Ecological, Behavioural and Morphometric Characteristics of the Giant Cricket (*Brachytrupes membranaceus* L.) in Oji River LGA, Enugu State, South East, Nigeria: A Prelude to Semi-intensive Rearing Technique

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ABSTRACT

Ecological, behavioural and morphometric characteristics of the giant cricket (Brachytrupes membranaceus L.) in two towns (Awlaw and Achi) within Oji River Local Government Area of Enugu State, South east, Nigeria was investigated as a prelude to develop useful technique for semi- intensive rearing of the insect in simulated environment. Five hundred metres land area was marked out around the locations where the index trees were found in the two localities using line transect and the sites were used as study sites and visited once every week for three months Mid-March to June ending. The result showed ten species of trees that act as indicators of the presence of the cricket in the two towns. The burrows for male Brachytrupes membranaceus cricket were significantly higher in number and more in depth compared to that of females, but there was no significant difference on the burrow width for male and female burrows. The female though more robust in appearance, did not show any significant difference (P>0.05) in the body weight when compared to males. Of all the morphometric parameters assessed, only the pronotum length and femur length showed significance differences (P<0.05) between the male and female records. The ecological studies showed the possibility of rearing the cricket by simulating its natural milieu of Brachytrupes membranaceus in a netted outdoor environment (enclosing male and female) under laid with sandy soil at enough depth to give room for burrowing activities of Brachytrupes membranaceus and surrounded with its cherished tree species.

INTRODUCTION

The shortage of animal protein in the diet of Nigerians and other developing countries necessitates a search for alternative animal protein sources (Ebenebe, 2005) to augment the conventional meat proteins in meeting the animal protein needs of the populace. This paucity of animal protein in many developing countries and associated nutritional deficiency disease has prompted FAO and WUR (2013)collaborative effort in promoting entomophagy as a measure to improve animal protein consumption and prevent deficiency diseases such as Kwashiokor in Sub-Saharan Africa (van Huis 2013). van Huis (2003) listed about 250 edible insect species from Africa. Seventy-eight percent of which are Lepidoptera, (30%), Orthoptera (29%) and Coleoptera (19%), and 22 percent Isoptera, Homoptera, Hymenoptera, Heteroptera, Diptera and Odonota. DeFoliart (1997) estimated the number of insect species eaten worldwide to be about 1000, of which in African countries: 30 species are consumed in Congo, 22 in Madagascar, 36 in South Africa, 62 in the Democratic Republic of Congo (D.R. Congo), and 32 in Zimbabwe. In the same vein, Ramos-Elorduy (1997)

compiled about 1391 insect species eaten worldwide, of which 524 are eaten in 34 countries of Africa representing 38% of all species consumed. Nutritional and other health benefits of edible insect have also been documented by many authors (Ekpo and Onigbinde (2004), Banjo *et al.* (2006), Ebenebe *et al.*, (2007), Edijala *et al*. (2009), Braide *et al*. (2010) and Nzikou *et al*.(2010). Amadi (2016) showed that the nutritional value of edible insect compared favourably with that of conventional meat proteins.Van Huis (2016) and Blasquez *et al*. (2012) showed that edible insects are richer in protein (60%) compared to beans (23.5%), lentils (23.5%) or soybean (41.1%). Blasquez *et al.* (2012) also showed that edible insects are higher in protein content compared to chicken (43%), egg (46%) or beef (54%), so according to them only fish (81%) surpass insects in protein content. Of the edible insects consumed in Nigeria, Ebenebe (2016) reported that *B. membranaceus* is the most preferred edible insects in Nigeria. According to them, while the Giant cricket (*B. membranaceus*) is the most preferred edible insect in the south east Nigeria, they are seasonal and mostly unavailable in some areas as the population has continued to decline due to farming practices especially tillage and use of agrochemicals. Miantsia *et al.* (2018) also observed that the population of *B. membranaceus* is declining in the wild for the same reason.

