

Diet and Nutritional Profile of the Mona Monkey (*Cercopithecus mona*, Schreber, 1774) in Okomu National Park, Nigeria: Preliminary Study

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Abstract: The mona monkey (*Cercopithecus mona*) is found in Okomu National Park (ONP), a lowland rainforest in southwest Nigeria. Here we present preliminary data on the nutrient content of plant foods consumed by mona monkeys in ONP during dry and wet seasons. Our objectives were to (1) determine which foods are consumed by mona monkeys within and outside the protected area and (2) assess the nutritional contents of the food items. We collected feeding behavior and dietary data using an *ad lib* sampling method for 37 days during the dry and wet seasons in 2011, 2012, and 2013. We also opportunistically collected discarded foods for nutritional analyses using standard measures: crude protein, crude fat (ether extract), ash, nitrogen free extract, which is a measure of starch and sugars. We documented that the species fed on 31 number of plant species belonging to 21 families; 64% of the plant parts consumed were fruits, 55% of which were exclusively consumed during the wet season. They also ate seeds (28%) and nuts (8%). Two species, the fruits of the white teak (*Gmelina arborea*) and the seeds of atobeme (Bini) (*Jateorhiza macrantha*), were new to the literature on plants consumed by *C. mona*; the former, an introduced species, is an alternative food source, while the latter is known to have medicinal values to humans and probably to nonhuman primates. Mona monkeys obtained 79% of their diets within and 21% outside the Park. Nutrient density was higher during the dry season. Percent crude protein of 7.02 ± 1.92 (n = 14) was within the 6.4 – 8.0% recommended by National Research Council (2016) for primates in captivity. Park managers are encouraged to take management actions to ensure that these monkeys source their entire diet from within the Park, to mitigate potential human-wildlife conflict.

Key words: diet, feeding behavior, mona monkey, Okomu National Park

INTRODUCTION

Okomu National Park, Edo State, is a lowland rainforest area rich in biodiversity (Numbere 2018). It is home to endemic white-throated monkeys (*Cercopithecus erythrogaster*), and other mammals like forest elephants (*Loxodonta cyclotis*), Maxwell's duikers (*Philantomba maxwellii*), red

river hogs (*Potamochoerus porcus*), African forest buffaloes (*Syncerus caffer nanus*), diverse avifauna species, butterflies, and plant species. There are eight nonhuman primate (NHP) species, including the mona monkey (*Cercopithecus mona*, Schreber, 1774; Aremu *et al.* 2012).

As with the vast majority of primate populations in West Africa, *C. mona* is found almost entirely within protected areas such as ONP. Indeed, outside national parks, wildlife refuges, or forest reserves, *C. mona* populations are either in precipitous decline (as is the case in urban areas of Lagos and Awka in Nigeria, Nwufoh 2011; Olaleru 2016) or have been extirpated altogether via a commercial bush meat trade and habitat conversion (Anadu 1987; Ogunjemite *et al.* 2013). Tooze & Baker (2008) re-introduced mona monkeys into Iko Esai Community Rainforest, Cross River State, Nigeria which was outside any state or nationally protected area and where the monkeys' population was nearly extirpated. In Nigeria, *C. mona* is legally protected under the Federal Decree 11 of 1985, which is rarely enforced (Tooze & Baker 2008). The conservation status of *C. mona* was Least Concern for many years but, after a global assessment, was changed to Near Threatened (Matsuda Goodwin *et al.* 2020).

Beyond serving as a refuge from hunting and habitat conversion, protected areas must provide sufficient food resources to sustain viable populations of primary consumers. A lack of key foods at critical periods can result in animals leaving park boundaries to meet energetic or nutritional requirements, via crop-raiding, which almost always results in conflict with humans and lethal control of the raiding animals (Hill 2017). Thus, central to the management and conservation of primary consumers in protected areas is an assessment of their feeding options throughout the year. To this end, this study catalogued plant food species and food items that were eaten by mona monkeys in dry and wet seasons and assessed the nutritional composition of those foods. We selected *C. mona* because of all the NHPs in the Park, it was the only species for which encounter rates of 0.22 animal sighting/km; density 4.47 ± 1.24 groups/km² (Akinsorotan *et al.* 2011) were sufficiently reliable to observe feeding behavior.

