

## Feeding Ecology of Primates in Southern Sector of Gashaka-Gumti National Park (Filinga Range), Taraba State, Nigeria

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### Authors' contributions

This work was carried out in collaboration between all authors. Authors BTT and DES designed the study, wrote the protocol and wrote the first draft of the manuscripts. Author GOY performed the statistical analysis, managed the analyses of the study and the literature searches. All authors read and approved the final manuscripts.

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### ABSTRACT

Primates along with many other animal taxa are forced to cope with large shifts in basic ecological conditions because of rapid anthropogenically induced changes of their habitats. One of the coping strategies for primates is to adjust their diet to these changes. Little is known, however, about primates feeding ecology in fragmented habitats and many species remain studied. The feeding ecology of primates in Gashaka-Gumti National park, Taraba State, Nigeria particularly in Filinga range was studied for six weeks. Direct observation along predetermined transects with the aid of binoculars was used in data collection. The visits were made between 06.00 h – 11.00 h and the evening 15.00 h – 18.00 h in the park. Data were collected from the plants species the primates fed upon. Five species of primates were identified, *Papio anubis*, *Cercopithecus aethiops tantalus*, *Colobus gureza*, *Cercopithecus nictans* and *Cercopithecus mona* respectively. Diurnal, arboreal and grouping were observed as feeding behaviour exhibited by the identified primates. The result revealed that primates feed on wide variety of plants with preference for *Landolphia owariensis*

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followed by *Anogeissus leiocarpus* respectively. Each primate displayed a level of selectivity and utilization of the plant species used as food source. Both Baboon and Tantalus monkey utilized *Elaeis guineensis* most (34.9%, 26.7%) with *Vitex doniana* and *Brachystegia eurycoma* being least (5.8%, 5.0%) utilizes. Mona monkey, Black and White *Colobus* both utilizes *Anogeissus leiocarpus* most (51.4%, 15.7%) and the least was *Landolphia owariensis* (10.8%) and *Parkia biglobosa* (5.1%) respectively. Putty-nosed monkey utilized *Landolphia owariensis* most (49.2%) and *Erythrophleum suaveolens* least (34.3%). Black and White *Colobus* showed a wide selection of food sources, feeding on ten out of fifteen plant species identified, including (*Landolphia owariensis*) fruits. Mona monkey on the other hand showed a high selectivity, feeding on four out of the total plants species utilized. Primate's species were observed to feed mostly on leaves and fruits. Conservation and proper management of the range condition of the park should be encouraged to enhance proper co-existence between flora community and fauna species of the area.

**Keywords:** Feeding; ecology; primate; Gashaka-Gumti national park; Filinga range.

## 1. INTRODUCTION

Feeding ecology is a central component of a species' biology, relating to its survival, reproduction, population dynamics, habitat requirement and pattern of sociality [1]. Food is extremely important to all living organisms. 'It provides nutrients for growth, maintenance, reproduction and is the source of energy [2].

According to Kate [3] understanding the diet of an animal helps to interpret its ranging behavior in relation to food availability and it also indicates some of the ecological relationships between plants and animals.

Primates are made up of animals like the chimpanzees, gorillas, and monkeys, lemurs, lorises, galagos, pottos, sifakas, indris, aye-ayes, and tarsiers. However, the smallest living primate is the pygmy mouse lemur, which weighs around 30 g. and the largest is the gorilla, weighing up to around 175 kg [4].

Primates use variety of food sources such as leaf, fruit, seed and animal which gives their body basic elements like carbohydrates, fats, proteins, vitamins, and minerals. Di Bitetti and Janson [5] revealed that food availability is the most important ultimate cause of seasonality and its availability dictates the daily movement patterns of groups of primates [2]. Gottfried and Martha [6] observed that the environment and the primate itself play an important role in determining the type of food sources, thus, additional food components will influence the density of primates that an area can support as well as modulate the population dynamics [7].

Numerous endemic species are threatened with extinction primates inclusive, majorly through

human induced influence and only small proportion of the area is fully protected.

Primates were observed to be leaf eaters, fruit eaters, seed eaters, insect eaters in Gashaka-Gumti National Park.

