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A PRELIMINARY STUDY OF SCORPION DIVERSITY IN OGIDI, IDEMILI NORTH LOCAL GOVERNMENT AREA, ANAMBRA STATE

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ABSTRACT
Knowledge of arthropod diversity in the Ogidi rain forest zone of the southeast Nigeria is scarce. In the study of invertebrates, scorpions are among the poorly investigated of animal diversity, which are one of the oldest terrestrial groups on the planet. In spite of their obvious medical importance we know less about scorpions than other arachnids. A study of reconnaissance and habitat survey was conducted to determine the diversity of scorpion species and the ecological factors that support their abundance and constancy dominance in Ogidi, Idemili North local government area of Anambra state, Nigeria. Five sample site designated "A" to "E" were mapped out for the study using the Global Positioning System (GPS). This study was carried out both in dry and rainy seasons. Samples were collected by Stone Rolling and Wood Turning, Digging ,Turning of Stacked Dry Grasses and Leaf Litter and Active Search at Night using Torch Light. A total of 63 scorpions belonging to one family Buthidae, three genera and three species were recorded. This study shows that *Buthus occitanus* 32(50.8%), *Hottentotta bilura* 24(38%), and *Androctonus bicolor* 7(11%) were the most dominant species in the rain forest zone of Ogidi. The highest diversity was recorded in *Buthus occitanus*, followed by *Hottentotta bilura* and least *Androctonus bicolor*. This study of diversity will spark off more studies on their biology and economic importance.

Keyword;- ***Diversity, abundance Ogidi , Preliminary and Scorpion*.**

Introduction
Biodiversity or biological diversity was coined by naturalists who were concerned about the rapid destruction of natural environments (Lévêque & Mounolou, 2008). Thus the awareness of the impact on destruction of natural environments and threats on biological resources, researchers proceeded to the study of sustainability and the conservation of these natural heritages. In the study of invertebrates, scorpions are among the poorly investigated of animal diversity, which are one of the oldest terrestrial groups on the planet. They have a wide distribution, and are excellent biological models to be explored (Polis, 1990).
The order Scorpiones is a distinctive group of arachnids including the oldest fossils in the class, dating back to almost 433–438 million years ago.(Dunlop, 2013). Currently more than 1,500 species of scorpions, distributed in 18 families, are described worldwide (Prendini & Wheeler, 2005). They are found in different biomes and habitats which includes forests, grasslands, and high mountains, and caves (Predini 2005).

Biodiversity conservation in this region is hindered by the lack of sufficient orientation on the need to have an ecosystem impact assessment plan, and the realization that each component of the ecosystem (including the scorpions) have a function in the overall functioning of the ecosystem. Scorpions are distributed worldwide except in Antarctica, the boreal areas and some oceanic islands (Prendini, 2005). In general, scorpion species distributions depend on a range of climatic and environmental variables such as temperatures, rainfall, elevation, slope aspect, soil properties, vegetation type and land cover (Polis, 1990; Prendini, 2005). Their natural habitat is in the northern hemisphere to the geographical latitude of 52 degree and in the south to the geographical latitude of 50 degree. Although they are not as morphologically diverse as spiders and mites, the order comprises nearly 2,231 species in 208 genera and 20 families [Predini, 2011], Protection of local biodiversity is further threatened by the scarcity on ecological data on native species, particularly invertebrates, so the actual richness of terrestrial arthropod species is likely to be underestimated. Also, observations on the ecology and geographical distribution of cryptic species, such as scorpions, frequently lack empirical support. Considering that the composition of arachnid assemblages can be influenced by the degree of human activity and also by the size of forest fragments (Miyashita *et al*. 1998, Shochat *et al.* 2004).

The possession of the feared sting has also deeply robbed the scorpions of their "*deserved recognition"* in most arthropod researches and projects. And funny enough the scorpions have refused to vanish. It is sad that very little is mentioned of them as other arthropods, especially in Nigeria. Many other countries like US have gone far to recognize possibilities that these scorpions may have positive medical importance, as have been reported in the development of the tumor paint**,** and development of anti-cancer drugs. (The MICAD Research Team, 2004). Realization of opportunities in the study of scorpions will help to raise awareness and further accord recognition to the feared arthropod. This study of diversity will spark off more studies on their biology and economic importance.

Materials and Methods

Description of study area.

