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Correlation between Flora Diversity and Abundance of Bat (*Eidolon helvum*) in Bowen University, Iwo, Nigeria

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ABSTRACT

The study was conducted in Bowen University Campus Iwo, Osun State, Nigeria. Systematic sample stratification was used to stratify the bat- occupied and unoccupied zones based on the presence of roost trees occupied by bats and to identify all tree samples to species level and enumerated. Many parts of the University Landscape represented the main bat trees occupied as bat roost site. Some other factors that describe the physical appearance of the trees were also observed such as diameter at breast height (DBH), Canopy cover, tree height, number of branches and bark condition. Correlation between bat abundances and available food resources is at $p > 0.005$. High population index of bats at the site determine their life cycle and simultaneously design a conservation strategy. Observation is on negative impact of bats on trees resulting from suppression of flowering/fruitletting and defoliation. The Biodiversity of the study site is solemn in bats conservation management.

Keywords: Reconnaissance survey, systematic sample, roost site, correlation, bat conservation.

INTRODUCTION

Bats including the straw colour fruit bat (*Eidolon helvum*) are one of the most important, yet least understood groups of animals in the world. They have been in existence for more than fifty million (50) years and are known to play a vital role in both natural and managed ecosystem. A quarter of nearly 1,000 different species of this animal is known today. This means they are diverse. Bats traditionally are not viewed as charismatic except in the most extreme desert and Polar Regions. (Vivian, 2007). Myths and superstition of centuries have made bats among the world's least appreciated wildlife species. Decades of unwarranted human fear, misinformation and persecution of bats at their roost site have pressed populations into severe decline nearly everywhere in the World and endangered many species (Bat Conservation International, BCI, 2004). Conversely, the moral, ethical and

aesthetic justification for bats conservation made the species to be ecologically and economically important (BCI, 1989). The (*Eidolon helvum*) which is the subject of this study inhabits forest and savannah and found up to an elevation of 2000m in Ruwenzori Mountains (Kingdon, 1974).

It is gregarious and prefers to roost in tall trees, but has been found in lofts, rocks and caves (Nowak, 1991). In this country, bats select trees of particular species for roosting and feed mostly at night (Okon, 1974). Among the common trees used for roosting are *Eucalyptus saligna* (Myrtaceae), *Cocos nucifera* (Palmae), *Elaeis guineensis* (Palmae) and tree species of *Ficus* (Moraceae) (Jones, 1972). Bats can display fidelity to roosting areas, and often roost colonially in order to reduce thermoregulatory costs, reduce predation risk, reduce costs of rearing young through cooperative breeding, and

increase information exchange (Kerth *et al.*, 2001; Kunz, 1982; Kunz & Lumsden, 2003). Roost-switching behavior also is displayed by many bat species, where members of a colony regularly switch between a pool of suitable roosts within an area (Lewis, 1995, O'Donnell & Sedgely 1999). Hence, suitable roost sites are expected to have specific physical attributes, with the persistence of bats in urban landscapes predicted to be dependent in part on the maintenance of suitable roosting habitat, which includes many suitable roost trees. Harvesting of roost trees, mostly in site where uncontrolled and illegal logging are rampant has contributed to species population decline.

Most rural African protein source of meat comes from wild animals ranging from rats, squirrels, monkeys; antelopes, birds and bats are not left out. One of the forest resources believed to be easily accessed by the resource poor rural dwellers is bush meat. It connotes to be wild animal protein being hunted for human consumption bat inclusive. Bush meats also serve as cheap protein source to the rural people that may not be able to afford meats from domestic animals (Branch, 2000). When bats choose their roost sites, they select trees of various heights and sizes and their colonies can number up to one million. As expected of bat the individual of each species perch upside down. In the western coast of West Africa, precisely Ivory Coast, bats migrate from the tropical forest zone where they live between June and December, to the interior of Niger basin where it appears in January and stay till May (Happold, 1987).