According to Volker and Yianna, [8] Baboons consumed African black plum (*Vitex donaina*) which has a contraceptive effect and potentially reduces mortality during the raining session, and Chimpanzees are highly frugivorous and usually relay on few important food species yet as omnivorous, also incorporate animal prey in their diet [9]. The Gashaka-Gumti Chimpanzees use a varied toolkit for extractive foraging, for example they harvest insects throughout the year via digging sticks and probes, to obtain honey from stingless-bee and honey bee nests, dipping wands to prey on army ants and fishing rods to eat arboreal ants [10].

David et al., [11] revealed that the Howlers monkey used 16 plants species as sources of leaves, fruits and flowers when foraging in a Cacao plantation in Comalcalco, Mexico, and for Grey-checked mangabeys (*Lophocebus albigena*), however, they have omnivorous feeding habits, consuming the fruits, seeds, leaves and flowers [12]. Tamarin feed on plant exudates; claw-like nails enable this primate to exploit food resource that otherwise be inaccessible by other species [13]. The buff sakis (*Pithecia albicans*) were primarily seed predators, relying heavily on young seeds of certain key plant families, such as the Spotaceae and Leguminosae ripe fruits, ripe seeds, young leaves, flowers and nectar [14]. Gorillas fed largely on fruits in the forest; their basic diet is fibrous parts of plant including shoots, young

leaves and bark, however, they selected fruits as their alternative food resources in the fruiting season [15]. Black howler monkey (*Alouatta pigra*) feeds on fruit, foliage, flowers i.e. folivores, frugivores [16] while the Proboscis Monkey are selective feeders; use of tree species as food sources is not based simply on relative density, given their high biomass and predilection for consuming seeds of dominant species [17], they may help to maintain and increase vegetation diversity. The pithecline monkey (*Cacayao calvus* and *Chiropites albinasus*) have frugivorous feeding habits [18]. Wolly monkeys are primarily frugivorous [19]. The distribution and abundance of food resources will determine the strength of competitive interactions for access to food resources [6] and when there is abundance of food, competition is less and selectivity becomes very high. However, during scarcity primates species increased the amount of time spent feeding [20].

Primate feeding ecology is examined on the level of the organism, stating the level at which one can quantify the diet, the proportion of diet involved which consists each type of plant parts (e.g. fruit, seed, pith, leaf and flower) of each species of plant consumed and the time spent. Feeding ecology is based on each resource of the micronutrient feed on (e.g. protein, sugar etc.) or of total calorie intake” [1]. The objective of this study therefore was to identify the primate species present, their feeding behaviour

and determine the plant part utilized (leaf, fruit, seed, flower,) by each primate species at the southern sector of Gashaka-Gumti National park.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

This study was carried out in Gashaka-Gumti National Park (GGNP), located between 6°55'1"-8°05'1"N and 11°11'1"-12°13'1"E in North-Eastern Nigeria as shown in Fig. 1. GGNP was established in 1991 and represents Nigeria's largest National Park covering 6600 km<sup>2</sup> [21], it was created by Federal Decree (now Act) in 1991 by the merging of Gashaka Game Reserve with Gumti Game Reserve [22]. The mean annual rainfall varies from 1200 mm in the northern part to about 3000 mm in the Southern part of the park [23] while the relative humidity is about 15.7%. The major vegetation type of the park consists of woodland. Some distinctive fauna species found in GGNP include Buffalo (*Syncerus caffer*), Roan antelope (*Hippotragus equinus*), Senegal kob (*Adenota kob*), Lion (*Panthera leo*), Leopard (*Panthera pardus*), Mona monkey (*Cercopithecus mona*), Hunting dog (*Lycaon pitctus*), Giant eland (*Taurotragus debianus*), Oribi (*Ourebia ourebi*), Guinea fowl (*Numida meleagris*) and Monitor lizards (*Varanus niloticus*) among others [24].

