



## Morphometric parameters and aspects of the feeding habits of the Straw-coloured fruit bat (*Eidolon helvum*) on Obafemi Awolowo University Campus, Ile-Ife, Nigeria

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### Abstract

Morphometric parameters of bats and observation in the wild were carried out with a view to determining the sexual differentiation in terms of morphometrics and the food preference of the straw coloured bats in the wild. Specimens were obtained using mist nets on a bi-weekly basis between the hours of 5.00 a.m. – 7.00 a.m. while observation for feeding habits was made daily between 5.00 am – 9.00 am and 5.00 pm – 9.00 pm. The mean weight recorded was  $277.40 \text{ g} \pm 2.09$ . The mean wing length and breadth was  $34.59 \pm 0.36 \text{ cm}$  and  $14.89 \pm 0.17 \text{ cm}$  respectively. The wing span ranged from 66 cm to 83 cm and the total length of the bats ranged from 16 cm to 20 cm with the mean value at  $17.68 \pm 0.41$ . Bats were observed feeding on other parts of the trees including the leaves and the bark of some trees.

**Keywords:** bats, morphometrics, *Eidolon helvum*, roost, forage

### 1. Introduction

Bats are mammals which belong to the Order Chiroptera, their forelimbs form webbed wings which are long and tapering at the tip, making them the only mammals naturally capable of true and sustained flight [1]. Bats do not flap their entire forelimbs, as birds do, but instead flap their spread out digits which are very long and covered with a thin membrane or patagium [1]. They are the second largest order of all classified mammal species worldwide, with about 1,240 bat species divided into two suborders i.e. the less specialized and largely fruit-eating megabats, or flying foxes, and the highly specialized and echolocating microbats [2]. This mammal dwells in large colonies and is an essential seed disperser and pollinator of plants. They form one of the largest non-human aggregations and the most abundant groups of mammals when measured in numbers of individuals [3]. Bats have been found at altitudes as high as 2000 m, preferring tall trees for roosts [4] and sometimes using habitats in large built up areas like the colony of bats on the campus of the Obafemi Awolowo University, Ile-Ife [5]. Roosts are usually situated in groves and thickets close to human habitation, local shrines and marshy areas, which offer sanctuary to the bats [6]. Many species of bats roost during the day time in foliage, caves, rock crevices, hollows of trees, beneath exfoliating bark, and different man-made structures [3] and at night become active searching for food [7]. Bats play an important part ecologically as regards soil nutrients and its distribution due to the wide range which they travel and their utilization of different habitats for roosting and foraging which facilitates nutrient transfer within ecosystems [8, 9]. They also serve as prey to a number of vertebrates such as amphibians, birds, reptiles, and mammals [10, 11]. Bats are sometimes regarded as superstitious creatures and have been persecuted for this reason [12].

One of the most important fruit bat species that forms large colonies, and certainly plays a key role in seed dispersal and

plant pollination, is the straw-colored fruit bat (*Eidolon helvum* [13]. Fruit bats are an important species in the maintenance and re-establishment of natural vegetation [14]. The straw colored fruit bat is a highly social species that lives in large groups. Colonies of this species are rarely found in protected areas or deep in dense forests, but within human habitation or in big towns [4].

Their role in spreading seeds and pollination is particularly important in tropical rainforest succession and community composition [15, 16]. Members of a colony are known to have the ability to traverse 59 km or more on foraging flights which enhance seed dispersal, their long annual migrations have enormous impacts on community composition [17]. Straw-colored fruit bats are native to Nigeria [18] and are found in isolated colonies comprising millions of individuals in many parts of south-western Nigeria [6]. Colonies may show extreme roost-site fidelity [18]. The straw-coloured fruit bat is the main agent of seed dispersal for the rare African tree *Milicia excelsa* [19] and over one hundred and fifty types of plants depend on bats in order to reproduce [20].

