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Diversity and Medical Care Implication of Scorpions in Hong Local Government Area, Adamawa State, Nigeria

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Abstract

A research study on Diversity and Medical Care Implication of Scorpions in Hong Local Government Area, Adamawa State, Nigeria was carried out to determine the habitat characterization of scorpions,the diversity and abundance as well as the seasonal variation and distributions of scorpion in the area under study. Despite the notoriety of scorpions envenomation, worldwide distribution, medical, ecological and conservation importance, many families and genera of scorpions are yet to be studied. In this research, effort was intensified toward identifying species diversity in the study area. The local government was divided into two zones, the northern and the southern zone. Three localities were selected from the northern zone which were Garaha, Mijili and Kwarhi and three localities were selected from the southern zone which were Kram-Hong, Dzumah and Pella in which three study sites were chosen for the collection of scorpion; the Hills Farm Land and Residential Areas. A total of four hundred and five scorpions (405) scorpions were collected across the localities. Mijili gas thes highest abundance of scorpions with 48.15% of the specimen, while Kram-Hong shows the least abundance with 2.72%. in term of species abundance ,Hottentotta hottentotta was found to more abundant with 54.54% while the least was Pandinus imperator with

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1.23%. with the respect to seasonal variation, results showed that scorpions are more available during raining season with 83.44% while dry season has the lowest abundance with 15.56%. with regard to monthly distribution, september has the highest distribution with 23.21% while January has the lowest distribution with 7.16%. The result of scorpions abundance based on the study sites shows that Hills has highest abundance with 46.17% compared with the collection of scorpions from the residential area with 23.70%. data on relative abundance of scorpions from micro habitat revealed that scorpions collected from bark of trees, under stones and pilled blocks shows highly significance difference with P <0.05 over that from garbage, crevice and gravels with lowest abundance of scorpions. In conclusion, the entire scorpions obtained were identified as indigenous species with the exception of Androctonus bicolor. Hottentotta hottentotta remains the widely distributed species found under stones, between bark of dry trees and between pilled blicks. Therefore, frequent identification and inventory of available species of scorpions and the study of this period of high occurrence would provide baseline data for risk reduction of scorpion envenomation and entomorphobia of dangerous and congeneric species.

Keywords: Scorpion diversity, Habitat characterization, Seasonal variation, Hottentotta hottentotta, Pandinus imperator

INTRODUCTION

Scorpions are amongst the most important venomous creatures in the world, specifically in tropical and subtropical regions. Each year, about 1.2 to 1.5 million individuals are stung by scorpions throughout the globe (Anderson, LA et al; 2019),, out of which three thousand to five thousands leads to death. Scorpions are more common in the arid and tropical areas including desert. Several species of scorpion are dangerously poisonous and can be lethal to human beings and other animals. Lourenço WR, Rossi A. (2016) listed 82 species of scorpions which are of medicinal importance. Out of the 82 species of medicinal importance identified by Cloudsley and Thomson, about 13 species were found in Africa (Cloudsley –and Thomson, 2015) Scorpions are a rather depauperate group within the class Arachnida with approximately 2,100 known species. They can be classified among the most ancestral arthropods both in origin and body morphology. They first appeared as aquatic organisms during the Silurian (approximately 450 million years ago – MYA) and underwent rather small morphological changes since (Jeran AJ. 2011, scort 2017). Their apparent conservative form led some authors to define the/m as 'living fossils'. However, scorpions

must have certainly developed major biochemical, physiological, behavioral and ecological adaptations that have combined to ensure their continued success over the past 450 million years (Dunlop, JA. 2018).

Scorpions can be considered fascinating animals, the interest shown by people in general is only connected with their negative reputation of 'killers of men'. Nevertheless, only a limited number of species, probably less than 50, are actually responsible for serious or lethal incidents. It is true, however, that the interest on scorpion research in many distinct biological fields was generated by the fact that a number of species possess venoms with potent toxins, capable of killing humans (Nasir, 2017, Drang, et al., 2017). Most deadly species belong to the family Buthidae; though, species belonging to two other families, Scorpionidae and Hemiscorpiidae, also threaten humans. Research has shown that several species of scorpions have been identified in Nigeria, such species includes *Babycurus neglectus* in Eastern Nigeria, *Buthus (Hottentotta) hottentotta* in the Northern Guinea Savannah, *Pandinus imperator,* (Belfield, and Toye, 2011). Other identified species include *Uroplectes xanthogrammus, Androctonus honggarens*which belong to the family Buthidae (Belfield, and Keegan, 2011). Toye (2011), reported that two scorpions' species are predominantly distributed due to their ecological requirements.*Pandinus imperator* is endemic in the forest zones of Nigeria especially in the lowland rainforests of Enugu and Ibadan while *Buthus (Hottentotta) hottentotta* is found in the Northern Guinea Savannah of Zaria. They are found in Sudan and Sahel Savannah of Nigeria. Some species of *Buthus (Hottentotta) hottentotta* are found in Jos plateau (Toye, 2012).