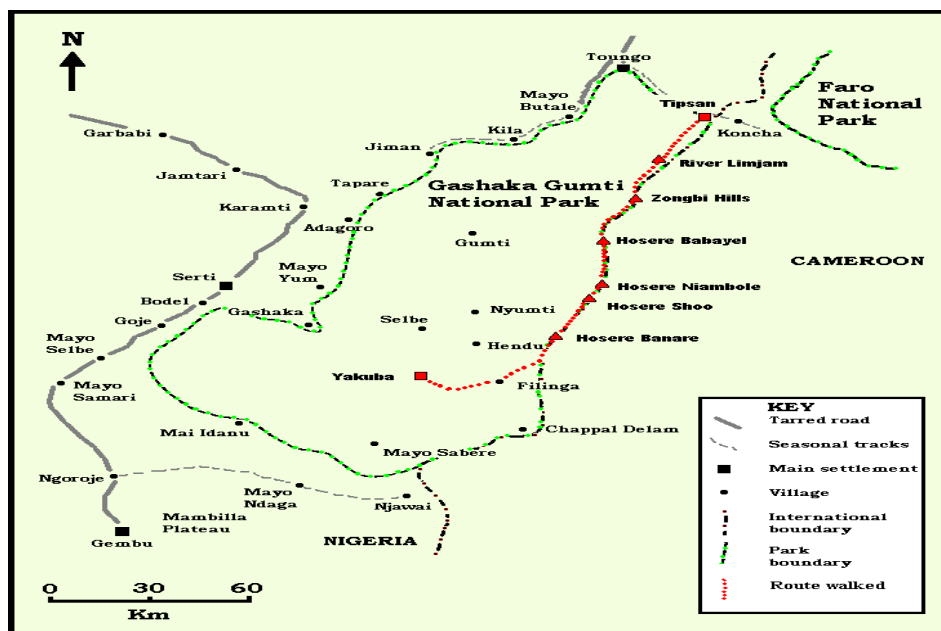


Fig. 1. Map of Gashaka-Gumti national park

## 2.2 Data Collection

Data were collected from predetermined transects, made up of existing trails in the following four locations:

**Gashaka Base Camp 1:** 5 Km trail from Mayo Gashaka (River) through the village to Base camp where the Rangers reside, across Mayo Gamgam (river). Habitat type, rainforest (N:07.3711, E:011.49202).

**Gashaka Base Camp 2:** 6 Km trail after Mayo Gashaka (river) on the road to Mayo paa. Habitat type, Guinea savanna (N: 07.36.597, E: 011.48847).

**Putty nosed site:** 5 Km trail across Mayo Gamgam River on your way to Kwano research station. Habitat type, rainforest (N: 07.354141, E: 011.52826).

**Kwano site:** 12 Km trails at Kwano research station. Habitat type, rainforest (N: 07 32 917, E: 011 58 458).

Purposive sampling method was used to select these sites. Data were collected from June- July, eight days for each location, using direct observation method [25].

The trails were walked in the morning 06.00 h – 11.00 h and the evening 15.00 h – 18.00 h by the author and 3 game guards who are familiar with wildlife species. Activities such as type of primate sighted, plant species fed on, part of plant eaten, and feeding behaviour was recorded. A guide book was used where possible. The study sites were observed to cover two types of vegetation Guinea savannah and montane rainforest.

Materials used for data collection were; a Global Positioning System (Germin GPSMAP 78S) for taking coordinates of the study sites and primates location, a digital camera (Sony cyber shot DSC-HX200V) for taking pictures and a pair of binocular (Crown field 7.5-) for viewing and identification of species.

## 2.3 Data Analysis

Data were analyzed using simple descriptive analysis such as bar chart, tables and percentage utilization using this formula by [26] as follows.

% utilization of plant species was determined as follows:

$$\left( \frac{\text{Total number of sightings feeding on a particular plant species}}{\text{Total number of sighting for all species eaten}} \right) \times 100$$

## 3. RESULTS

Five species of primate were identified during the survey. Relative abundance of the different primates species are shown in Fig. 2. They were the Baboons (*Papio anubis*), Tantalus monkey (*Cercopithecus aethiops tantalus*), Putty-nosed monkey (*Cercopithecus nictans*), Black and White colobus monkey (*Colobus gureza*) and Mona monkey (*Cercopithecus mona*). The most frequently sighted primates species were the Baboons and Putty-nosed monkeys which constituted 28.4% each while the least sighted was Mona monkey, accounting for 5.0%. The presence of primate species in the southern sector of GGNP as shown in Table 1, revealed that all the primates were observed to feed in groups, exhibited diurnal and arboreal feeding behaviours.