METHODS

Study area

The research was conducted in Okomu National Park (Figure 1). Okomu National Park is a tropical lowland rain forest located in Ovia Southwest Local Government Area of Edo State, Nigeria (6° 15' – 6° 25' N; 5° 9' – 5° 23' E). The annual rainfall ranges from 1,524 to 2,540 mm and average monthly humidity is between 30.2 to 65.0%. Approximately 202 km² of the Park is part of a former 123,800 ha Okomu Forest Reserve gazetted in 1935 (Oduwaiye *et al.*

2002). An area of 156 km² of the Reserve was given to Okomu Oil Palm Project by the federal government (Obasogie & Ogunjemite 2014). The vegetation of ONP is a typical Guinea-Congo lowland rainforest characterized by a mosaic of swamp forest, secondary high forest, and open scrub on well drained plateau sites (Aminu-Kano & Marguba 2002; Ezealor 2002; Ogunjinmi *et al.* 2009; Aremu *et al.* 2012). Lianas (such as *Tetracarpidium conophorum*), climbers, and stranglers made the forest difficult to traverse or observe animal activities.

Foraging activities of the mona monkeys were observed in four compartments (44, 53, 54 and 56) of the park, nearby farms, and an oil palm plantation. The nutritional analyses were conducted only on food from within the park. Other compartments were also surveyed, but mona monkeys were not sighted or were not foraging when sighted. These four compartments had food resources for the monkeys despite the poaching pressures. The park is made up of 79 compartments of 1.6 km² each.

Feeding data collection

FO collected the feeding data during periods of active foraging (0630–1130; 1600–1830) over 37 days (6 days in 2011, 15 days in 2012, and 16 days in 2013; Appendix I). FO, along with two park staff on most occasions and with BGO during the last data collection in 2013, walked the jeep tracks and trails in search of *C. mona* groups. Once from a 40 ft high tree house (Compartment 52), FO sighted two mona monkeys that were resting and grooming on a treetop. Such incidence was not recorded in the study. Because of extensive poaching that occurs within the park, study subjects are unhabituated and fled almost immediately upon detecting us. Therefore, we do not have accurate information regarding the group density or composition per group. Based on our last visit in November 2013, we estimate that group size ranged from 5 to 15 individuals. When we encountered the monkeys, we observed their feeding behavior for 5–10 minutes or until they fled or were out of sight to determine the plant species and plant parts eaten. Number of feeding bouts and bites were not recorded. Over 20 groups were encountered, although some may have been the same troops. We opportunistically collected samples to determine which parts of the plants were consumed (following Rothman *et al.* 2011). FO collected partially eaten discards from fresh feeding activities and those from earlier feedings when the monkeys had departed. Where such portions were not enough for analysis, efforts were made to collect similar parts from the same plant or another plant