The house cricket mostly farmed by many big farms in Europe, America and Asia is not consumed in Nigeria (Pers. Obs) but *Brachytrupes membranaceus* is cherished as food in various parts of Nigeria both by young and old people. Besides, while the house cricket *Acheta domesticus* captive rearing is well documented in literature (Miech *et al*. 2016, Ayieko *et al.* 2016, Halloran *et al.* 2018), *Brachytrupes membranaceus* has not been amenable to captive management due to its unique ecological needs and behavioural characteristics. Cricket is not uncommon in the sand soil along the bank of River Niger where it burrows to the depth up to 2 m (Pers. Obs 2012 in our first Preliminary Studies). Burrows in this sandy soil are recognized by the presence of a small sandy mound. The burrows are not just vertical but involve a lot of diversion before the main gallery where one cricket lives. Büttiker and Bünzil (1958) reported that *B. membranaceus* are nocturnal and digs burrows of 50 to 80cm (20 -30 inches) deep, the burrows are dug with their mandibles and fore legs while the dug-out sand is usually pushed out in a heap at the entrance of the burrow, such mound or heap of sand might be up to 30cm in height.

There are four subspecies of *B. membranaceus* in Africa: *B. membranaceus* Colosseus, Sausure1899 (Madagascar), *Brachytrupes membranaceus* hoggarensus1941 Chopard (Algeria), 1952 (Mauritania), B.*Brachytrupes membranaceus* Drurry1770 (Kenya and Tanzania and other East African countries). *Brachytrupes membranaceus* has also been reported in Nigeria (Agbidye *et al* (2009), Okore (2014) and Ebenebe (2017)). In Nigeria the giant cricket *Brachytrupes membranaceus* is known by different names in different dialects: Apina (Eleme, Port Harcourt), Pina (Ogoni), Ediang (Ibibio), Gyare (Hausa) (Amadi *et al*. 2016) and Abuzu (Igbo) (Ebenebe, 2015).

The giant cricket (*Brachytrupes membranaceus*) has a plump brown body with a broad head, long antennae and very powerful legs (Hill, 2008). The head and body length is about 4 to 5 cm (Hill 2008) and body weight of 4.54g (Amadi 2016). Lakhdari *et al*. (2015a) reported that the weight of cricket of *Brachytrupes megacephalus* species varies with season, with the adults weighing 2.63g and in summer it weighs 3.54g. According to them, the head length of adult is 13 to 14mm and femur length17 to 22mm. Lakhdari *et al*. (2015b) observed significant difference in the head and protonium length of male and female cricket of the *Brachytrupes megacephalus.*

With regards to the nutrient composition of *Brachytrupes membranaceus*, Adeyeye and Awokunmi (2010) noted that *Brachytrupes membranaceus*is a good source of protein, carbohydrate and energy. Amadi *et al*. (2016) reported that protein content of 20.22% in *Brachytrupes membranaceus* compares favourably with that of chicken (19.80%) and lean meat (21.71%), while its fat content of 18.10% is quite higher than what obtains in chicken (7.23%) and lean meat3.80%. Agbidiye *et al.* (2009) reported protein content 35.06% and fat content of 53.05% while Adeyeye and Awokunmi (2010) reported protein content of 29.10% and Fat of 4.20%. Okweche *et al.* (2023) reported that cricket and fish recorded higher amount of protein compared with other nutrient sources. Sere *et al*. (2022) compared nutritional composition of *Brachytrupes membranaceus* and *Macrotermes subhyalinus* from Burkina Faso and showed that the two insect defatted isolates were alternative sources of minerals, proteins and essential fatty acids and so could be used to combat protein deficiency.

There is need to undertake a thorough study of the insect in their natural milieu. Such a field study should investigate the ecological, morphometric and behavioural characteristics of the giant cricket *B. membranaceus* as a prelude to simulating its natural habitat in semi- intensive enclosures so as to lure it into breeding in such enclosures.

This study was therefore aimed at discovering the ecological, behavioural and morphometrics characteristics of the giant cricket (*Brachytrupes membranaceus*) in three towns in Oji River LGA where *Brachytrupes membranaceus* is consumed in large quantities and also sold in large numbers in their local markets

Materials and Methods

i. Experimental Site

The experiment was carried out in two localities: Awlaw and Achi town, both in Oji River Local Government Area of Enugu State, Nigeria (Fig 1). Oji River is located at Latitude $06^0$16N and longitude $07^0$16 E, with altitude of 140m above sea level. The mean annual rainfall is 2000mm, while the annual temperature ranged between 26.8^0C to 32.5^0C; the average Relative Humidity is 84%. The Local government (Oji River) (Fig 2) has an area of 403km and a population of 126,587 at the last 2006 census. The major water body in the area is a fast flowing Oji river, a tributary of Anambra River which itself is a major tributary of the River Niger (Ugwuanyi. 2015). The choice of these towns as study sites was based on the fact that while the cricket is rarely seen in many localities, large quantities of *Brachytrupes membranaceus* are sold in their local markets, besides the people in the community use the crickets for special dishes on their festive occasion and in welcoming important guests.