In West Africa, over 120 species of fruits-and nectar- eating bats are found. With particular reference to Ghana, there are about fifteen (15) fruit- eating bats feeding on a wide range of trees in the forest landscape (Kankam & Oduro, 2009). The bat feeds on leaves, flowers and large proportion on fruits on different families of tropical forest plant species. As for Eidolon helvum it feeds on the following fruits both cultivated and wild plants such as *Musa sapientum* (Musaceae), *Carica papaya* (Caricaceae) *Mangifera indica* (Anacardiaceae), *Kigelia eathiopica* (Bignoniaceae) and *Terminalia Speceis* (Fujita & Tuttle, 1991). As an index part of their economic value, they are being hunted in most of West African countries as a source of "Lean Meat". The meat is usually

consumed at home while some are occasionally sold at the local market. Anthropogenic activities contribute to population decline of wildlife species bats inclusive. This major hunting of bats in Ghana takes place at the peak period of dry season (Kamins *et.al.*, 2011).

MATERIALS AND METHODS

Study Area

Bowen University Campus is fully residential located on a 640 hectares site in Iwoland on a geographical coordinate's longitude 7° 62'N and latitude 4°14'E. Iwo itself is in Osun state about 46.6 km south west of Ibadan the largest city in Nigeria. The University is a private one owned and operated by the Nigerian Baptist Convention. It is housed within the old 1,300 acres (6 km²) Campus of the former Baptist College, a teacher – training institution on a beautiful hill on outskirts City of Iwo. The Campus is renowned for its large residential fruit bats roost sites.

Sampling Procedure

Reconnaissance survey was conducted through random sampling techniques to stratify the campus into bat-occupied and unoccupied zones based on the presence or absence of roost trees occupied by bats. Eleven sample plots of 20m x20m size were systematically distributed in each stratum many parts of the study area represented the main bat roost site. Each plot was sub-divided into tree belt transects for effective coverage of the area. All trees found to be greater than and seen to be greater than 10 cm and above at diameter at breast height (DBH) in all plots were identified to the species level and counted. Some factors that describe the physical appearance of the trees (DBH, Tree height or basal area, number of branches and bark condition) were also observed.

Data Analysis

Data collected were analyzed using different statistical tools. Vegetation sampling analysis was carried out by using statistical direct computer package. Descriptive statistical analysis using t-test tables, charts and histogram were employed. The impact of bats on trees was analyzed using the DBH measurements to calculate the basal area of plant species. The canopy cover was calculated by using the formula of Hall and Swaine, 1981 given below:

$r = D^{2/4}$ where D is the average crown diameter.....(equation one)

RESULTS

Observation of the flora species influence revealed that seven flora species belonging to seven families were recorded in the bat occupied zone within the study site as presented in Table 1. The highest number 14 or 46.6% of the trees sample is *Mangifera indica*, followed by 5 or 16.6% of *Tectonia grandis* and *Rhapidophyllum* species respectively are shown in Table 2.

Table1: Flora species available at the study site.

S/N	Botanical Name	Family	Common Name	Local Name
1	<i>Mangifera indica</i>	Anacardiaceae	Mango	Mongoro
2	<i>Cassia fistula</i>	Fabaceae	Pudding pie	Aridan-toroo
3	<i>Tectonia grandis</i>	Verbenaceae	Teak	Igi gedu
4	<i>Rhapidophyllum spp.</i>	Arecaceae	Ornamental palm	Igi Agbon
5	<i>Irvingia gabonensis</i>	Irvingiaceae	Bush mango	Ooro
6	<i>Terminalia catappa</i>	Combretaceae	Tropical almond	Igi furutu
7	<i>Vitex doniana</i>	Lamiaceae	African oak/vitex	Oori nla/Oori

Table2: Frequency and percentages of flora species identified

S/N	Tree Species	Frequency	Percentage
1	<i>Mangifera indica</i>	14	46.67
2	<i>Cassia fistula</i>	3	10.00
3	<i>Tectonia grandis</i>	5	16.67
4	<i>Rhapidophyllum spp</i>	5	16.67
5	<i>Irvingia gabonensis</i>	1	3.33
6	<i>Terminalia catappa</i>	1	3.33
7	<i>Vitex doniana</i>	1	3.33
	Total	30	100

The preponderance of *Mangifera indica* is closely correlated to the abundance of bats which has a significant coefficient at ($p > 0.005$) Table 3. There is a high frequency of tree species used as bat roost site. Thus, indicating a close correlation between flora species and bats.