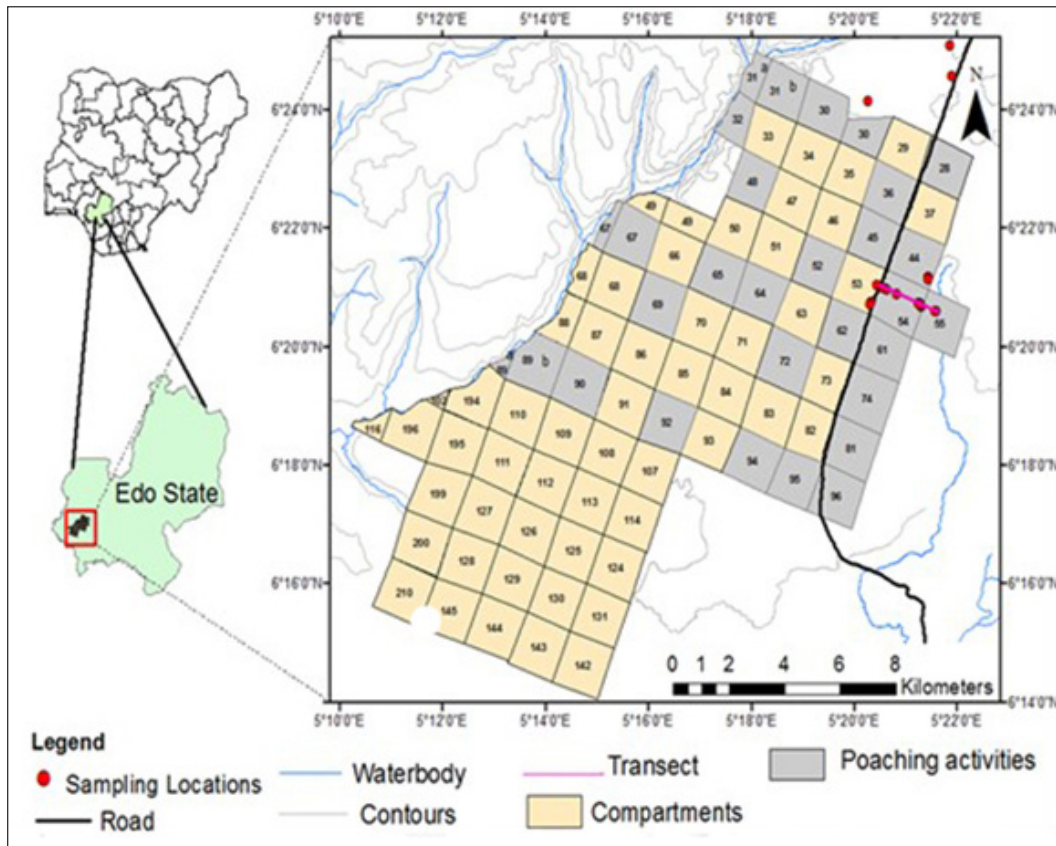


Figure 1. Map of Okomu National Park, Nigeria, its compartments and sampling points.

of the same species. FO collected the geographical position of feeding bouts with a Garmin eTrex. Like most guenon species, our study subjects consumed insects and other arthropods (Butynski *et al.* 2013; Matsuda Goodwin & Tooze 2016), but arthropods were not included in this study.

Categorization of food samples

FO categorized the collected food samples based on the parts consumed into fruits, nuts, and seeds. These plant part distinctions were based on Dutta (1998). The fruit is the matured or ripened ovary. A seed is the fertilized ovule which at maturity can develop into a new plant under required conditions. A nut is a dry one-chambered and one-seeded fruit; a dry fruit where the ovary wall becomes hard at maturity and the seed is free within the walls of the ovary (Sabaté *et al.* 2006).

Analyses of nutrient contents

FO collected, weighed, and air-dried plant portions that represented the parts the monkeys ate while in the field. Within 48 hours after collection, all samples were taken to the laboratory in the Department of Zoology, University of Lagos for

oven drying. Due to budget constraints, nutritional analyses were conducted on only 14 (six and eight for dry and wet seasons, respectively) of the 26 food samples collected in 2011 (12 in dry, and 14 in wet seasons, Appendix 1). After oven-drying, FO conducted nutritional analyses of the samples at the Laboratory in the Department of Animal Science, University of Ibadan.

Proximate analyses for crude protein (CP), ether extracts (EE, a measure of crude fat), crude fiber (CF), nitrogen free extract (NFE), and ash of the 2011 food samples were carried out on a dry matter basis using the method described in the Association of Official Analytical Chemist (1990). A 6.25 factor was used to estimate crude protein in the samples by multiplying the amount of nitrogen, because many plants and animal proteins are known to contain on average 16% nitrogen (van Soest 1994; Rothman *et al.* 2008). Since CF contains cellulose and hemicellulose (substances that produce energy) and does not indicate the actual fiber content of the food, detergent fiber method was also used to determine the fiber fractions of the samples. Fiber fractions were analyzed using the methods described by van Soest *et al.* (1991) for neutral detergent fiber (NDF),

acid detergent fiber (ADF), and acid detergent lignin (ADL). Hemicellulose (HC) and cellulose (C) were determined by difference. The amount of HC in the foods was determined by subtracting the value of ADF from that of NDF, while that of CEL were estimated by subtracting the ADL value from that of ADF (Sommer *et al.* 2011).

Data analyses

Descriptive statistics were run using Microsoft Excel. Proximate and fiber fraction analyses were not replicated for any sample due to budget constraints. Mean and standard deviations were determined by pooling values of the plant parts into groups using the method of Milton (1999).

RESULTS

Plant parts consumed by *C. mona* in ONP

Figure 2 illustrates the percent of each plant part category consumed by the study subjects; fruits constituted the largest proportion of ingested plant parts (64%), followed by seeds (28%), and nuts (8%). Table 1 lists the repertoire of wild, cultivated, and introduced plant species consumed by *C. mona* during the study period (2011–2013) as well as the season in which they were consumed. The monkeys consumed different parts of 31 species belonging to 21 families. Of these, 79% were obtained within the Park (wild and introduced plants), while 21% were raided cultivated plants. Two species, *Gmelina arborea* and *Jateorhiza macrantha*, were observed for the first time as being eaten by *C. mona*. Of 31 plant species, ten were consumed solely during the dry season, 17 only during the wet season, and seven were consumed during both seasons. Only two of the seasonal overlaps, *Alchornea cordifolia* and *Musanga cecropioides*, were wild plant species; the other five were cultivated species.