Fig 1: Map of Enugu State Showing the Study Area (Oji River LGA)



Fig 2: Map of Oji River LGA showing the Study sites (Awlaw and Achi)

ii. Ecological Studies

a). Locating the Burrows and Harvesting of the Cricket (*Brachytrupes membranaceus)*

About 500m^2 was mapped around areas with a number of the index trees in each site using line transect. The sites were visited once every week and the number of burrows in each site recorded. On each visitation to the sites, the natives chosen as guides used the presence of identified tree species as indicators of the presence of the cricket. The burrows are usually found under such trees. Visible, unhidden burrows which the natives believed to be occupied by snakes and other burrowing animals were avoided, while burrows found by gentle scrapping of top soil with cutlass and hoe harbouring *Brachytrupes membranaceus* were counted and their depth and width measured by use of twine and measuring tape to trace the tunnel to the gallery from which *Brachytrupes membranaceus* was harvested. The method did not involve flooding of the burrow with water as described by Lakhdari *et al.* (2015c).

b). Identification of tree species

The tree species which the natives used as indicators of the cricket's presence were taken alongside with their fruits to the experts at the Department of Botany, Nnamdi Azikiwe University, Awka, Anambra State and Horticultural Department, Federal College of Agriculture Ishiagu, Ebonyi State as well as Department of Forestry and Wildlife, Nnamdi Azikiwe University, Awka. The choice of the two institutions was for confirmation of the botanical names. The natives belief were not superstitious or presumptions rather based on their indigenous knowledge that the cricket (*Brachytrupes membranaceus*) feeds on these plant species.

c). Characteristics of Male and Female Burrows

The number of burrows of male and female burrows in each site was counted and recorded. The depth and width of each burrow from which male or female cricket was harvested was measured. The measurements were also recorded and later used for computation.

iii. Morphometric Study

Upon capture, the *Brachytrupes membranaceus* were taken to Physics Laboratory at Nnamdi Azikiwe University, Awka for various morphometric measurements using a paper, Venier caliper and Sensitive scale (Camry EK 5055). The sensitive weighing scale (Camry EK 5055) was used in taking the weight of individual cricket to the nearest0.01grams. Of all the crickets cut, weight of 100 randomly selected adults which had all their parts intact were used in the statistical analysis. Linear body measurements of the 100 adult crickets taken included:

- Body length
- Width of the head
- Length of pronotum
- Femur length
- Inner wing length
- Outer wing length

All linear measurements were taken in centimeter to the nearest 0.01cm using Venier caliper

(Plate 10 -13).

iv). Behavioural Characteristics

a). Morphological features of Male and Female

The morphological features by which the male and female crickets were differentiated was also noted by visual examination of all parts of the body.

b). Noise from Male Cricket

The cricket responsible for the chirping sound in their burrow was monitored by night marking of the burrows using stuck in peg beside the burrows. The marked burrows were dug the following morning to harvest the occupant. The season of the noise was also noted.

v. Socioeconomic Studies

Oral interview was used to assess the socioeconomic values of the cricket trade as it affects household incomes. About 10 families were randomly selected in the two communities and were queried on the economic value of the business to their family life. Members of the research team also visited the local markets to interview buyers and sellers regarding the socioeconomic values of the cricket in the two communities.

vi). Oral Interview

Twenty elderly men and women were selected from the two communities and interviewed orally to elucidate information on the season of harvest of matured cricket and the nymph, behavioural characteristics of the matured cricket and nymph, uses of the cricket and nymph, exact localities of the cricket in the two communities and the reason.