There are two Orders in the Class Arachnida, the Arancao (Spider) and Scorpions (Scorpions) within the Subphylum Chelicerata. Besidethe Arachnida also include the following orders: Thelyphonida (whip scorpions). Amblypygi (Tailless whip scorpions); Solifugae (wind-scorpions or camel-spider), Pseudoscorpiones (false scorpions), Opiliones (Harvestmen) and some other less important Orders. None of these minor Orders have any medical significance because they are not venomous, therefore, control is unnecessary as they provide excellent control of cockroaches (Gouge *et al*.. 2005, Knauer, et al., 2017 and Cloudsley-Thompson, 2015).

Scorpions are of medical concern not only for the severity of the envenomation but the entomophobia they cause especially where dangerous species exist (Kapka and Tibesti 2012).

Many ecological factors plays a role in Habitat selection and distribution of scorpions and the survival of the population is dependant on food, reproduction and shelter from predators and adverse climate Lourenço WR, Rossi A. (2016). Some scorpions such as, *Euscoipius* species are forest dwellers, whilst the best known scorpions, *Buthus* species and *Androctonus* species are inhabitants of dry and desert regions (Kapka and Tibesti 2012, Hendrixson, 2006).

Scorpions in the forest zones usually find shelter under loose barks of trees or logs, others creep under stones, and some inhabit burrows e.g. *Pandinus* sp (Talal, et al., 2015). Those in the Savannah zones hide mainly under stones and bricks Teruel R, Roncallo CA (2008). The colours of scorpions are determined by the nature of their environments (Terue lLA,2008). Habitats determined their colours. In Nigeria, the yellowish species are more numerous under stone, block and under log of trees. The brownish group are frequently seen between tree barks *(Butryospermum paradoxun)* and in crevices (Monod L, 2005). Scorpions live under quite different conditions of temperature and humidity. They respond to microclimatic variations and each species seem to live and reproduce within strictly limited characteristic ecological conditions. Nevertheless, scorpions have managed to survive in conditions of heat and drought largely on account of their nocturnal habits and subterranean habitats. Thus, scorpions avoid extreme temperatures and predators. Scorpions exposed to temperature above 40° C have been reported to have lost water rapidly. This is more pronounced in arid species such as *Buthus occitanus* and *Buthus (Hottentotta) hottentotta* (Monod L, 2005) whose morphological features have adapted them to withstand diverse conditions of high temperatures. This really accounted for their habitat selection (Wikipedia

org., 2005).

Scorpions are nocturnal, therefore, in the day time they hide in burrows, under stones, rock, firewood, tree barks, and crevices, outdoors, and frequent basements, closets, shoes, clothes and other quiet places indoors (Malahyde, and Prendini, 2006). One unique feature of the scorpion is the fluorescence of their cuticle under ultra-violet light when viewed at night. The Emperor scorpion *(Pandinus imperator)* fluoresces greenish-blue under ultraviolet light in the night (Big zoo, 2005). Scorpion colours range from black, brown, tan, and yellowish to red (Kapka and Tibesti 2012).

MATERIAL AND METHODS

Study Area

Hong is both a town and a Local Government Area in Adamawa State, Nigeria bh . It is located between latitude 70 and 11013'54"N and longitude 110 and 14055'49"E. Hong Local Government Area was created in 1991. Hong is bounded by Mubi Local Government Area to the East, Gombi Local Government Area to the West, Song and Maiha Local Government Areas to the South and Askira-Uba Local Government Area to the North. Hong Local Government Area has a land area of about 117,240km2 with a projected population of 226, 100 (NBS web). The area falls within Sudan Savannah zone and have a tropical wet and dry climate. Dry season last for five months (November to March) while the wet season last from April to October (7 months). The major occupation of people in the area is farming, few are traders and civil servants. The major crop grown in the area includes; groundnut, sorghum, maize, rice and millet.

Sampling Techniques

The local Government Area was divided into two Zones, the Northern and the Southern Zone. Three localities was selected in the Northern sector which will include *Kwarhi*, Mijilli and *Garaha* while in the Southern Zone, three localities was equally selected which include; Kram-Hong, Dzumah and Pella.