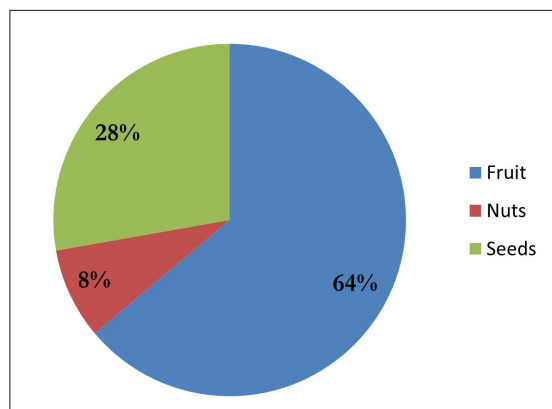


Figure 2. Proportions of plant food parts consumed by *Cercopithecus mona* in Okomu National Park, Nigeria.

Nutrient and fiber fractions of foods consumed during dry and wet seasons

Figures 3 and 4 detail the nutritional content and fiber fractions of the foods consumed by *C. mona* during the dry season. *Carica papaya* had the least DM. The highest CP value of 17.06% was found in *Ficus mucoso*, while the highest EE value of 45.80% was found in *Theobroma cacao*. The highest NFE value of 81.55% was found in *Musa paradisiaca*. *Musanga cecropioides* had the highest NDF and ADF values of 69.70% and 61.07%, respectively. The highest CEL content of 35.95% was recorded in *Musa paradisiaca*. The nutrient contents of foods consumed during the wet season are indicated in Figure 5; Figure 6 displays the fiber fractions of those same foods. *Tetracarpidium conophorum* and *Theobroma cacao* had the highest CP and EE values of any wet season foods at 31.94% and 51.40%, respectively. The highest NFE value of 69.65% was found in *Musa paradisiaca*. *Jateorhiza macrantha* had the highest NDF, ADF, and ADL values of 65.10%, 47.40%, and 43.67%, respectively. Hemicellulose content was highest in *Gmelina arborea* with a value of 28.00%, while 21.14% was the highest CEL and was found in *Tetracarpidium conophorum*.

Mean nutrient and fiber fraction contents

Table 2 provides the mean nutrients and fiber fraction contents of *C. mona* foods. Fruits had higher NFE, ash, NDF, and ADF values than seeds and nuts, whereas seeds and nuts were higher in DM, CP, EE, and all other fiber fractions except ADL than fruits.

DISCUSSION

Data presented here are preliminary, based on a small sample size of animals, on only a subset of plant foods, over a short sampling period. Nonetheless, given the dearth of detailed nutritional information on primates in general, and on the guenons of West Africa in particular, our data improves the understanding of primate feeding behavior in increasingly threatened habitat.

Cercopithecus mona consumed parts of 31 plant species, most of which were fruits and obtained within the park. Alarape *et al.* 2018 reported a 75% fruit diet of four species of NHPs in Pandam Wildlife Park, Plateau State, Nigeria. Seven of the wild food plants and the parts consumed recorded in this study were the same with that of bonobos in Wamba forest in Zaire (Idani *et al.* 1994). For the eight similar wild food plant, raphia, they recorded the shoot as the part bonobos consumed. In another study in Lekki Conservation Centre, Lagos, Nigeria

Table 1. Wild and introduced and/or cultivated plant species consumed by *Cercopithecus mona* in Okomu National Park, Nigeria, in dry and wet seasons. D = Dicotyledon, M = Monocotyledon, DS = Dry Season (November – March), WS = Wet Season (April – October).