The identified species of primates exploit variety of food sources, in Table 2, fifteen (15) different species of plant were utilized by the primates as food, fourteen (14) of which were tree species and one (1) grass species, bark of tree, insect were also used as food by the Primates. The frequently used plant species in the park by all primates as showed in Fig. 3 are *Landolphia owariensis*, *Anogeissus leiocarpus* respectively. Each Primate species exhibited pattern in their feeding by showing level of utilization of the plant species. The most utilized plant species by the Baboon in (Table 3) was *Elaeis guineensis* accounting for 34.9% and the least utilized plant species was *Vitex doniana* (5.8%). Similarly, Tantalus monkey most utilized plant species was *Elaeis guineensis* which made up 26.7% and the least utilized plant species was *Brachystegia eurycoma* constituting 5.0% (Table 4). Mona monkey as shown in Table 5 utilized *Anogeissus leiocarpus* (51.4%) plant species most and *Landolphia owariensis* (10.8%) was least utilized. Mona monkey however used only four plant species out of the total number of fifteen plant species identified. This could be a display of selectivity, which may have direct effect on habitat selection. It was observed that Mona monkeys were identified only in the rainforest of Kwano location.

**Table 1. Primate species sighted and their feeding behaviour at GGNP**

Common name	Scientific name	Diurnal	Group	Arboreal
Baboons	<i>Papio Anubis</i>	+	+	+
Tantalus monkey	<i>Cercopithecus aethiops tantalus</i>	+	+	+
Black and white Colobus	<i>Colobus gureza</i>	+	+	+
Putty-Nosed monkey	<i>Cercopithecus nictans</i>	+	+	+
Mona monkey	<i>Cercopithecus mona</i>	+	+	+

Key: + Presence of the feeding behaviour.

Field work, 2014

**Table 2. Plant species utilized as food by primates at GGNP**

S/no	Plant species	Family	Local name	Common name
1	<i>Anogeissus leiocarpus</i>	Combretaceae	Marke	Dye
2	<i>Annona senegalensis</i>	Annonaceae	Gwandar daji	Senegal annona
3	<i>Brachystegia eurycoma</i>	Leguminosae	Wombo	-
4	<i>Daniellia oliveri</i>	Leguminosae	Maje	West African copal
5	<i>Elaeis guineensis</i>	Palmae	Kwara manja	Oil palm
6	<i>Erythrophleum suaveolens</i>	Caesalpinodeae	Gwaska	-
7	<i>Gmelina arborea</i>	Laminaceae	-	Gmelina/beechn wood
8	<i>Khaya senegalensis</i>	Meliaceae	-	Mahogany
9	<i>Landolphia owariensis</i>	Apocynaceae	-	White rubber vine
10	<i>Parkia bicolor</i>	Mimosaceae	-	African locust bean
11	<i>Parkia biglobosa</i>	Mimosaceae	Dorowa	Locust bean
12	<i>Parinari excelsa</i>	Rosaceae	Tuwon biri	Rough skinned plum
13	<i>Uapaca togoensis</i>	Euphorbiaceae	Wawa kurmi	-
14	<i>Vitex doniana</i>	Verbaseae	Dinyar	Sweet
15	<i>Andropogon gayanus</i>	Poaceae	-	Gamba grass

Field work, 2014

**Table 3. Plant species fed by ground/terrestrial Baboons (*Papio anubis*) GGNP**

Plant species	Part(s) eaten	Number of primates sighted feeding on particular plant species	% Utilization
<i>Vitex doniana</i>	Fruit/leaf	11	5.8
<i>Elaeis guineensis</i>	Fruit	66	34.9
<i>Annona senegalensis</i>	Fruit	18	9.5
<i>Andropogon gayanus</i>	Grass	12	6.4
<i>Parinari excels</i>	Fruit	14	7.4
<i>Uapaca togoensis</i>	Leaf	21	11.1
<i>Landolphia owariensis</i>	Fruit	47	24.9