In each locality, three habitat was chosen for the collection of scorpion as study sites, these include the hills, farmland and the residential Area.

Procedure for Sample Collection and Safety Precaution

The following methods were employed for collection: stone rolling and wood turning, digging, turning of stacked dry grasses and leaf litter as well as active search at night using torch light, when the scorpions are most active since they are nocturnal in behavior.

Scorpions sighted on the field were sprayed with boric acid to render them unconscious, picked with forceps and immersed into a specimen sample bottle containing 70% formalin which serves as a preservative. The sample bottle was labelled with the name of the locality and the micro habitat where such scorpion was obtained.

Sample Identification

The samples collected were photographed, recorded and preserved properly. Morphological characteristics was used to identify species and their sex. These

characteristics includes arrangement of the body (Prosoma, Opisthosoma and the Sting), the shape of the sting and Pedi palps and the number of teeth on the pectins was used for the identification. Identification key used in this study is as stated and provided by Adis(2002).

Research and Experiment Design

Research is the plan, structure and strategy of investigation conceived to obtain answers to research questions control variances so that conclusion could be drawn. In this research, descriptive survey was used because the study involves determinations of the diversity and abundance of scorpions in their natural habitat.

The area under study was divided into three sites; the hill, residential area and the farmlands. Each of this study site was further subdivided into microhabitats. Scorpion captured during data collection were emersed into a specimen bottles labeled with the name of the microhabitat where they were captured in each microhabitat was obtained to determine the abundance of each study site and the microhabitat (Table 4.7).

Equally, the study period covered from the month March to August. The month of March to May was considered as the dry season whereas June to August was considered as the rainy season. Scorpions captured during each month was recorded and mode based on seasonal distribution was determined as seen in (Table 4.6)

Method of Data Analysis

The researchers make use of statistical package for social science (SPSS) VERSION 22 for the Data processing because it is more convenient, accurate and comfortable.

Data collected was subjected to analysis of Variance (ANOVA)to determine differences in terms of season, relative abundance, localities, sites and habitat. Duncan's Multiple Range Test (DMRT) was used to compare difference between means of the seasons, localities and habitat and relative abundance. Student's t-test was used to determine the significant between the sexes as well as seasonal distribution.

RESULTS

A total of 405 scorpion specimens were collected from the different localities in the study area. The scorpions collected where identified and classified into the families Buthidae and scorpionidae. From the collections 400 (98.80) scorpion specimens were classified under

the family Buthidae with 300 (75%) females and 31 (7.8%) males while 5(75%) belonged to the family scorpionidae. Two (0.5%) of the specimens from the family Buthidae belonged to the species Antroctonus bicolor while another 2(0.5%) belonged to the species Buthus occitanus. Three hundred and ninety six (97.78%) of the family Buthidae belonged to the species Hottentotta hottentotta (Table 1).

Table 2 showsthe prominent m rphometic features of identification which includes the prosomal, mesosomal and metasomal segements. The data from table 2 reveals that in Hottentotta, hottentotta, the mean ratio between prosomal, mesosomal and metasomal segments in length of the female *H. hottentotta* was 1: 1, 2: 1, 3:1 respectively while that of the male scorpion specimen was 1: l, 1:5:1, 4:1 respectively. Also, the mean difference in the length of the female metasomal and that of the male shows that there was a significant difference in ($P<0.01$)in their metasomal lengths. There was no significance difference in the lengths of the mesosomal of both sexes.

In Table 3, it shows that in *A. bicolor* the length of metasomal segment was longer than the sum length of prosoma and 1 mesosomal segment with 0.40cm and 0.60cm respectively. The mean ratio between the length of prosomal, mesosomal and metasomal segment was 1:1, 1:5:1, 4:1 respectively (Table 3).

Table 4 shows that in *Buthus occitanus* the length of metasomal. The mean ratio in these body segments were1:1, 2:1, 3:1 respectively.

Table 5 reveals that in *Pandinusimperator,* the length of the metasomal segment was equal to the sum of the lengths of prosomal, mesosomal and metasomal. Themean ratio in this body segments were 1:1, 2:1, 3:1 respectively.

The result in Table 6 reveals that Garaha locality as a rural center had the highest number of scorpions with total of 195(98.15%) compared with Pella which had the least with 9(2.22%), Kwarhi had 33(8.15%), Dzumah had 92(22.72%) scorpions collection, Kram-Hong had 11 (2.72%) and Mijili had 6 (16.05) regarded as urban center. The scorpion specimen values showed a significance difference ($P<0.05$).