Species	D/M	Family	Common Name	Parts Consumed	DS	WS
Wild food plants						
<i>Alchornea cordifolia</i> Schumach. Mull.	D	Euphorbiaceae	Christmas bush	Fruit	x	x
<i>Annona glabra</i> L.	D	Annonaceae	Monkey apple	Fruit (ripe & unripe)		x
<i>Barteria nigritana</i> Hook. f.	D	Passifloraceae	ekú (Yoruba)	Fruit		x
<i>Brachystegia nigerica</i> Hoyle and A.P.D. Jones	D	Fabaceae	Bean-pod tree	Seeds		x
<i>Chrysophyllum africanum</i> A.D.C.	D	Sapotaceae	African star apple	Fruit (ripe)	x	
<i>Ficus exasperata</i> Vahl	D	Moraceae	Sandpaper fig	Fruit (ripe & unripe)	x	
<i>Ficus mucosa</i> Welw. ex Ficalho	D	Moraceae	Fig	Fruit (ripe & unripe)		
<i>Irvingia gabonensis</i> Baill.	D	Irvingiaceae	Bush mango	Fruit and seeds (ripe)		x
<i>Jateorhiza macrantha</i> Hook. f. Exell & Medonca	D	Menispermaceae	Atatobeme (Bini)	Seeds (ripe)	x	x
<i>Macaranga barteri</i> Müll. Arg.	D	Euphorbiaceae	ohaha (Bini)	Seeds	x	x
<i>Musanga cecropioides</i> R. Br. Apud Tedlie	D	Cecropiaceae	Umbrella tree	Fruit (ripe & unripe)	x	x
<i>Myrianthus arboreus</i> P. Beauv.	D	Cecropiaceae	Corkwood	Fruit		x
<i>Pycnanthus angolensis</i> (Welw.) Warb.	D	Myristicaceae	White cedar	Seeds (ripe)	x	
<i>Raphia hookeri</i> G. Mannand H. Wendl.	M	Arecaceae	Raphia palm	Fruit (ripe)	x	
<i>Spondias mombin</i> L.	D	Anacardiaceae	Hog plum	Fruit (ripe)		x
<i>Staudtia stipitata</i> Warb.	D	Myristicaceae	umaza (Bini)	Nuts	x	
<i>Sterculia oblongata</i> R.Br.	D	Sterculiaceae	okoko (Yoruba)	Nuts	x	
<i>Strombosia pustulata</i> Oliv.	D	Olacaceae	itako (Yoruba)	Fruit	x	
<i>Tetracarpidium conophorum</i> Hutch. & Dalziel	D	Euphorbiaceae	African walnut	Seeds (when mature)		x
<i>Xylopia aethiopica</i> A. Rich.	D	Annonaceae	Negro pepper	Seeds (ripe & unripe)		x
Cultivated food plants						
<i>Ananas comosus</i> L. (outside the park)	M	Bromeliaceae	Pineapple	Fruit (ripe & unripe)		x
<i>Carica papaya</i> L. (outside the park)	D	Caricaceae	Pawpaw	Fruit and seeds (ripe)	x	
<i>Elaeis guineensis</i> A. Chey. (in & outside park)	M	Arecaceae	Oil palm	Fruit & seeds (ripe & unripe)	x	x
<i>Musa paradisiaca</i> L. (in & outside the park)	M	Musaceae	Plantain	Fruit (ripe & unripe)	x	x
<i>Musa sapientum</i> L. (in & outside the park)	M	Musaceae	Banana	Fruit (ripe & unripe)	x	x
<i>Theobroma cacao</i> L. (outside the park)	D	Sterculiaceae	Cocoa	Fruit and seeds (ripe & unripe)	x	x
Introduced food plants						
<i>Dacryodes edulis</i> H.J. Lam	D	Bursaceae	Local pear	Fruit		x
<i>Duranta repens</i> L. (ornamental hedge shrub)	D	Verbenaceae	Pigeon berry	Fruit (ripe)		x
<i>Elaeis guineensis</i> A. Chey. (in & outside park)	M	Arecaceae	Oil palm	Fruit & seeds (ripe & unripe)	x	x
<i>Gmelina arborea</i> Roxb.	D	Lamiaceae	White teak	Fruit		x
<i>Mangifera indica</i> L.	D	Anacardiaceae	Mango	Fruit/tender seeds (ripe & unripe)	x	
<i>Psidium guajava</i> L.	D	Myrtaceae	Guava	Fruit (ripe & unripe)	x	x

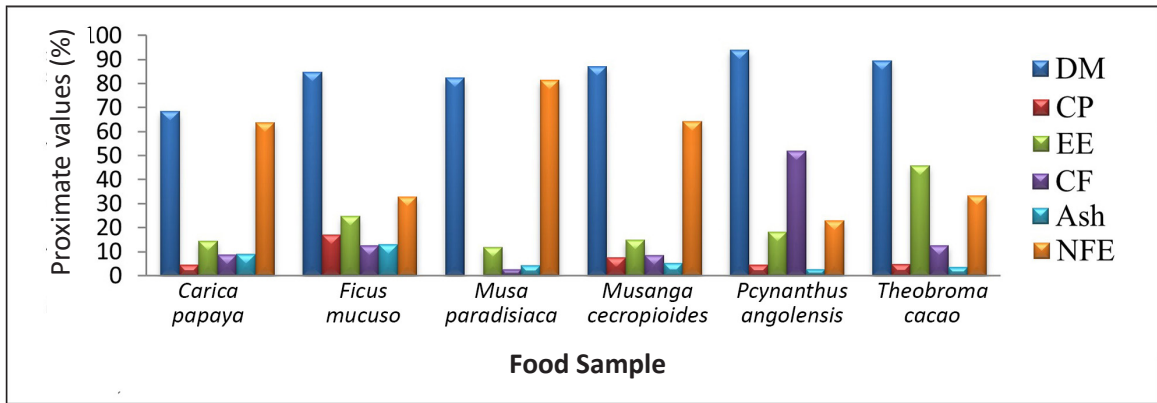


Figure 3. Nutrient composition of dry season's foods of *Cercopithecus mona* in Okomu National Park, Nigeria. DM = Dry matter, CP = Crude protein, EE = Ether extract, CF = Crude fiber, NFE = Nitrogen free extract.

