dry matters, % CP: percentage crude protein, % CF: percentage Crude fibre, % NFE: percentage Nitrogen free extract

4.8: Frequency of preferred food eaten in dry season

As a result of seasonal variation, the fruiting season of plant species in the park also varies. Therefore, plant species consumed in the wet season by *Cercopithecus erythrogaster* are significantly different from the available plants species consumed in the dry season. Table (4.10) below shows the percentage frequency composition of preferred food eaten in dry season by *Cercopithecus erythrogaster*

Table 4.10: Plant species , Eaten by White throated Monkeys in Dry Season in Okomu National Park.

Plants species Eaten in Dry Season by *Cercopithecus erythrogaster* in Okomu National Park	Frequency	Percentage(%)	Parts Eaten			
			YL,	ML,	FR,	FL
Piper guineensis	28.0	10.1	—	X	X	—
Mangifera indica	20.0	7.3	—	—	X	—
Spondia mombin	35.0	12.6	X	X	X	—
Cola nitida	32.0	11.6	—	—	X	—
Irvingia smithii	48.0	17.3	X	X	X	X
Juglan nigran	38.0	13.8	X	—	X	X
Chrysophyllum africanum	36.0	12.9	X	—	X	—
Xylopia aethiopica	40.0	14.4	X	X	X	X
Total	**277.0**	**100.0**				

4.9 Food Quality of *Cercopithecus Erythrogaster* in Dry Season

Nutritional composition analysis of different food consumed by *Cercopithecus erythrogaster* in the dry season in Okomu National Park revealed that *Mangnifera indica*, *Spondia mombin* and *Chrysophyllum africanum* has the highest percentage crude protein content (Table 4.11).

Table 4.11: Proximate Nutrient composition of Food items Eaten by *Cercopithecus erythrogaster* in the dry season in Okomu National Park

Plants species Eaten in dry season By *Cercopithecus erythrogaster*	%DM	%CP	%Cfat	%CF	%Ash	%NFE
Piper guineesis	70.96	6.62	18.72	35.60	10.02	21.04
Mangifera indica	77.83	8.02	20.05	38.11	11.65	22.17
Spondia mobin	68.08	7.95	17.12	32.06	10.95	31.92
Cola nitida	58.73	4.45	16.05	30.18	8.05	41.27
Irvingia smithii	67.40	5.43	23.65	34.09	4.23	32.60
Juglan nigran	57.94	6.81	19.11	28.65	3.37	42.06
Chrysophyllum africanum	75.67	7.59	27.65	36.08	4.35	24.33
Xylopia aethiopica	53.62	6.65	14.08	27.22	5.67	46.38

% DM: percentage dry matters, % CP: percentage crude protein, % CF: percentage Crude fibre, % NFE: percentage Nitrogen free extract

4.10 Abundance and Diversity of Plant Species Utilized as Food in Okomu National Park.

The aim in preparing a complete plant species inventory of plants utilized by *cercopithecus erythrogaster* in the park is to record all possible species utilized in different ranges of the park. It therefore constitutes a baseline study which provides information on plant species index of richness, abundance and diversity in both seasons using the Shannon-Weiner function. (H^+). The formular is given as

$$H = \sum_{i-1}^{S} Pi \log Pi$$

Where

Hi - Index of diversity

Pi – Proportion of the number of a species

Log – Natural log

Table: 4.12 **Diversity And Abundance Of Preferred Plant Species In Wet Season**

Plant species utilized in wet season	Ranking position	No of species recorded	Wet season P_i	Utilization $P_i n P_i$
Bacteria nigritiana	1	25	0.200	-0.322
Deterium senegalensis	2	23	0.151	-0.285
Myrianthus arboreus	3	21	0.138	-0.273
Elaeis guineensis	4	18	0.118	-0.252
Iruinga gabonensi	5	16	0.105	-0.236
Macaranga barteri	6	12	0.078	-0.198
Allanblackia floribunda	7	10	0.066	-0.179
Musanga cercopiodes	8	9	0.059	-0.166
Garcina kola	9	9	0.059	-0.166
Cleistopholis paten	10	9	0.059	-0.166
Total		**152**	**1000**	**-2.243**