RESULTS

i. **Identification of Host Plant species**

The trees identified to be associated with giant field cricket (*Brachytrupes membranaceus)* are presented in Table 1. Ten species of trees were observed in this study to be consumed by the cricket and the villagers used their presence to denote presence or absence of the cricket (Plate 1 – 6). Lakhdari (2015c) using feacal analysis reported on eight species of plants belonging to eight different families consumed by the cricket *Brachytrupes megacephalus* (*Phoenix dactylifera, Nerium oleander, Chrysanthemium, Myoporumsandwicense, Armenia maritama, Prunus armeniaca, Solanum lycopersicumm* and *Cherry fantasia*). None of the plants reported in their study was observed in this study, while *Phoenix dactylifer* (Date palm) was the only big tree they observed, all the plants recorded in this study are big trees with fruits, two of which are edible, the rest are not edible fruits.

Table1: Host Plant Species

S/N	Local Name	English Name	Botanical Name
i		Cashew	*Anacardium occidentale*
ii	Okpokolo	?	*Anthocleista vogelii*
iii	Nka/Oka/ Ahaba	?	*Achio batari*
iv	Ubele		*Mesobeteri batari*
v.	Icheku/ Cheleku/ MbaCheleku	Velvet Black berry	*Dalium guineensis*
vi.	UtoMpoma	?	?
vii	Ogodo	?	?
viii	Ububo	?	?
ix	Utu	?	?
x	Ikemuoji	?	?

? The information is still awaiting consensus agreement by experts

ii. Number of Male and Female Burrows

The total number of burrows recorded in each town and the frequency of male and female burrows recorded in the study areas are presented in Table 2. The highest number of burrows was recorded in Awlaw and the least in Achi. There was significant difference (P< 0.05) between the frequency of male burrows in comparison with that of females. More male burrows were recorded in the three towns investigated. Many authors are of the view that mating takes place in the male burrow, so the female leaves her burrow to that of the males following the males characteristic attracting chirping sound.

Table 2: Total Number of Burrows in Each locality and Frequency of Male and Female Burrows

Towns	No of Burrows	Frequency of Male Burrows	Frequency of Female Burrows	SS
Awlaw	110	59	51	
Achi	84	47	37	
∑ X	194	106	88	
X	92	53	44	SS

*Statistical Significance (**SS**): There is significant difference in the frequency of male burrows compared to female, with male cricket occurring most

iii. Mean of Burrow Dimensions

The means of burrow dimensions (width and depth) recorded in the three towns are presented in Table 3. There was no significant difference (P>0.05) in the width of male and female burrow but the male burrows were significantly (P<0.05) deeper than that of the females in all the sites. The burrow depth range of 28.62± 0.11to 40.78± 0.21 and 25.66±0.17 to36.77±0.24 for males and female (Plate 7 and 8) respectively is lower than the burrow depth range of 50 to 80 cm reported by Büttiker and Bünzil (1958) and 60 to 80cm reported by Hills (2008). Accumulation of litter made up of the leaves of their cherished vegetation in the study sites may have resulted to this shallower depth of their habitation in these three sites.

Table 3: Means of Burrow width and depth in the Three Towns (cm)

Towns	Burrow width		*S/NS	Burrow depth		*S/NS
	Male	Female		Male	Female	
Awlaw	9.17±0 .22	9.56 ±0.12	NS	28.62 ± 0.11	25.81± 0.12	S
Achi	10.02 + 0.10	9.79+ 0.24	NS	31.41 + 0.30	25.66+ 0.17	S

S = Significant, NS= Not Significant

iv. Body Weight and Morphometric Characteristics of the Cricket (*Brachytrupes membranaceus)*

The body weight and morphometric characteristics of the male and female crickets in the three sites are presented in Table 4. Although physically, the female appeared more robust, with fattier abdomen than the male, there was no significant difference (P>0.05) in the body weight of male and female crickets, but numerical value of female 3.82 ±0.66g was higher than that of males 3.66 ±0.22g. The body weight recorded is within the range of 3.54g reported by Amadi (2016) for *B. membranaceus* and 4.54g reported by Lakhdari (2015a) for *B. megacephalus.* Of all the morphometric parameters assessed, only the pronotum length and femur length showed significance difference (P<0.05) between the male and female records. Lakhdari *et al*. (2015b) also observed significant difference in the protonium length of male and female cricket of the *Brachytrupes megacephalus* species. Lakhdari *et al*. (2015ba) also reported, the head width of 1.3 to 1.4cm which is similar to 1.10 ± 0.22 and 0.90 ± 0.17cm recorded for male and female respectively but femur length of 2.76 ± 0.24 and 2.56 ± 0.20cm is somewhat higher than their record of 1.7 to 2.2cm for adult *Brachytrupes megacephalus* species of cricket.