Table 1: Distribution of Scorpions in Hong Local Government Area of Adamawa State, Nigeria

Families	Buthidae						Scorpiondiae		Total
Species	A.bicolor		B.occitanus		H.hottentotta		P. imperator		
Sex Localities	M%	F%	M%	F%	M%	F%	M%	F%	
Kwarhi	00(00)	00(00)	00(00)	00(00)	4(1.0)	29(7.2)	00(00)	00(00)	65(16.1)
Mijili	00(00)	00(00)	00(00)	00(00)	6(1.5)	59(14.6)	00(00)	00(00)	195(48.1)
Garaha	2(0.5)	00(00)	00(00)	2(0.5)	16(3.5)	174(43.0)	00(00)	3(0.7)	11(2.7)
Kram-Hong	00(00)	00(00)	00(00)	00(00)	00(00)	11(2.7)	00(00)	00(00)	92 (22.7)
Dzumah	00(00)	00(00)	00(00)	00(00)	5(1.2)	85(21.0)	00(00)	2(0.5)	9(2.2)
Pella	00(00)	00(00)	00(00)	00(00)	00(00)	9(2.2)			
Total	2(0.5)	00(00)	00(00)	2(0.5)	29(7.2)	367(90.6)	00(00)	5(1.2)	405

Source: direct field collection of scorpions species, 2024

Table 2: Morphometric features and sexual Dimorphism in *H.hottentotta*obtained from Hong Local Government Area of Adamawa State, Nigeria

	Female					Male					(cm)
Morphometric Features	No. collection (%)	No. month	Mean length (cm)	Standard Error	Ratio	No. of Collection	No. of month	Mean length (cm)	Standard Error	Ratio	Mean length difference (cm)
Prosomal Segment	367 (92.68)	6	0.74 ±0.07	0.07	1:1	29(7.32)	5	0.81 ±0.16	0.16	1:1	0.07
Mesosomal Segment	367(92.68)	6	1.49± 0.13	0.13	2:1	29(7.32)	5	1.22± 0.24	0.24	1:5:1	-0.27
Metasomal Segment	367(92.68)	6	2.23± 0.14	0.14	3:1	29(7.32)	5	3.24± 0.56	0.56	4:1	1.01

Source: computed values from ANOVA, 2025

Table 3: Morphometric features of *Androctonus bicolor* obtained from Hong Local Government Area of Adamawa State, Nigeria

Morphometric Features	Male			
	No of collection	No. of months	Mean Length (cm)	Ratio
Prosomal Segment	2(0.5)	1	$0.40\pm7x10^{-3}$	1:1
Mesosomal Segment	2(0.5)	1	$0.60\pm14x10^{-3}$	1:5:1
Metasomal Segment	2(0.5)	1	$1.60\pm3x10^{-3}$	4:1

Table 4: Morphometric features of *Buthus occitanus* obtained from Hong Local Government Area of Adamawa State, Nigeria

Morphometric Features	Female			
	No of collection	No. of months	Mean Length (cm)	Ratio
Prosomal Segment	2(0.5)	1	$0.37\pm3x10^{-3}$	1:1
Mesosomal Segment	2(0.5)	1	$0.73\pm7x10^{-3}$	2:1
Metasomal Segment	2(0.5)	1	$1.10\pm2x10^{-3}$	3:1

Table 5: Morphometric of features of *Pandinus imperator* obtained from Hong Local Government Area of Adamawa State, Nigeria

Morphometric Features	Female			
	No of collection	No. of months	Mean Length (cm)	Ratio
Prosomal Segment	5(1.23)	2	2.34 ± 0.13	1:1
Mesosomal Segment	5(1.23)	2	3.51 ± 0.29	2:1
Metasomal Segment	5(1.23)	2	5.85 ± 0.51	3:1

Table 6: Seasonal Variation of Scorpion Distributionobtained from Hong Local Government Area of Adamawa State, Nigeria

Seasons	**Rainy season collection of scorpion**				**Dry season collection of scorpion**			
Months	August	September	October	November	December	January	Total	Mean $\bar{X}$
LOCALIITIES								
Kwarhi	7(1.73)	9(2.22)	9(2.22)	6(1.48)	0(00)	2(0.49)	33(8.15)	2.75±1.13
Mijili	10(2.47)	15(3.70)	18(4.44)	10(2.47)	7(1.43)	5(1.23)	65(16.05)	5.42±1.18
Garaha	33(8.15)	41(10.12) *2(0.49) +2(0.49)	40(9.88)	42(10.38)	24(5.93)	15(3.70)	195(48.15) *3(0.740 +2(0.49) X2(0.49)	16.25±4.94
Kram-Hong	2(0.49)	40(0.99)	3(0.74)	(00)	(00)	2(0.49)	11(2.72)	
Dzumah	23(5.68)	22(5.43)	20(4.97) *1(0.25)	16(3.95)	7(1.73)	4(0.99)	92(22.72) *2(0.49)	7.67±1.46
Pella	3(0.74)	3(0.74)	(00)	2(0.49)	0(0.00)	1(0.25)	9(2.22)	0.75±0.48
Sub total	78(19.26)	94(23.21) *2(0.49) +2(0..49)	90(22.22) *1(0.25)	76(18.77)	38(9/38)	29(7.16)		
					Total dry	**67(16.54%)**	**TOTAL 405**	
Total rainy	**338 (83.46%)**							