Table 4.13: Diversity and abundance of preferred plant species in dry season

Plant species utilized in wet season	Ranking position	No of species recorded	Dry season P_i	Utilization $P_i n P_i$
Piper guineensis	1	28	0.139	-0.317
Mangnifere indica	2	26	0.179	-0.308
Spondia mombin	3	22	0.152	-0.226
Kola nitida	4	20	0.138	-0.273
Irvinga smithii	5	16	0.110	-0.234
Juglan nigran	6	15	0.103	-0.234
Chrysophyllym africanum	7	10	0.068	-0.182
Xylophia aethiopica	8	8	0.055	-0.159
Total		**145**	**1.000**	**-1.386**

4.10: Discussion

4.11: Population Troop size of *Cercopithecus erythrogaster* in Okomu National Park

The result revealed that Arakhuan range harboured the highest population of *Cercopithecus erythrogaster* compared to other ranges in the park. (Table 4.1 and 4.2). This may not be unconnected with the low rate of habitat disturbance in the range. The presence of river Arakhuan provide water for wildlife population throughout the year, most especially during dry season when other water sources in the park must have dried. Low population of *Cercopithecus erythrogaster* recorded in Baibui Creek range and Julius Creek range (Table 4.1 and 4.2), is an indication of high hunting pressure and high rate of human disturbance from adjoining settlement around the ranges. Adult constitutes highest individuals in all the groups sighted in the wet and dry season, representing a total of 50 and 27 individuals respectively, followed by subadults and Juveniles with a total population of 22 and19 individuals. The low population sampled in wet season was as a result of poor visibility due to vegetation growth and close canopy cover that usually characterize wet season in the park (Table 4.3 and 4.4) *Cercopithecus erythrogaster* is arboreal and diurnal in nature. The species are usually very active during the day, usually in the morning and in the evenings (Table 4.5)

4.12: Feeding Habits of White-throated Monkey

Plant species eaten by white-throated monkey in both seasons were relatively high. The rate of consumption of fruits was closely followed by young leaves due to the succulent and sweet nature of young leaves. This is in agreement with the view of (Field and Blankensip, 1973) that animals preferred young succulent parts of plants. However, there was a significant difference between the varieties of different plant species

consumed in both the wet and dry seasons ($P<0.05$). It was also discovered that matured leaves were lignified, fibrous with little or no water content (Table 4.1). In addition, some plant species such as the Xylopia aethiopica, Juglan nigran and Spondia mombin were also consumes by *Cercopithecus erythrogaster* along side the major plants identified in (table 4.6). It was however revealed that the whole parts of the above identified animal species were consumed (Table 4.7). However, it was noted that the active period of white-throated monkeys was in the morning and evening, monkeys engage on group food search with the dominant male at the edge or on top. Most cases Adult usually share food to the Juveniles. Foodstuff are usually handled by hand before eating (Table 4.8).

4.13: Proximate Composition of Food of White-throated Monkey collected in Rainy Season

4.14: Percentage dried matter content in rainy season

White-throated monkeys consumed mainly unripe fruits from different species of trees and shrubs in the park. The consumption of unripe fruits is mainly due to the facts that most ripe fruits tends to fall off from their parent tree when matured, though they occasionally eats leaves and flowers, especially when fruits are scarce. This is in agreement with the view of Aremu et al, (2002) that food of white-throated monkeys in the park is more abundant in the rainy season than in the dry season.

However, ten specimen from different tree species were collected for laboratory analysis in the rainy season (Table 4.9). The result revealed that *Elaeis guineensis* has the highest percentage dry matter contents. This was closely followed by *Barteria nigritiana* and *Detarium senegalensis*. While the least dry matter content was recorded in *Musanga cercopiodes*, *Gracina kola* and *Cleistopholis* patens. However, there was no significant different between the dried matter content of plants consumed by White-

throated Monkeys in both season at (P<0.5). However, this assertion was not in line with the view of Olomu (1987) that the dry matter content of plants are almost the same irrespective of the season.

4. 15: Percentage Crude Protein Rainy Season

In addition, highest percentage crude protein was recorded in *Myrianthus arboreus*, this was followed by *Allanblanckia* and *Elaeis guineensis*, while the least percentage crude protein was recorded in *Cleistopholis patens. This was* followed by *Irvingia gabonensis* and *Garcina kola*. The results further revealed that *Elaeis guineensis, Barteria nigritiana* and *Irvinga gabonensis* recorded the highest pewrcentage fat contents, while the least percentage fat content was recorded in *Myrianthus arboreus, Garcina kola* and *Musanga cercopiodes*. There was a significant difference between the percentage crude protein content consume in both dry and wet season by *Cercopithecus erythrogaster* (P>0.5). This in agreement with the view of Odum (1980) that seasonal variation affects crude protein contents of tropical plants.