The straw-coloured fruit bat's diet vary widely as they feed on food items such as the bark, flowers, leaves, nectar and fruits of trees. Domesticated bats forage on apple, orange, banana, grape, guava and vegetables. The fruit preferred by most fruit-eating bats are fleshy and sweet but not particularly strong smelling or colorful [21]. Fruit bats don't always meet their water requirements from their food intake. Sometimes they gently skim the surface of water bodies, trap water on their fur and then land nearby to lick water from their chest fur [3]. The straw-coloured fruit bat is the most heavily harvested bat for bush meat in West and Central Africa, and this is believed to be a major factor in reported population declines [18, 22]. It is classified as Near Threatened by the International Union for Conservation of Nature (IUCN) and its population trend is on the decline. Threatened by a combination of factors such as

habitat loss, felling of trees (especially trees on which bats roost), negative perceptions and traditional beliefs which exacerbate the level of intolerance to the bats and their roosting camps, the fruit bats need to be protected from unnecessary persecution, avoidable population loss and the threat of extinction.

The straw-coloured fruit bat is an Old World fruit bat that is recognized worldwide as a key species in bush meat utilization, human health threats and ecosystem function [17, 22, 23, 24]. Certain genera have remarkably wide-ranging feeding habits. Marshall [25] recorded that *E. helvum* fed on flowers of about 10 genera. In some cases, food preference and availability varies with place and season, but there are a number of indications that fruit bats may show preferences if choices are available [25]. For example, in West Africa, the straw-coloured fruit bat appears to favour the flowers of *Ceiba* to *Pateca* flowers in the family's Bombacaceae and Leguminosae respectively, the fruits of *Chlorophora* to *Solanum* fruit in the family's Moraceae and Solanaceae, an the flowers and fruits of *Musa*, in the family Musaceae. Floral resources such as nectar, pollen, petals and bracts, fruit, seeds and the leaves are not left out in their consumption [25]. Insect remains have been found in the alimentary canal or intestines of bats but their ingestion is possibly inadvertent.

Studies on wild bats include attempts to collect and analyze food items that they have been observed eating and to identify food consumed through examination of faecal or stomach content. [26, 27, 28].

Fruit bats are highly efficient in extracting the liquid portion of chosen foods. They have fewer teeth than insectivores [29] and their teeth are broad and relatively flat for crushing fruits, allowing the bats to squeeze out and swallow the juices [26]. The fibrous portion remaining is much reduced in moisture and is spat out in tightly compressed pellets [26, 30]. Large volumes of food are processed through the digestive tract rapidly, with transit times ranging from 75 to 100 minutes [31, 32]. The gastrointestinal tracts of the fruit bat species that have been studied is highly modified compared to bat species with other feeding strategies [33].

Variation in animal body size has functional consequences for a diverse array of life history attributes and is therefore subject to an equally diverse array of selection pressures [34, 35]. The multifaceted nature of adaptive variation in body size suggests that consistent spatial correlations with particular ecological variables are generally not to be expected, nonetheless, geographic trends in size variation of many homeothermic species are well characterized by empirical generalizations such as Bergmann's rule.

This study aims to determine the sexual differentiation in terms of weight, wing span and food preference of the Straw-coloured fruit bat on Obafemi Awolowo University campus.

## 2. Materials and Methods

Obafemi Awolowo University lies between latitude 7°26'N and 7°32'N and longitude 4°31'E and 4°35'E with a landmass of 5,605 hectares and at an altitude 300 m above sea level. The climate is characterized by rainy and dry seasons. The mean ambient temperature ranges from 20°C to 30°C, with a

Mean of 26°C. This annual rainforest which dries out during The harmattan while it is favoured during the rainy season. The sites used for the field observation were the Biological Sciences area, Parks and Garden area, Fajuyi hall of residence, Faculty of Arts environs.

The specimens required for morphometric analysis were obtained using mist nets and non-lethal traps baited with fruits. The collection took place from August to September, 2016 on a bi-weekly basis between the hours of 5.00 a.m. – 7.00 a.m. while observation for feeding habits was made daily between 5.00 am – 9.00 am and 5.00 pm – 9.00 pm.