FO observed that mona monkeys consumed shoots and fruit pulp of raphia. It is most likely that the *C. mona* in ONP consumed this part of the raphia in addition to the fruit pulp. The lower number that was recorded during the dry season could be attributed to the effects of rainfall on the phenology of fruit trees (Milton *et al.* 2005). More observation days in the wet season could have attributed to the higher figures recorded during this season (Appendix 1). While a lack of data on the nutritional content required by primates makes comparison difficult, some preliminary comparisons are possible. For example, the high NFE in *C. papaya*, *Musa paradisiaca*, and *Musanga cecropioides* implied that the monkeys preferred to use high energy diets that are readily available as fruits (Lambert 2007). The crude protein content of fruits and a nut was $8.79 \pm 2.73\%$ ($n = 11$) – a level exceeding the recommended 6.4–8.0% dietary dry matter of protein for adult primates in captivity (NRC 2003). It was, however, similar to the average crude protein content of 7.0

$\pm 1.1\%$, for seven species of fruits consumed by the Venezuelan red howler monkeys (*Alouatta palliata*), and $6.3 \pm 0.6\%$ for eight species of wild fruits eaten by gorillas (*Gorilla gorilla diehli*) in Cameroon (Milton 1999).

We observed consumption of two species (*Gmelina arborea*, an introduced tree species; *Jateorhiza macrantha*, a native climber) that are new to the literature for *Cercopithecus mona* diet. *Gmelina arborea* is native to Asia and known to be consumed by primates there (Ajuri & Rao 2006) and in Ghana, comprises 8.4% of the diet of *Colobus vellerosus* (Teichroeb & Sicotte 2009). *Jateorhiza macrantha* has high crude protein and crude fat, though the nitrogen free extract (more or less a measure of starches and sugars) was low. Interestingly, the plant has been known for its medicinal uses among different human groups in forest areas where this climber is found (Burkill 1997, Terashima & Ichakawa 2003). The leaves have anti-inflammatory properties (Ajayi *et al.* 2015).

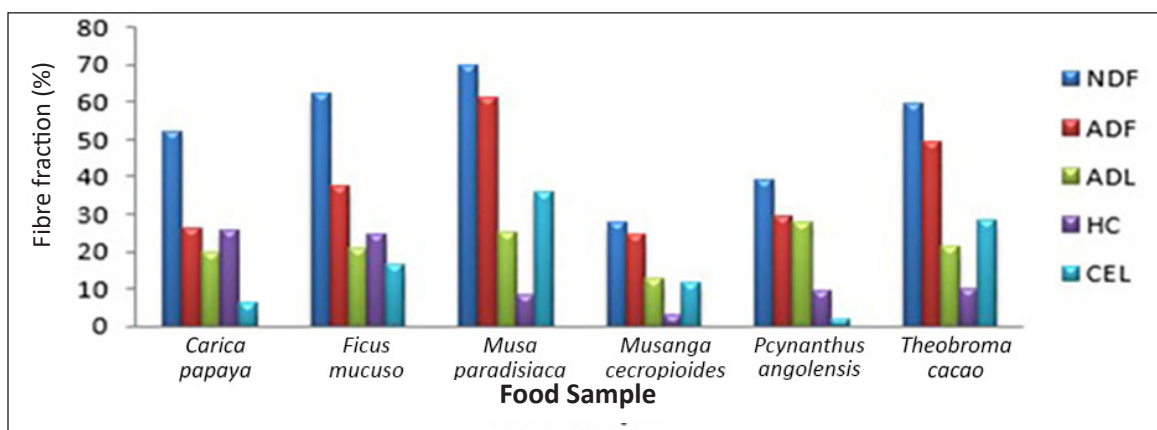


Figure 4. Fiber fraction contents of dry season's foods of *Cercopithecus mona* in Okomu National Park, Nigeria. NDF = Neutral Detergent Fiber; ADF = Acid Detergent Fiber; ADL = Acid Detergent Lignin, HC = Hemicellulose and CEL = Cellulose.