4.16: Percentage Crude Fibre and Nitrogen Free Extract In Rainy Season

The highest percentage crude fibre was contained in *Detarium sengalensis*, this was closely followed by *Barteria nigritiana* and *cleistopholis patens*, while the least percentage crude fibre was found in *Musanga Cercipiodes,* this was followed *Allanblanckia floribunda* and *Elaeis guineensis*. (Table 4.9). Also the highest percentage ash content was recorded in *Irvingia gabonensis, Detarium senegalensis* and *Barteria nigritiana*, while *Cleistopholis patens*, *Macaranga barteri* and *Garcina Kola* recorded the least percentage ash content. Furthermore, the highest percentage nitrogen free extract was recorded in *Musanga Cercipiodes,Garcina kola* and *Cleistopholis patens*, while the least percentage Nitrogen free extract was recorded in *Elaeis guineensis*, this was closely

followed by *barteria nigritiana* and *Detarium senegaleensis* (Table 4.10). This is in line with the view of field and Blankenship, (1983) that crude fibre, fat and nitrogen free extracts are relatively high in the rainy season.

4.17: Frequency Rates of Consumption of Food Items in Dry Season

The result further revealed that eight specimen of food items eaten by white-throated monkeys in the dry season were collected from different trees and shrubs in the park. The result showed that *Irvingia, smithii, Xylopia acthiopica* and *Juglan nigran* has the highest rate of consumption, while *Mangifera indica, Piper guineensis* and *Kola nitida* has the least frequency percentage consumption in the dry season (Table 4.11). This assertion is in line with the view of Olomu (1987) that leafy plants are mostly consumed in the dry season by monkeys.

4.18: Proximate Analysis of Plants Species Consumed in Dry Season

4.19: Percentage Dry Matter Content in Dry Season

The results further showed that *Mangifera indica, Chrysophyllum africanum* and *Piper guineensis* has the highest percentage dry matter of all the food consumed in the dry season, while the least percentage dry matter was recorded in *Xylopia aethiopica, Juglan nigran and Kola nitida* (Table 4.12). The result further revealed that *Mangifera indica* and *Spondia mombin* has the highest percentage crude protein. This was closely followed by *Chrysophyllum africanum*, while the least percentage crude protein was recorded in *Kola nitida, Irvingia Smithii and Piper guineensis*, this support the early view of (Geist, 1974).

4.20 Percentage fat, crude fibre and nitrogen free extract content in dry season

Chrysophyllum africanum, Irvingia smithii and *mangifera indica* has the highest percentage fat, while the food preference containing the percentage fat was recorded in Xylopia aethiopica, Kola nitida and *Spondia mobin.* (Table 4.12), *Mangifera indica, Chrysophyllm africanum* and *Piper gineensis* recorded the highest respectively while least percentage crude fibre was recorded in Xylopia *aethipica, Juglan nigran* and *Kola nitida.* In addition, *Mangifera indica and Spondia mobin has percentage by Piper guineensis.* Ash content, while the least percentage Ash content was recorded in *Juglan nigran Irvingia smithii* and *Chrysophyllum africanum.* The highest percentage Nitrogen free extract was recorded in *Xylopia aethiopica, Juglan nigran and Kola nitida.* While the least percentage Nitrogen free extract was recorded in *Piper guineensis, Mangifera indica* and *Chrysophyllum africanum* (Table 4.12). This is also in line with the view of (Geist 1984) that nutritional composition of primate foods are usually higher in the rainy season.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

It could be generally concluded that the present relative abundance of white-throated monkey *(Cercopithecus erythrogaster)* recorded in both wet and dry seasons in the park could sustain the effective breeding population size in the near future. But this may be threatened by wildlife habitat destruction which include uncontrolled burning of vegetation, illegal tree felling and poaching. It was observed that all groups of *Cercopithecus erythrogaster* sighted were wary, which is an indication of high hunting pressure and human disturbances on the existing population of wild animal species in the park. The sex ratio of 1.2 shows that *(Cercopithecus erythrogaster)* are polygamous in nature and this may be why adult male establish and defend their territories which usually consists of many adult and subadult females against adult male intruders. Also it was observed that distribution of the food preference of white- throated monkey and its availability throughout the year have a direct influence on the distribution and abundance of *Cercopithecus erythrogaster* population status at any time.