The captured fruit bats were taken to the laboratory in cages, anaesthetized with chloroform, after which morphometric data of the specimens such as the length of the wing, the breadth of the wing, the wing span and the total length of the specimens were taken using a graduated meter rule. Precaution was taken to put on rubber gloves while handling the bats to prevent being bitten. Salter Weighing Machine was used for measuring the weight of bats. A pair of binoculars was used for observing the bats while feeding. The sexes of the bats were determined by checking for scrotal sacs. After all parameters had been noted, the bats were returned to their sites of capture and then released. Partly digested and undigested food items recovered from the roosting sites were identified at the Ife herbarium, Obafemi Awolowo University.

## 3. Results and Discussion

Results from the selected sites were pooled together as there was no significant difference in the parameters taken. Morphometric data of 470 bats were taken, the weight of the bats ranged between 189 and 404 g with a mean weight of 277.40 g and a standard deviation of 45.34. (Table 1). The wing length ranged from 28 to 47 cm with a mean of 34.59 cm while the wing breadth from 12 to 21 cm with a mean of 14.89 cm. The wing span on the other hand ranged from 66 to 83 cm with while the total length of the bats ranged from 16 to 20 cm.

Table 2 shows that the weight of male bats ranged from 198 to 414 g while that of the females was between 210 and 350 g (Table 3) with mean weights of 273.33 and 269.88 g, and standard error of 2.69 and 3.27 respectively. The wing length of male bats varied from 28 to 47 cm with a mean length of 43.96 cm and an error of 1.33.

Bats were observed feeding not only on fruits but also on other parts of the trees including the leaves and the bark of some trees. The plant species observed to be roosted on and sometimes fed on by the bats are shown in table 5. Feeding activity appeared to go on passively with some of the trees almost completely defoliated due to their foraging activity.

**Table 1:** Range and Mean  $\pm$  Standard Error of Observed Morphometric Parameters of the Straw-Coloured Fruit Bat.

	Range			
	N	Minimum	Maximum	Mean $\pm$ S. E
Weight (g)	470	189	404	277.40 $\pm$ 2.09
Wing Length (cm)	470	28	47	34.59 $\pm$ 0.36
Wing Breadth (cm)	470	12	21	14.89 $\pm$ 0.17
Wing Span (cm)	470	66	83	75.08 $\pm$ 0.41
Total Length (cm)	470	16	20	17.68 $\pm$ 1.00

**Table 2:** Range and mean  $\pm$  standard error of observed morphometric parameters of male straw-coloured fruit bat at the selected sites.

	Range			
	N	Minimum	Maximum	Mean $\pm$ S.E
Weight (g)	291	198	414	273.33 $\pm$ 2.69
Wing Length (cm)	291	28	47	34.96 $\pm$ 1.33
Wing breadth (cm)	291	12	21	15.55 $\pm$ 0.63
Wing Span (cm)	291	69	83	76.26 $\pm$ 0.86
Total length (cm)	291	16	20	17.29 $\pm$ 0.62

**Table 3:** Range and mean  $\pm$  standard error of observed morphometric parameters of female straw-coloured fruit bat at the selected sites.

	Range			
	N	Minimum	Maximum	Mean $\pm$ S. E
Weight (g)	179	210	350	269.88 $\pm$ 3.27
Wing Length (cm)	179	29	39	33.90 $\pm$ 1.98
Wing breadth (cm)	179	12	17	13.79 $\pm$ 0.94
Wing Span (cm)	179	66	81	73.12 $\pm$ 1.15
Total length (cm)	179	16	19	17.29 $\pm$ 0.85

**Table 4:** Analysis of variance of the morphometric data of male and female bats

	Male		Female		Anova	
	Mean $\pm$ S. E	Mean $\pm$ S. E	f	p		
Weight (g)	273.33 $\pm$ 2.69	269.88 $\pm$ 3.27	0.4081	0.8586		
Wing Length (cm)	34.96 $\pm$ 1.33	33.90 $\pm$ 1.98	0.1063	0.7754		
Wing breadth (cm)	15.55 $\pm$ 0.63	13.79 $\pm$ 0.94	0.1569	0.7351		
Wing Span (cm)	76.26 $\pm$ 0.86	73.12 $\pm$ 1.15	0.0938	0.8302		
Total length (cm)	17.29 $\pm$ 0.62	17.29 $\pm$ 0.85	0.04	0.86		