The study was carried out at Ogidi, Idemili north local government area of Anambra state, Nigeria. It lies below 300m above sea level and between latitude 6, 9^{o}N, and longitude 6,52^{o}E (distancesto.*com*) in the tropical rainforest zone of Nigeria and experiences two distinct seasons (dry and wet) brought about by the two predominant winds in Nigeria: the Southwestern monsoon winds from the Atlantic Ocean (rainy season) and the Northeastern dry winds from across the Sahara desert (dry season). The area has an average rainfall of 2169mm and temperature of 27-30^{o}c between June and December but rises to 32-34^{o}c between January and April, with the last few months of the dry season marked by intense heat. The topography within 2 miles of Ogidi contains only modest variations in elevation, with a maximum elevation change of 358m and an average elevation above sea level of 420 m.(climate-data.org)

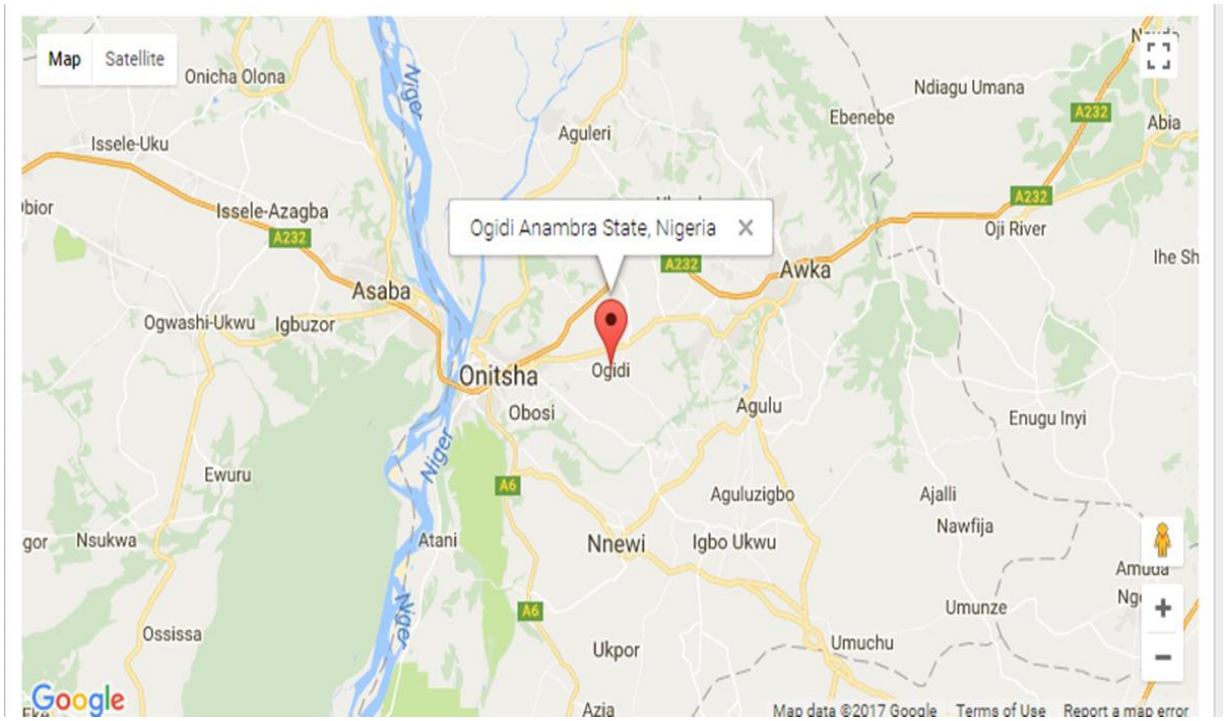

FIG1; MAP SHOWING THE LOCATION OF OGIDI ON THE MAP OF ANAMBRA STATE, NIGERIA.

Reconnaissance Study

A preliminary study was undertaken using the Global Positioning System (GPS) to determine the various possible habitats where the scorpions could be collected as in Ayadiuno and Sunday (2010). . The following ten different micro-habitats were encountered namely, (1) stones on hilltops (2) scrub-land with stones, (3) Stacks of grasses and leaf litter(4) croplands , (5) grassy hilltops with stones, (6) black soil in orange orchards, (7) under packed logs of wood, (8) hill slopes with boulders, (9) plantain plantations and (10) heaps of stony rubble.

Experimental Design

The area for study was mapped out in relation to the reconnaissance study above, and the following major areas marked A, B, C, D and E for the study. In each of the five microhabitats/sites investigated, habitat description were recorded. A: Ugwuoma area, This is a large compound, with gardens and houses ,B: Ilo-igwodo area, comprises a large area with small bushes, debris, wood piles and stone heaps, C; Akpakaogwe area- is a large fenced compound with a large open field, and bushes, Tree stumps and leaf litter, D: The farmlands and forest area- this is a typical forest zone, with grasses, trees, leaf litter, and rock surfaces. E; Timber/wood shops at Nkwo ogidi market, by Ugwu Nwasike, Ogidi. The study was carried out in both dry and rainy seasons, between November 2016, and July 2017.