Field work, 2014

**Table 4. Plant species fed by ground/terrestrial Tantalus monkey (*Cercopithecus aethiops tantalus*) GGNP**

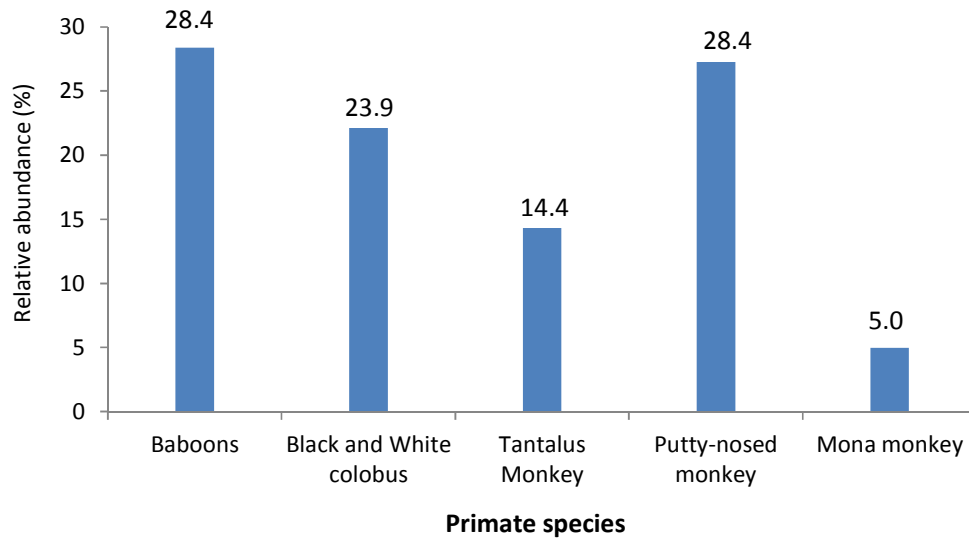
Plant species	Part(s) eaten	Number of primates sighted feeding on particular plant species	% Utilization
<i>Brachystegia eurycoma</i>	Fruit	6	5.0
<i>Gmelina arborea</i>	Fruit/leaf	28	23.3
<i>Elaeis guineensis</i>	Fruit	32	26.7
<i>Anogeissus leiocarpus</i>	Leaf	22	18.3
<i>Parinari excels</i>	Fruit	14	11.7
<i>Uapaca togoensis</i>	Fruit/leaf	18	15.0

Field work, 2014

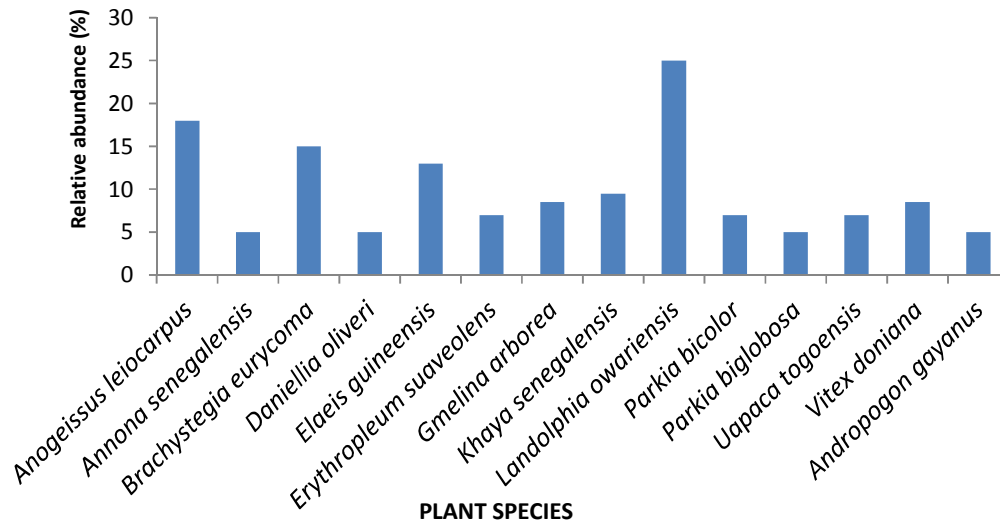
**Table 5. Plant species fed by Mona monkey (*Cercopithecus mona*) GGNP**

Plant species	Part(s) eaten	Number of primates sighted feeding on particular plant species	% Utilization
<i>Anogeissus leiocarpus</i>	Leaf	19	51.4
<i>Khaya senegalensis</i>	Leaf	7	18.9
<i>Brachystegia eurycoma</i>	Leaf	7	18.9
<i>Landolphia owariensis</i>	Fruit	4	10.8

Field work, 2014



**Fig. 2. A bar chart showing the relative abundance (%) of the types of primate species identified in the study area**



**Fig. 3. The most frequently used plant species by all the primates in the study area**

Black and White *Colobus* on the other hand has the highest number of plants species used as food in the study area, accounting for ten out of fifteen plant species identified as shown in Table 6, the most utilized plant species was *Anogeissus leiocarpus* which made up 15.7% and the least utilized plant species was *Parkia biglobosa* accounting for 5.1%. Finally, the plant species utilized by Putty-nosed monkey as indicated in Table 7 with the most utilized plant species as *Landolphia owariensis* which constituted 49.2% and *Erythrophleum suaveolens* constituted just 3.3%.