Key: without symbol = *H. hottentotta;*= *P. imperator,* +=*B. occitanus*

Scorpions Collected from different Study Sites

1. Hills

A total of 173(42.72%) scorpion specimens were collected under the stone microhabitats. *H.hottentotta* had the highest number of 171 (42.2%). *A.bicolor* was 1(0.25%) and also 1(0.25%) for *B. occitanus* in Mijili. It was observed that the collection from under stones had the highest collection of crevices with 4(0.99%) and 10(2.47%) respectively (Table 7).

2. Farmlands

Four different scorpion genera were collected from this study site. A total of 96(23.70%) scorpion specimens were collected from this study sites. Barks of dry trees had the highest number with 64 (15.80%) over the scorpion collections from under dry grasses and old rodent holes with 27(6.67%) and 5(1.23%) scorpion specimens respectively. A total of 89(21.97%) collections of *H.hottentotta* recorded the highest over *A.bicolor* with 1(0.25%) and *B.occitanus* with 1(0.25%) from the family Buthidae. *Pandinus imperator* from the family scorpionidae was the only species collected from old rodent holes (see Table 7)

3. Residential Areas

The species *H.hottentotta*122 (30%) was the only species collection from residential areas. Piledblocks had 74(18.30%), the highest collection of *H.hottentotta* over the 37(9.14) collection from firewood and garbage with 11(2.72%). Therefore, the ANOVA showed that there was no significant difference (P<0.05) in terms of scorpions relative abundance between the study sites (Table 8)).

Hills shows the highest with 187(46.17%) compared with collection of scorpions from residential area and farmland which were 122(30.12%) and 96(23.70%) respectively (Table 9).

The data on relative abundance of scorpion collected in the microhabitats revealed that, scorpion specimens collected from the barks of dry trees, under stones and piled blocks showed highly significant difference (P.<0.05) over that from garbage, crevices and gravels with the lowest scorpion specimens (Table 10).

Table 7: Relative Abundance of Scorpions in Various Microhabitats in Hong Local Government Area Adamawa State

Study site		Hill			Farmland		Residential Areas				
Microhabitat	Under stones	Between gravels	Between crevices	Between barks trees	Under dry leaves	Old rodent holes	Piled blocks	Piled fire wood	Garbage	Total	%
Kwarhi	11(2.7)	(00)	(00)	5(1.23)	2(0.49)	(00)	9(2.22)	4(0.99)	2(0.49)	33	8.15
Pella	21(5.19)	(00)	3(0.74)	11(2.72)	6(1.48)	(00)	15(3.70)	6(1.49)	3(0.74)	65	16.05

Mijili	96(23.70) +1(0.25) *1(0.25)	4(0.99)	6(1.48)	19(5,19) *1(0.25)	12(2.96) +1(0.25)	*3(0.47)	24(6.93)	22(5.43)	5(1.23)	195	48.15
Kram-Hong	4(1.99)	(00)	(00)	2(0.49)	1(0.5)	(00)	4(0.99)	(00)	(00)	11	2.72
Garaha	36(8.89)	(00)	(00)	23(5.68)	6(1.48)	*2(0.49)	19(4.69)	5(1.23)	1(0.25)	92	22.72
Dzumah	3(0.74)	(00)	1(0.25)	2(0.49)	(00)	(00)	3(0.74)	(00)	(00)	9	2.22
Total	**173(42.72)**	**4(0.99)**	**10(2.47)**	**64(15.80)**	**27(6.69)**	**5(1.23)**	**74(18.27)**	**37(9.14)**	**11(2.72)**	**405**	**100**
Mean $\bar{X}$	**28.8**	**0.67**	**10.67**	**10.67**	**4.50**	**0.83**	**12.33**	**6.17**	**1.83**	**67.50**	**7.50**
SE±	**14.70**	**0.67**	**3.84**	**3.84**	**1.82**	**0.54**	**3.44**	**3.33**	**0.79**	**30.12**	**13.45**