**Table 5:** Trees on which bats roosted and fed.

Common Name	Local Name	Botanical Name	Family
Flame tree/ Flamboyant	Sekeseke	<i>Delonix regia</i>	Fabaceae
Hildegardia	Okurugbedu	<i>Hildegardia diabarteri</i>	Sterculiaceae
African nutmeg tree	Lakosin	<i>Mondora myristica</i>	Annonaceae
Dracaena	Ope kanna kanna	<i>Dracaena arborea</i>	Agavaceae
African nut tree	Erin mado/ Akoko	<i>Newboldia laevis</i>	Bignoniaceae
Kola	Obi gbanja	<i>Cola nitida</i>	Sterculiaceae
Fig tree	Oba Odan	<i>Ficus lutea</i>	Moraceae
Brimstone tree	Oruwo	<i>Morinda lucida</i>	Rubiaceae
True kola	Obi abate	<i>Cola acuminata</i>	Sterculiaceae
African locust bean	Irugba	<i>Parkia biglobosa</i>	Mimosaceae
Almond tree	-	<i>Prunus amygdalus</i>	Rosaceae
Oil palm	Ope	<i>Elaeis guineensis</i>	Arecaceae
Pawpaw tree	Ibepe	<i>Carica papaya</i>	Caricaceae

Observations showed that straw-coloured fruit bats in Obafemi Awolowo University campus fed mainly on fruits, flowers and leaves of plants, similar to the reports of Marshall [25] and Wilson [21]. The bats appeared to show preference for ripened pawpaw fruit while feeding due to the more succulent nature of this plant. Bats, however, are known to be opportunistic foragers feeding on available food items. Their feeding pattern seemed stereotyped as they were observed to feed in a seemingly fixed way i.e. they opened up the fruit, ate the succulent parts and spat out the remainder of the food item as reported by Franklin [20]. They were, however, observed to feed on other fibrous fruits such as mangoes and almond. These high fiber content fruits are known to aid digestion. Bats were observed feeding on the trees on which they roost even during day time though not as actively as they do at night.

The average size of the bats observed in this study was 19 cm and this comparatively large size may be as a result of the near absence of their natural enemies and availability of food. This large size, however, makes them subject of interest to humans who sometimes hunt them for food. Roasted bats with palm wine is not an uncommon delicacy in Ile-Ife and some other Yoruba towns in Southwestern Nigeria which may not have been the case had the bats been smaller in size.

Although the larger of the bats observed in this study were males, this discrepancy in size could not be ascribed to age difference as the age of the bats were not determined. Both sexes seemed to be equally active during feeding therefore the size difference could not be attributed to the consumption of more food. However, the analysis of variance (table 4) indicated that there was no significant difference between both sexes based on the parameters taken. Although not apparent during feeding, the bigger bats would require more food than the smaller ones. Clutton-Brock *et al.* [34] provided a simple hypothesis to explain the difference in survival rates between the males and the females and opined that the greater the eventual body weight differences between males and females the more food the growing males need to eat compared with the females which needed them for their physiological requirement. The availability of food at proximal locations to the Obafemi Awolowo University campus may be responsible for the large colony and continuous availability of the bats as suggested by Hodgkison *et al.* [36] who opined that the abundance and predictability of food sources may determine the density of fruit bats that an environment can support.

Bats on Obafemi Awolowo University campus were somewhat regarded with mixed feelings because many regard them as annoying due to a few reasons such as the trees the bats roost on were located in areas that were regularly utilized as car parks and walkways which were soiled by bat excrement or even when they dropped on passersby or on parked cars. The noise made by these bats were also annoying in areas where academic activities took place. These had led to some trees being cut down to reduce roosting sites. The loss of roost trees inadvertently led to overcrowding on other available roost trees which puts more pressure on the trees by increasing the rate of defoliation and an increase in the chances that the branch will break off (due to the weight of the bats) thereby exacerbating the roosting conditions. Similar threats are faced in such other roosting sites.

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