Collection of Sample

Methods used in the sampling/collection was based on the ecological behavior of the scorpions. The arachinids, been that they are not homogeneous in distribution and their preference to hibernate in microhabitats. The following methods were employed for their collection, Stone Rolling and Wood Turning ,Digging ,Turning of Stacked Dry Grasses and Leaf Litter and Active Search at Night using Torch Light when the scorpions are most active (nocturnal). The collected samples were placed in arthropod sample bottles containing 90% alcohol and marked to distinguish the different sites and preserved .

Identification

The samples collected were photographed, recorded and preserved properly for theirmorphological characteristics which includes arrangement of the body (Prosoma, Opisthosoma and the sting), the shape of sting and pedipalps and the number of teeth on the pectine were used for the identification. The arachinid

identification key used in this study is as stated and provided by Kovarick 2012. The identification to species level was as in Fekri, *et al*.,. (2012).

Statistical analysis

Simpson's index of diversity was used to calculate the diversity of the scorpions
$D = \Sigma n (n - 1)/ N(N - 1)$ where N = the total number of organisms of all species and n = the total number of organisms of particular species from which Simpson's Diversity Index, 1 – D, is found. To overcome the problem of the counter-intuitive nature of Simpson's Index, the reciprocal of the Indexes were also taken Simpson's Reciprocal Index 1 / D. Constancy was calculated as follows: $C = (p \times 100)/N$, where C = constancy in % for each species; p = number of sites in which the species is present; N = total number of sites. Species were classified as constant (when present in > 50% of sites), accessory (present in 25% to 50%) or rare (<25% of sites). Dominance was calculated following Palissa *et al*. (1979) as D% = (i/t) X 100, where: i = abundance of species A and t = total abundance. In this case, species were classified as eudominant (when dominance was higher than 10%), dominant ($5\% < D \leq 10\%$), subdominant ($2\% < D \leq 5\%$), recessive ($1\% < D \leq 2\%$) or rare ($D < 1\%$).

Results

A total of 63 scorpions were captured during the study which was carried out in both rainy and dry seasons. The results of the study were recorded with regards to the month, period (rainy season and dry season), number and the sites of collection as represented in the tables below.

From the table above, out of the 63 scorpions caught from the different sites, dry season had the highest number of 34 while 29 were caught in the rainy season. In terms of the different sites, site E(19) had the highest collection for both the dry season and rainy season followed by site A (12), B (12), C (12) and the least in site D (8)

TABLE 1: Showing the number of scorpions caught and the location within the period of study.

Periodmonth		Site/location						
		A	B	C	D	E	Total	
Dry season i	October	1	1	4	1	1		8
	November	2	2	1	2	4		11
	December	1	0	1	0	3	5	
	January	1	2	1	0	2	6	
	February	0	3	0	1	0	4	
Total		5	8	7	4	10	34	
Rainy season	March	1	2	2	1	2	8	
	April	3	1	2	0	1	7	
	May	3	0	1	0	3	7	
	June	0	1	0	2	2	5	
	July	0	0	0	1	1	2	
Total		7	4	5	4	9	29	

TABLE 2: SHOWING THE DIFFERENT SPECIES ENCOUNTERED AND THE NUMBER CAUGHT WITH THEIR ABUNDANCE IN THE SITES.

SPECIES	SITE A	SITE B	SITE C	SITE D	SITE	TOTAL
ABUNDANCE%						
Hottentotta bilura 7	3	3	1	10	24	38.0
Buthus Occitanus 3	9	8	4	8	32	50.8
Androctonus bicolar 2	0	1	3	1	7	11.0
TOTAL	**12**	**12**	**12**	**8**	**19**	**63**

From the table above, it could be observed that *Buthus occitanus (*50.8%*)* had the highest abundances and *Androctanua bicolor* (11%) recorded the least.

TABLE 3: SHOWING THE DOMINANCE VALUES OF THE SPECIES IN THE SITES.

	DOMINANCE %				
SPECIES	**SITE A**	**SITE B**	**SITE C**	**SITE D**	**SITE E**
Hottentotta bilura	12	75	66.7	50	42.1
Buthus Occitanus	16.7	0	8.3	37.5	5.3
Androctonus bicolor	*16.7*	*0*	*8.3*	*37.5*	*5.3*

The Buthus *occitanus* registered the highest dominance in site C, but the other sites registered a higher dominance of Hottentotta *bilura*. the least dominance was found in Androctonus *bicolor* for all the sites with no record in site B.