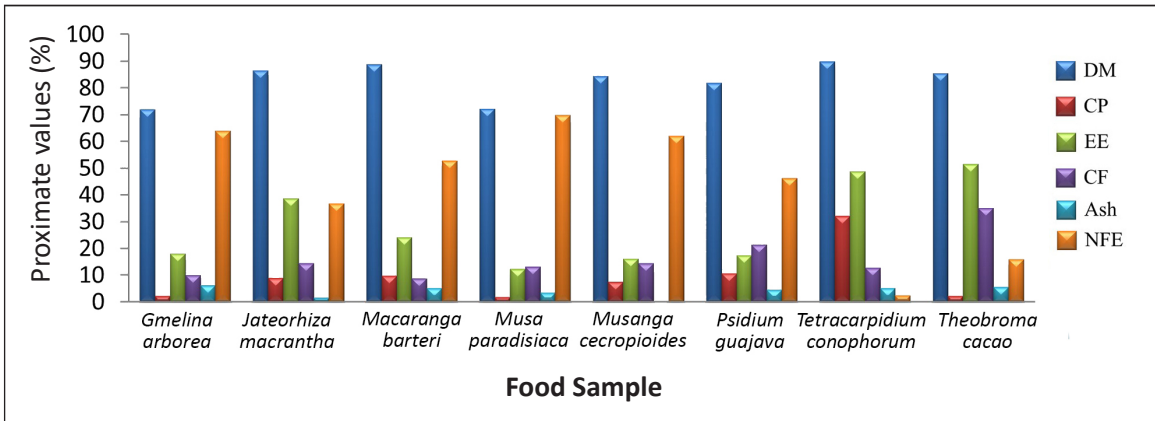


Figure 5. Nutrient composition of wet season's foods of *Cercopithecus mona* in Okomu National Park, Nigeria; DM = Dry matter, CP = Crude protein, EE = Ether extract, CF = Crude fiber, NFE = Nitrogen free extract.

While the study subjects obtained most of their food in the Park, introduced and cultivated plant species played an important role during the dry season when fewer foods were recorded. *Cercopithecus mona* consumed a number of foods used by humans, including *Elaeis guineensis*, *Irvingia gabonensis*, *Mangifera indica*, *Musa sapientum*, *Psidium guajava*, and *Tetracarpidium conophorum* – a similar set of foods consumed by *C. mona* elsewhere in Nigeria (e.g., Ayede, Isan and Awka Forest Reserves; Ejidike & Salawu 2009; Ejidike *et al.* 2010; Nwufoh 2011). Indeed, *C. mona* in Awka (eastern Nigeria) were reported to jump across fences into gardens to raid food crops such as cashew (*Anacardium occidentale*), pawpaw (*Carica papaya*), local pear (*Dacryodes edulis*), mango (*Mangifera indica*), plantain (*Musa sapientum*), and guava (*Psidium guajava*) (Nwufoh 2011). Several studies have shown that other NHPs such as red-capped mangabeys (*Cercocebus torquatus*) and white-throated monkeys (*Cercopithecus erythrogaster*), and other mammals such as baboons (*Papio spp.*) regularly raid crops along forest edges (Naughton-

Treves *et al.* 1998; Matsuda Goodwin 2007, 2016; Ehardt 2016).

We encourage managers to take actions to ensure that monkeys source their entire diet within Park boundaries to avoid human-wildlife conflict which could exacerbate the number and intensity of threats to this species. However, the behavioral flexibility and generalist nature of *C. mona* diet may be key to their survival as they adapt to increasingly anthropogenic landscapes with human horticultural resources.

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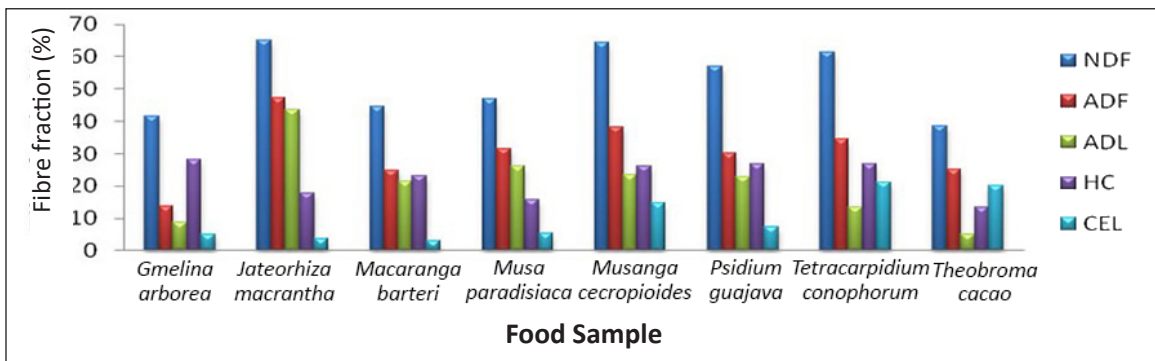


Figure 6. Fiber fraction contents of wet season's foods of *Cercopithecus mona* in Okomu National Park, Nigeria. NDF = Neutral Detergent Fiber; ADF = Acid Detergent Fiber; ADL = Acid Detergent Lignin, HC = Hemicellulose and CEL = Cellulose.