The study reveals that bats mostly feed on *Mangifera indica* (Mango trees) during the dry season and feed on any other species including shrubs at the off season of mango (Figure 1).

Table 3: Diameter at breast height (DBH) and height of the floral species.

Site	Tree species	DBH	Height(m)
A	<i>Mangifera indica</i>	4.25	12.0
	<i>Cassia fistula</i>	1.4	10.0
	<i>Cassia fistula</i>	1.6	10.5
B	<i>Mangifera indica</i>	3.6	7.50
	<i>Mangifera indica</i>	4.2	12.0
	<i>Mangifera indica</i>	4.0	10.75
C	<i>Mangifera indica</i>	3.1	6.0
	<i>Rhapidopyllum spp</i>	3.0	6.0
	<i>Rhapidopyllum spp</i>	3.01	8.0
D	<i>Terminalia catappa</i>	1.52	9.70
	<i>Mangifera indica</i>	1.05	1.50
	<i>Rhapidopyllum spp</i>	2.21	6.50
	<i>Irvingia gabonensis</i>	1.2	5.0
E	<i>Tectonia grandis</i>	1.80	10.0
	<i>Tectonia grandis</i>	1.70	14.0
	<i>Tectonia grandis</i>	1.93	12.0
F	<i>Mangifera indica</i>	3.25	8.0
	<i>Mangifera indica</i>	2.78	7.50
	<i>Mangifera indica</i>	3.60	7.0
G	<i>Tectonia grandis</i>	0.85	9.75
	<i>Tectonia grandis</i>	1.95	8.25
H	<i>Vitex doniana</i>	1.64	9.20
I	<i>Mangifera indica</i>	2.80	6.0
	<i>Mangifera indica</i>	3.40	7.0
	<i>Mangifera indica</i>	4.60	8.40
J	<i>Rhapidopyllum spp</i>	1.87	5.0
	<i>Rhapidopyllum spp</i>	5.8	4.0
	<i>Cassia fistula</i>	3.30	6.0
K	<i>Mangifera indica</i>	2.60	6.5
	<i>Mangifera indica</i>	2.25	7.0

DBH- Diameter at breast height

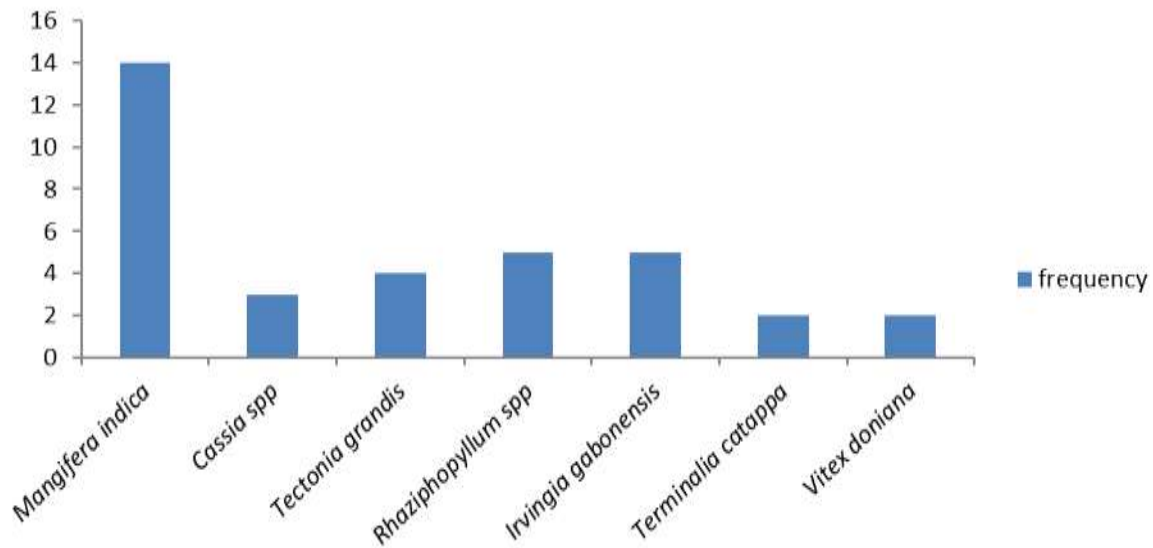


Figure 1: Flora species used as roosting site by bats

There is a high mean basal area of each flora species found at the study site. Data analysis reveals that the mean basal area of the tree cover domicile by bats in the study site is 8.29 M²/ha for *Mangifera indica*, followed by 7.94 M²/ha for *Rhapidophyllum* species, 2.14 M²/ha for *Tectonia grandis*, and 1.13 M²/ha for *Irvingia gabonensis*. The mean basal area of the tree cover by bats in M²/ha