5.2 Recommendations

The following recommendations are made based on the findings of this study:

* As a matter of urgency poaching, uncontrolled bush burning, illegal tree felling, and illegal encroachment into wildlife habitats should be controlled within the park boundaries as a measure to conserve the existing population of white-throated monkey (*Cercopithecus erythrogaster)* in the park.

* The park authority should intensify and encourage the process of wildlife habitat enrichment management strategy, which involves planting of preferred plant species of

Cercopithecus erythrogaster such as *Myrianthus arboreus, Allanblackia floribunda, Barteria nigritiana, Elaeis guineensis, Irvingia Smithii, Juglan nigran, Garcina kola* and *Piper guineensis* within the home range of *Cercopithecus erythrogaste.*

* Wildlife conservation education should be given more attention by the park authority through the use of posters, radio and personal contacts, so as to educate the inhabitants of adjoining communities of Okomu National Park on the need to conserve the existing population of renewable natural resources in their locality.

* Also the park should encourage continuous animal population and feeding habit assessment to ascertain the *Cercopithecus erythrogaster* population status at any time being an endangered animal species.

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APPENDIX 1

Table 1: Checklist of some plants species in Okomu National Park

Family	Occurrence	Botanical Names	Habit
Agavaceae	10	*Dracacena deisteliana*	Shrub
	3	*Dracaena Mannii*	Shrub
Annonaceae	21	*Anonidium mannii*	Tree
	24	*Enantia chlorantha*	Tree
	4	*Monodora tenuifolia*	Tree
	8	*Cleistopholis patens*	Tree
	3	*Polyalthia suavelens*	Tree
	6	*Picralima nitida*	Tree
	5	*Funtumia elastica*	Tree
	3	*Astonia boonei*	Tree
	12	*Rauvelfia vomitoria*	Tree
Burseraceae	3	*Santirla trimera*	Tree
	1	*Dacroyedes edulis*	Tree
Caesalpiniacene	5	*Berlinia confusa*	Tree
	4	*Berlinia macrophylla*	Tree
	9	*Athonotha macrophylla*	Tree
	2	*Afeelia bipindensis*	Tree
Capparidaceae	4	*Euadenia trifolialata*	Shrub
	4	*Bucholzia coriacea*	Tree
	3	*Triplohiton scleroxylon*	Tree

Sterculiaceae	7	*Sterculia oblonga*	Tree
	3	*Cola millenii*	Shrub
Iruingiaceae	3	*Iruingia gabonesis*	Tree
	2	*Klainedoxa gabonesis*	Tree
Sapindaceae	1	*Pancouia turbinate*	Shrub
Moraceae	2	*Antiaris africana*	Tree
	1	*Myrianthus arborea*	Tree
Piperaceae	2	*Piper guineensis*	Herb
	1	*Grewia mollis*	Shrub
	2	*Grewia pubescens*	shrub
	10	*Glyphaea breuis*	Shrub
	6	*Grewia Greacea*	Shrub

Source: **Haruna S.Z. (2003)** Ethnobotanical survey of Okomu National Park (unpublished)

Appendix II

Table 2: Checklist of some Animal Species in Okomu National Park.

Zoological Names	Common Names
Pan-troglodytes Verus	African Chimpanzee
Cercocebus torquatus	Red-capped mangabey
Cercopithecus mona	Mona monkey
Cercopithecus nictitans	Putty-nosed monkey
Cercopithecus erythrogaster	White-throated monkey ***
Artherurus africanus	Bush-tailed porcupine
Euxerus erythropus	Striped ground squirrel
Thryonomys swinderianus	Cane rat
Aethomys spp.	Bush rat
Phataginus tricuspis	Tree pangolin
Dendrohyrax dorsalis	Tree Hyrax
Loxondonta africana	Forest Elephant
Potamochoerus porcus	Red river hog
Tragelaphus scriptus scriptus	Bush buck
Cephalophus maxwwelli	Maxwell's duiker
Cephalophus sylvicultor	Yellow backed duiker
Python regius	Royal python
Crocodylus niloticus	short snorted crocodile
Chelonia spp.	Forest tortoise
Acathina acathina	Giant snail
Syncerus cafer nanus	African forest buffalo

Hipposideros rubber Leaf nosed bat.

*** Animal in Focus

Source: Haruna S.Z. (2003) Ethnobotanical **survey of Okomu National Park**
(unpublished)