Key: without symbol = *H. hottentotta;* *= *P. imperator,* += *B. occitanus*

Table 8: Two ways ANOVA showing Differences in scorpion collection in term of seasonal variation

Source of Variance	DF	MS	F.VALUE	P>VALUE
Seanson	1	0.1750	0.01	0.9372N
Localities	5	411.13	14.72	< 0.0001*
Season/Localities	5	33.47	1.20	0.3211NS
Error	60	27.93		
Corrected total	71			

Significant difference (P>0.05)

NS No Significant difference (P>0.05)

Table 9: Scorpions' Relative Abundance from different Study Sites in Hong Local Government Area of Adamawa State

Study site	Microhabitats	Number of scorpions (%)	Means
Hill	18	187(46.17)	10.39±5.45 [a]
Residential areas	18	122(30.12)	6.78±1.91 [a]
Farmlands	18	96(23.70)	5.33±2.52[a]

Means in the same column with the same letter are not significantly different (P>0.05)

Table 10: Scorpions relative Abundance from different Microhabitats Across Hong Local Government Area of Adamawa State

S/No.	MICROHABITATS	NUMBER OF MICROHABITATS	NUMBER OF SCORPION (%)	MEANS
1.	BARK, STONE, BLOCK	18	311(76.79)	17.28±7.33[a]
2.	LEAVES, Gravel, Wood	18	68(16.79)	3.78±1.94[b]
3	Hole, crevice, garbage	18	26(6.42)	1.44±0.77[b]

Means in the same column with the same letter are not significantly different (P>0.05)

Seasonal Distribution of Scorpions in the Study Area

The result obtained depict that scorpions are mostly abundant during the raining season with the total of 338(83.46%) while the dry season recorded the lowest abundant of scorpions with the total of 67(16.54%). With the regard to the monthly distribution, results shows that November had the highest abundance with the total of 98(24.20%), while March recorded the lowest with the total of 29(7.16%) (Table 11).

Seasonal Distribution of Scorpion by Sex

The data obtained from table 11 and 12 shows the total number of female and males *H. hottentotta* collected throughout the year. A total of 229 (56.54%) of *H. hottentotta* was recorded during rainy season. Female specimens collected were 200 (49.38%) while the male specimen were 29(7.16%) during the rainy season. A total of 167 (41.23%) of female

specimens of *H.hottentotta* was collected during dry season. (Table 11 and 12).

The total number of scorpions collected throughout the seasons revealed that female*H.hottentotta* was significantly higher ($P < 0.01$) than male specimens of *H.hottentotta* Table 11and 12)

Table 11: Monthly abundance of *H. hottentotta* during the rainy season in Hong Local Government Area of Adamawa State

Month	Female (%)	Male (%)	Total
August	74	4	78
September	82	12	94
October	83	7	90
November	70	6	76
Total	309	29	338
Se ±	28.6±40	5.8±2.0	32.7±46

Table 12: Monthly Abundance of *H. hottentotta*During the Dry season in Hong Local Government Area of Adamawa State

Months	Female (%)	Male(%)	Total
December	29(7.16)	00	29(7.16)
January	38(9.38)	00	38(9.38)
Total	67(16.54)	00	67(16.54)
Se ±	334±11	00	334±11

DISCUSSION

Identification of scorpions from Hong Local Government Area.

The predominant families of scorpions collected were Buthidae and scorpionidae. Hong Local Government seemed to favour the distribution and survivorship of these scorpions' families. This conforms to the work reported by Vachon (2012) Cloudsley-Thompson (2012), Keegan (2018) Cheng *et al.* (2015), Prendini (2013) and Wikipedia org.

(2014), that these families are old world general that are abundantly distributed throughout the tropics within latitude 50°N and 50°S of the equator. The result of the morphological identification of scorpions collected revealed the preponderance of the family Buthidae over scorpionidae. This agreed with the findings of Toye (2011) that scorpions of the family Buthidae are more abundant in the Northern Guinea Savannah and Sahel Savannah of Nigeria. The abundance of the family in this bio geographical zone (Hong Local Government) could be governed by interaction of suitable ecological factors such as the climate, geology and vegetation (Lamoral, 2014). The bio geographical zone exhibits characteristic woodland and geological formation of highlands from cretaneous sediments and basement complex that provided suitable hide outs for the members of this Family (Buthidae).