shows that *Mangifera indica* has a total land area of 8.29 M²/ha, followed by *Rhapidophyllum* species that is of total land area of 7.94 M²/ha while *Irvingia gabonensis* has the least land area of a mean size of 1.13M²/ha. The study reveals that *Mangifera indica* and *Rhapidophyllum* species are in abundance which support the abundance of bats represented in Figure 2.

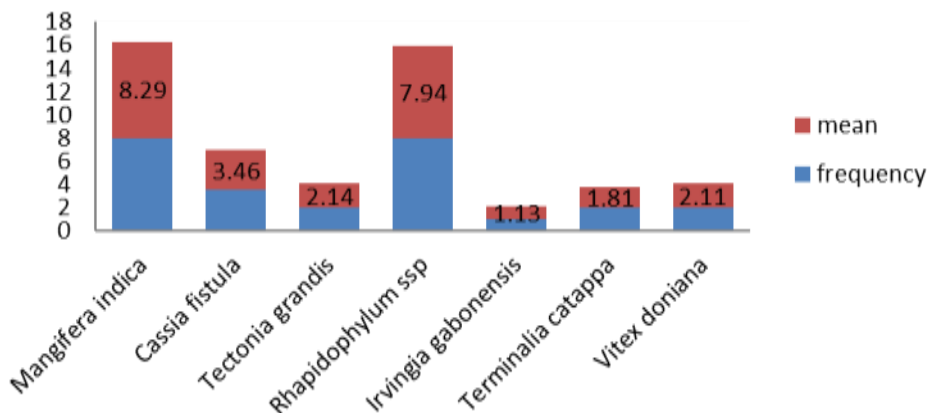


Figure 2: Mean basal area of the floral cover

DISCUSSION

The results obtained from the data analysis have shown that Bats population in Bowen University, Iwo has advanced and that more trees house bats in the Campus. It was recorded that seven families of sampled flora species contained bats. The average trees height in the Bowen University Campus is relatively found and seen to be greater than 10 cm and above at diameter at breast height (DBH) in all sampled plots. This is a great indicator that there are presence of some factors in the study site favourable to bats population, such as tree height, percentage of canopy cover, absence of predators, and absence of intense bat hunting as corroborated with the study of Akande (2002), that population ecology of bats depends on the aforementioned parameters. This support to the largest concentration of bats recorded from the tallest trees. The study also reveals that bats mostly feed on *Mangifera indica* (Mango trees) during the dry season and feed on any other species including shrubs at the off season of mango. This corroborates findings of (Ayoade *et al.*, 2012, Olaniyan, 2016) that fruit bats feed on several fruits of shrubs and trees which made them prolific dispersers of seeds in the forest landscape.

CONCLUSION

The habitation by bats was observed throughout the study site. The floral diversity of the site tallies with the abundance of bats as a result of food resources available to them throughout the year. The bats were found feeding on flowers and nectar of many indigenous trees such as *Mangifera indica*, *Cassia fistula*, *Tectonia grandis*, *Rhapidophyllum species*, *Irvingia gabonensis*, *Terminalia catappa* and *Vitex doniana* which they help to pollinate and make use of as roosting site. Consequently, the high population of bats in the site could be used to determine their life cycle and simultaneously design a conservation strategy.

Anthropogenic activities seem not to have impacted significantly on the site due in impact to the control of such activities by the Nigeria Baptist convention that has the title of the land. The study shows a negative impact of bats on Mango trees through suppression of flowering/fruitletting and defoliation. The population index of bats needs to be under monitoring to determine their population growth within the site.

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