Table 2. Mean and SEM of nutrients' contents of food groups of *Cercopithecus mona* in Okomu National Park, Nigeria. More than 14 mona monkey plant foods were identified during the six day visit in 2011 (Appendix 1). SEM= Standard Error of Mean, DM = Dry matter, CP = Crude protein, EE = Ether extract, CF = Crude fiber, NFE = Nitrogen free extract, NDF = Neutral Detergent Fiber, ADF = Acid Detergent Fiber; ADL = Acid Detergent Lignin, HC = Hemicellulose and CEL = Cellulose.

Plant part	DM	CP	EE	CF	Ash	NFE	NDF	ADF	ADL	HC	CEL
Fruits (n=8)	79.09	6.34	16.17	11.29	5.69	60.46	52.74	32.81	19.97	19.93	12.85
	± 2.53	± 1.97	± 1.45	± 1.92	± 1.36	± 5.23	± 4.84	± 4.89	± 2.20	± 3.37	± 3.65
Seeds & nuts (n=6)	88.94	10.28	37.78	21.88	4.76	32.36	50.22	31.28	21.90	19.46	9.38
	± 1.24	± 4.48	± 5.60	± 7.24	± 1.05	± 9.43	± 4.59	± 3.56	± 5.37	± 2.83	± 3.59

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Appendix I. Dates, seasons, and years of mona monkey food data collection.

Date	Days	Season	Feed Samples Recorded
21-23/3/2011	3	Dry	<i>Carica papaya</i> , <i>Elaies guineensis</i> , <i>Ficus exasperata</i> , <i>Ficus mucoso</i> , <i>Mangifera indica</i> , <i>Musa paradisiaca</i> , <i>Musa sapientum</i> , <i>Musanga cecropioides</i> , <i>Psidium guajava</i> , <i>Pycnanthus angolensis</i> , <i>Staudtia stipitata</i> , <i>Theobroma cacao</i>
5-7/7/2011	3	Wet	<i>Dacryodes edulis</i> , <i>Elaies guineensis</i> , <i>Gmelina arborea</i> , <i>Irvinga gabonensis</i> , <i>Jateorhiza macrantha</i> , <i>Macaranga barteri</i> , <i>Musa paradisiaca</i> , <i>Musa sapientum</i> , <i>Musanga cecropioides</i> , <i>Myrianthus arboreus</i> , <i>Psidium guajava</i> , <i>Spondias mombin</i> , <i>Tetracarpidium conophorum</i> , <i>Theobroma cacao</i>
2 – 8/2/2012	7	Dry	<i>Chrysophyllum africana</i> , <i>Ficus mucuso</i> , <i>Kola crassifolia</i> , <i>Musanga cercropoides</i> , <i>Pycnanthus arboreus</i> , <i>Staudtia stipitata</i>
14-18/5/2012	5	Wet	<i>Barteria nigritiana</i> , <i>Dacryodes edulis</i> , <i>Duranta repens</i> , <i>Mangifera indica</i> , <i>Theobroma cacao</i> , <i>Irvinga gabonensis</i> ,
8-10/10/2012	3	Wet	<i>Annona glabra</i> , <i>Barteria nigritiana</i> , <i>Musa paradisiaca</i> , <i>Musa sapientum</i> , <i>Musanga cercropoides</i> , <i>Theobroma cacao</i> , <i>Xylopiiaa ethiopica</i> ,
5-7/3/2013	3	Dry	<i>Chrysophyllum africana</i> , <i>Mangifera indica</i> , and others listed above
23-27/4/2013	5	Wet	<i>Annona glabra</i> , <i>Barteria nigritana</i> and others listed above
7-11/8/2013	5	Wet	<i>Barteria nigritana</i> , <i>Myrianthus arboreus</i> , <i>Nauclea diderrichii</i> , <i>Spondias mombin</i> , <i>Xylopiiaa ethiopica</i>
26-28/11/2013	3	Dry	<i>Brachystegia nigerica</i> , <i>Pentaclethra macrophylla</i> , <i>Pycnanthus angolensis</i> , <i>Sterculia oblongata</i> , <i>Strombosia pustulata</i>

Dry Season: 16 days; Wet Season: 21 days