TABLE 4: SHOWING THE DOMINANCE AND CONSTANCY OF THE SPECIES IN THE SITES.

	DOMINANCE %				
SPECIES	**SITE A**	**SITE B**	**SITE C**	**SITE D**	**SITE E**
CONSTANCY %					
Hottentotta bilura.	Eudominant	Eudominant	Eudominant	Eudominant	Eudominant 100 constant
Buthus Occitanus.	Eudominant	Eudominant	Eudominant	Eudominant	Eudominant 100 constant
Androctonus bicolor.	Eudominant	rare	Dominant	Eudominant	Dominant 80 constant

From the above table 4 *Hottentottabirula*and and *Buthus occitanus* were eudominant in all the sites, while the *Androctonus bicolor* was eudominant in sites A and D, dominant in sites C and E and rare in site B. All three species were constant.

DIVERSITY

D

TABLE 5: SHOWING THE SIMPSON'S DIVERSITY INDEX AND RECIPROCAL INDEX FOR THE SITES SAMPLED

SITE	SIMPSON'S INDEX	SIMPSON'S RECIPROCAL INDEX
A	**0.6**	**2.5**
B	**0.4**	**1.7**
C	**0.5**	**2**
D	**0.7**	**3.3**
E	**0.6**	**2.5**

TABLE 6: SHOWING THE OVERALL DIVERSITY OF THE SCORPION SPECIES OBTAINED

SPECIES	NUMBER	n(n-1)
Hottentotta bilura	24	552
Buthus Occitanus	32	992
Androctonus bicolor	7	42
TOTAL	**63**	**1586**

$D = \Sigma n (n - 1)/ N(N - 1)$
=1586/63(62)
=1586/3906
=0.4
Simpson's Reciprocal Index 1 / D= 2.5

DISCUSSION AND CONCLUSION

Out of 63 scorpions caught, 34 were caught in the dry season while 29 were caught in the rainy season (Table 1). The difference in the number could be as a result of microclimatic conditions and shelter availability. More scorpions were found between the months of October and March (Table 1) while the other months recorded lower presence. According to Selmane *et al,* 2014 ,there is strong negative correlation between scorpion occurrences and relative humidity. The climatic conditions of the rainy season in this area are characterized by high relative humidity which would cause a decline in scorpion activities. This corroborates the work of Chowel *et al, 2005, and* Selmane *et al , 2014* whose studies confirmed the increasing activity of scorpions with increasing temperature. The dry season obviously had the higher sunshine hours and consequently higher temperature, thereby favouring scorpion activities as witnessed by the figures obtained in Table 1. The 63 scorpions caught belonged to one family Buthidea with three species *Hottentotta bilura, Buthus occitanus,* and *Androctonus bicolor.*

According to site, the number of scorpions collected was highest in site E (19) Table 2, but the highest abundance was recorded for the *Buthus occitanus* (50.8%), followed by the *Hottentotta bilura*(38%) and the least being the *Androctonus bicolor* (11%) Table2. The overall species diversity and Simpson's reciprocal index had ahigh diversity index (0.4) and (2.4) respectively (Tables 5 and 6) showing that Ogidi has diverse scorpion species. This could be as a result of *Buthus occitanus* adaptation to varied microhabitat and environmental conditions as presented by the area of study. The abundance of *Buthus occitanus* also could be due the forest, stone heaps, leaf litters, wood piles and timbers which created suitable crevices for them to avoid desiccation. A calculation of their dominance also showed that the Buthus *occitanus* had the highest dominance among the three species, followed by the *Hottentotta bilura* and *Androctonus bicolor* was rare (Table 3) . Their dominance varied though, depending on the environmental conditions of the sites, but the analysis above gives a general overview. *Buthus occitanus* and *Hottentotta bilura* registered dominance in all the sites, but *Androctonus bicolor* was dominant in sites A, C, D, E and no record in site B (Table4). This could be as a result of the sites having a common microhabitat types with nearly a homogenous environmental conditions.

Conclusion

This study on scorpion diversity within ogidi has provided information on the various scorpion species that could be found within Ogidi and environs and Anambra State in general. This study has also provided a template for further studies on the diversity of scorpion species ,their biology and economic importance in Anambra and Nigeria in general.

Recommendations

Following the results of this study, the following are suggested:

1. Further studies into the medical, and economic importance of these scorpions should be encouraged so as to give them their deserved recognition in the study of arachnids
2. Scorpion reserves should be established,where the scorpions can be kept in their natural habitat, away from peoples homes, this would ensure that the scorpions, apparently facing dangers of extinction would be conserved.

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