#### 4. DISCUSSION

Primates of Gashaka-Gumti National Park constitute part of the rich biodiversity that made up the ecosystem. Five (5) species of primate were identified, these are Baboons (*Papio anubis*), Tantalus Monkey (*Cercopithecus aethiops tantalus*), Mona Monkey (*Cercopithecus mona*), Black and White *Colobus* (*Colobus guereza*) and Putty-Nosed Monkey (*Cercopithecus nictans*). The findings are in line with study on Primates species by [21], who

identified seven species (7) of Primates in the entire Park. However, the present research was carried out at the southern sector of the park, which could be attributed to the result obtained. Secondly Chimpanzee which can be found in tropical rainforest habitat was not identified in this research work because it needs a longer time of observation (one year or more) to be sighted [21].

All the Primates were observed to feed in groups, they exhibited diurnal and arboreal feeding behaviours, although Baboons and Tantalus monkey sometimes could climb down to pick on grass then climb up again. Primates species in this study were observed to feed mostly on leave and fruits i.e. folivorous and frugivorous which was similar to the result by [12]. It was observed that Black and White *Colobus* used a wide range of food sources which indicate easy adaptation and abundance of the species to Gashaka-Gumti National Park. Some research on Black and White *Colobus* revealed that they feed only on leaves [27], but it is interesting to note that, they feed on fruit (*Landolphia owariensis*) as indicated in Table 6.

**Table 6. Plant species fed by black and white *Colobus* (*Colobus guereza*) GGNP**

Plant species	Part(s) eaten	Number of primates sighted feeding on particular plant species	% Utilization
<i>Vitex doniana</i>	Leaf	30	12.7
<i>Daniellia oliveri</i>	Leaf	30	12.7
<i>Gmelina arborea</i>	Leaf	18	7.6
<i>Landolphia owariensis</i>	Fruit	21	8.9
<i>Anogeissus leiocarpus</i>	Leaf	37	15.7
<i>Erythrophleum suaveolens</i>	Leaf	19	8.1
<i>Parkia biglobosa</i>	Leaf	12	5.1
<i>Parkia bicolor</i>	Leaf	14	5.9
<i>Brachystegia eurycoma</i>	Leaf	28	11.9
<i>Khaya senegalensis</i>	Leaf	27	11.4

Field work, 2014

**Table 7. Plant species fed by putty-nosed monkey (*Cercopithecus nictans*) GGNP**

Plant species	Part(s) eaten	Number of primates sighted feeding on particular plant species	% Utilization
<i>Landolphia owariensis</i>	Fruit/leaf	147	49.2
<i>Vitex doniana</i>	Fruit	37	12.4
<i>Khaya senegalensis</i>	Leaf	20	6.7
<i>Brachystegia eurycoma</i>	Leaf	44	14.7
<i>Anogeissus leiocarpus</i>	Leaf	41	13.7
<i>Erythrophleum suaveolens</i>	Leaf	10	3.3

Field work, 2014

The Primates were observed to use fifteen (15) plants species as food sources of leaves, fruits when foraging in the Park. This agrees with David et al. [11], that 16 plants species were used by Howlers monkey as sources of leaves, fruits and flowering when foraging in Cacao plantation in Comalcalco, Mexico. The most frequently used plant species by the Primates was observed to be *Landolphia owariensis* and *Anogeissus leiocarpus* respectively. Mona monkeys on the other hand shows a level of selectivity, with fewer plant species used as food sources, this could probably have a direct effect on habitat selection. Mona monkey was seen only in a rainforest habitat. All the Primates identified were observed to exploit a variety of food sources probably due to the season.

## 5. CONCLUSION

A good knowledge of what the Primates feed on and its availability will determine maintaining strategies geared towards sustaining the Primate in their present habitat. This study has demonstrated that sustenance of primates in an ecosystem is vital considering their feeding habit which encourages the regeneration of plants through the activity of seed dispersal. Further studies should try to investigate the relative abundance of the identified plants in the area to determine if the habitat can adequately sustain the primates for a longer period.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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