The study also revealed the low occurrence of *Androctonus bicolor* and *Buthus occitanus* in all the study areas. *Androctonus bicolor* was reported as non-indigenous species, but an inhabitant of Egypt, Israel and Jordan (Keegan, 2017). Therefore, the presence of *Androctonus bicolor* in this study sites may be due to the fact that scorpions can be found outside their biogeographical range of distribution, possibly when they accidentally crawl into luggages, boxes, containers or shoes and are unwillingly transported via luggage's, if not, they are range resistant (Bush 2013: Cheng *et al*.., 2015 and Prendin, 2016) that *Buthus occitanu* showed low occurrence from the study sites, this may be attributed to the young ones liable to predatory' attack immediately after birth, thereby reducing their population before attaining maturity. This agrees with the report of Keegan (2019), and Prendin (2016) that *Buthusoccitanus* do not possess birth basket' after birth and are exposed to attacked by predators. *Buthus occitanus* was reported in indigenous species of Nigeria by (Toye 2011).

Androctonus bicolor and *Buthus occitanus* were identified by the possession of less and short trichobothria on their walking legs as well as their body. This conforms to the findings by Keegan (2018). Therefore, their low population may be attributed to the less trichobopththria on their body and walking legs that reduce the sensitivity of these genera to easily detect their predators as well as food. Generally, scorpions do not see well, but rely on the sense of touch, using pecties and trichobothria for navigation and hunting therefore, they are easily preyed upon. This agrees with the reports by Cloudsley and Thompson (2012) and Keegan 2018 that trichobothria are sensory bristles on the predipalps for detecting foreign bodies, environmental changes and predators.

The study revealed that *Hottentotta hottenttotta* showed its preponderance over other species and was widely distributed throughout the study area. It was also reported to be the most widely distributed and abundant species in the Guinea Savanna and Sudan Savanna of Nigeria (Toye, 2011). This may be attributed to the possession of some morphological features such as trichobothria and pectines and suitable ecological factors such as climate, geology and vegetation. The possession of long and numerous trichobothria was observed on the walking legs and pedipalps of these species*Hottentotta hottentotta* and *Pandinus imperator*. The possession of the features may be an advantage to their abundance over other identified species collected from the study sites. This agrees with the report by Cloudsley and Thompsopn (2012) and Keegan (2019) that since scorpions are nocturnal animals, trichobothria on the pedipalps possesss tacties sensillum, which response to vibrations and proprioceptive function (respond to internal stimuli) thereby providing means of defense even during the day time. The result revealed that *Pandinus imperator* was the only species obtained from the family scorpionidae in the Southern guinea Savannah of Garaha and Dzumah localities. This could be attributed to suitable climate condition (with mean temperature not exceeding 40°c), vegetation cover (woodland) and humid soil that permit burrowing. This agrees with the findings of Vacon (2012), Toye (2011), Lamoral (2007). Keegan (2018) and Prendini (2016) that *Pandinus imperator* are pelophilous organisms that is they are chelicera burrower. So they can burrow deep into soil from under stones or debris. It was observed that *Pandinus imperator* possesses larger pedipal with strong fingers. This morphological features enhance the degree of morphological burrowing activities. This confines them to new burrows or old burrows dugged by rodents. This agrees with the reportsof Toye (2011), Lamoral (2012), Keegan (2018) and Prendin (2016) that *Pandinus imperator* activities in other to avoid adverse climatic conditions. Also they are confined to the rainforest and Southern Guinea Savanna of Nigeria, therefore, regarded as forest zone species Toye, (2017).

The result of the study reveals that, the metasomal segment shows morphometric features of sexual dimorphism in male scorpion specimens that are longer and thicker than those in female species. This confirm with the reports of Cloudsley and Thompson (2012), Keegan (2018), Arkive (2015), Emperor (2015), Wikipedia org. (2016), Stockwell (2018), Wilson (2008) and Wikipedia org. (2009) that male metasomal segment are larger than the female metasomal segment since they are longer and thicker than the female metasomal segment. This could be attributed to numerous activities carried out by male metasomal

segment over the female metasomal segment. These include deliberate and prolong 'sexual sting' to sub-due female, entwining the tail with female mate's tail during 'courtship' and 'mating ritual' to effect gamete transfer Cloudesley and Thompson (2012), Keegan (2018), Arkive (2015) and Wikipedia (2009).

Pectinal length was also observed to be longer in male scorpion specimens with higher number of fulcra teeth than in the female scorpion specimens this coupled because of the number of functions performed by pectines in male. This agrees with the findings of Keegan (2018) and Arkive (2015) that male pectines perform numerous functions during 'matting ritual 'as they are used as chemoreceptor for identification of prey, suitable substrate and female mate as well as sweeping the suitable substrate for deposition of spermatophore. Also a female scorpion specimens that have large belly or mesosoma close to ground possess shorter pectines, while in males, the small mesosomal segment that stands high upon their legs possesses pectines exceedingly long (Cloudsley and Thompson (2021) and Stockwell (2018)).