Table 4: Body Weight and Morphometric Characteristics of the Cricket (*Brachytrupes membranaceus*

Parameter	Male	Female	S.S/NS.
Body weight (g)	3.66 ±0.22	3.82 ±0.66	N.S.
Body length (cm)	5.70 ±0.60	5.60 ± 0.60	N.S.
Head width (cm)	1.10 ± 0.22	0.90 ± 0.17	N.S.
Length of prontonium (cm)	0.74 ±0.08	0.66 ± 0.08	S
Femur length (cm)	2.76 ± 0.24	2.56 ± 0.20	S
Inner wing length (cm)	4.32 ±0.26	4.43 ±0.28	N.S.
Outer wing length (cm)	3.50 + 0.32	3.76 + 0.41	N.S.

v. Morphological and Behavioural characteristics

The male cricket has a patchy design on its wings while the female wings are smooth. The female on the other hand has a spine like stud extending from the ventral side of the abdomen, this is absent in the male (Plate 14 and 15). The crickets dug out of the burrows where chirping sound was heard at night were all male cricket. The chirping sound was made as attraction to the female.

Table 5: Socioeconomic values of cricket (*Brachytrupes membranaceus*)

Parameters	Male	Female	Remark
Cost	6-7@ N50 ($0.13)	4 - 5 @ N50 ($0.13)	Female has fatty abdomen that makes them tastier
Preference	Less preferred	Highly preferred	More flavor in the fatty abdomen of females
Average quantity caught/ Person/ Day	4- 5kg	1- 2kg	?
Ratio of Male to Female in a daily catch	2-3	1	
Mean contribution to family income	Variable , more costly towards the end of the rains, contributes more to protein needs than monetary gains		
Usage : Nymph	Caught between February to March: The nymph called "Mbisi" is mostly used for two highly cherished traditional soup " Ora and Egusi (Melon) soup		The nymph are usually found in the sandy/sandy loam soil but not under tree litter
Usage: Adult	Caught between May to early July. The matured one is called " Ebio" mainly used in eating a local dish of tapioca "Abacha" (African Salad)		Adult are usually found in the soil under the tree litter of the listed choice foods. The adult are not found under Cashew

		tree even though the cricket drags cashew leaves and fruit into its burrow
Exact Areas of Harvest	In Oji River Local Government- Akpugoeze, Inyi and Ugwuoba clayey soil and so the crickets are not found in the towns even though they cherish the cricket. People from these town purchase from local markets in Achi and Awlaw	In Awlaw three villages have crickets in large numbers because of the sandy loam and very sandy soils (AwlawIsiama, AwlawEtiti and Awlaw), In Achi the major village where crickets are found is Isikwe


Plate 1: OgodoPlate


Plate 2: Oka /NkaPlate


Plate 3:Okpokolo


Plate 4: Ubele


Plate 5: Ububo


Plate 6: Ikemoji


Plate 7: Burrow the gallery


8: Tracing the Burrow


Plate 9: Interview with a Family in cricket business



Plate 10: Femur length



Plate 11: Head width



Plate 12: Protonum length



Plate 13: Body length

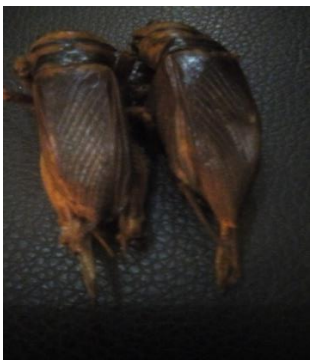


Plate 14: Female Wing with smooth vein

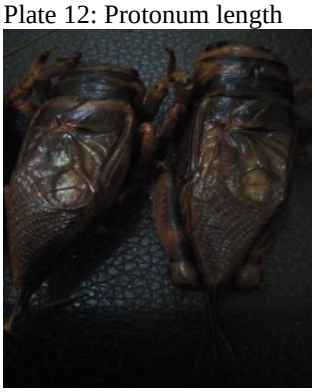


Plate 15 : Male Wing with patchy designed wing



Plate 14: Bowl of cricket for sale

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