Scorpions Collected from Different Microhabitats

The result also revealed scorpions to be predominant on hills than the residential areas and farmlands. This may be attributed to the movement of scorpions to maintain high altitude in case of high moisture. This is because scorpions' pectines are located underneath the belly which does not require water or high moisture as it is scorpion's external respiratory organism (Mazzotti and Bravo-Becherelle (2017), Cloudley-Thompson (2016) and Wikipedia org (2015).

The higher occurrence of scorpion specimens from under stones in the hill study sites, could be because, it provides a suitable hide out for other arthropods, for example crickets which are reported to be the palatable food for scorpions, as scorpions don't hunt for their prey, but wait for them under stones, barks of trees or crevices (Cloudsley-Thompson; 2016; Emperor, 2015 and Prendini, 2016).(Crevices, gravel, rodent holes, piled firewood, piled grasses and garbage) could be attributed to scorpions avoidance to predators, high moisture and extreme temperature. Scorpion species such as *Hottentotta hottentotta*, *Pandinus imperator* and *Buthus occitanus*) exposed to temperature above 40^{o}C have been reported to have lost water rapidly. This is more pronounced in and inhabitants (Toye (2011) and Prendini (2016)). The geology of the land surface in Nigeria and human

activities is the strong determinants of the breeding and distribution of most arthropods (Anene, 2014)

Seasonal variation and distribution of scorpion in Hong Local Government Area

The results of the study on the variation of scorpion sexes with seasons revealed that female scorpion specimens were in higher survival rate over the male during adverse climatic conditions. This conforms to the work reported by BlogSpot (2018) that, female scorpions have larger hepatopancreas compared to male specimens and females also have higher rates of water mobilization during desiccation, thereby tolerates adverse conditions over male scorpion specimens.

The abundance of adult's scorpions of both sexes in June is because it is part of the period of (April, May, June) onset of rainy season which is also regarded as scorpion migratory or mating period. This conforms to the findings of Warburg and Ben-Horin (2014) and Prendini (2013) that, scorpions avoid high moisture, therefore move to higher altitudes during the period of high moisture in the lowland or hibernate in case of cold weather and avoid feeding.

The higher relative abundance of scorpions in November which is the onset of harmattan, with high number of nymphal stage of scorpions collected conformed the description of this period as breeding period of scorpions (Cloudsley-Thompson (2012), Warburg-Ben-Horin (2016), Keegan (2018) and Wikipedia org. (2015).

Summary

The study is basically on habitat characterization and identification of scorpions of medical importance in some areas of Hong Local Government. The research aimed at providing base line data for scorpions' identification using scorpion standard identification keys. Most of the scorpions collected are *Hottentotta hottentotta*, *Androctonus bicolor* and *Buthus occitanus* which belong to family Buthidae, *Pandinus imperator* belong to the family scorpionidae was also collected. All the scorpions collected were indigenous species except *Androctonus bicolor* which might have been brought from the Middle East. *Hottentotta hottentotta* remains the predominant species collected and they lived under stones, between bark of dry trees and between piledblocks as their potential hide outs. Seasons have an

impact on scorpions' distribution in that, increase in moisture reduces scorpions' availability as they avoid high moisture. Also increase in temperature within optimal range increases scorpions' availability and abundance.

CONCLUSION

In conclusion the entire scorpions obtained were identified as indigenous species with the exception of *Androctonus bicolor*. *Hottentotta hottentotta* remains the most widely distributed species found under stones, between bark of dry trees and between piles blockss. Therefore, frequent identification and inventory of available species of scorpions and the study of this period of high occurrence would provide baseline for risk reduction of scorpion envenomation and entomorphobia of dangerous and congeneric species.

Recommendations

Further study on scorpions' biogeographical study and identification of available species in other parts of the country would provide base line knowledge for up to – date inventories of scorpions' diversity.

The study on Nigeria scorpion morphology, anatomy, taxonomy and cytogenetic identification features will fine tune the specific identification features and might lead to identification of new species or speciation.

Further study on scorpion venoms as well as scorpion biology will provide practical application in campaign against scorpion sting

Frequent identification of the available species will reduce the entomorphobia and provide means to check out the effect of the presence of *Androctonus ausralis*, *Centruroides exillicauda, leiurus quinquestraitus* and some of the congeneric species.

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