THE FIRST NATIONAL INVENTORY OF SPIDERS (ARANEAE) IN NIGERIA

[1]NWANKWO, Ogonna Daniel and [2]EWUIM, Sylvanus Chima

[1]Department of Entomology National Museum of Natural History, Smithsonian Institution, Washington DC, United State of America.

[2]Department of Zoology, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

Corresponding Author: Nwankwo, O. D. Department of Entomology National Museum of Natural History, Smithsonian Institution, Washington DC, United State of America. **Email:** ogdan.nwankwo@gmail.com **Phone:** +00-1-571-325-6082

Received: *February 19, 2019* ***Revised:*** *March 15, 2019* ***Accepted:*** *March 19, 2019*

ABSTRACT

The first inventory of Nigeria spiders was a combination of a field study carried out in Awka, south-east zone and collation of data on Nigeria spiders from experts across the globe. The sampling work in Awka was the second spider study in south-east and was done once a month for twelve months. A total of 238 species, 140 genera in 34 families were recorded from Nigeria in the present study. This is 2.4 % of the world spiders from 19 locations. No spider related research has ever taken place in the whole of north-west zone, while just a single species, Hersilia caudata recorded from the north-east zone. Salticidae was the most dominant family representing 35.0 % of the total species in Nigeria. It is also the most distributed alongside Araneidae and Sparassidae. They were found in four of the six zones of the country. Out of the 15 families that were exclusive to different zones, Nesticidae, Oxyopidae and Gnaphosidae were from Awka. Only eight out of the 34 families in Nigeria were not found in the south-west zone making south-west the most diverse in terms of population and diversity. Also, with six different locations, South-west stood as the most studied zone in Nigeria. It could be concluded from the result that very little is known of Nigeria spiders due to very little work done so far. Finally, the findings of this study provide a comprehensive data on Nigeria spiders.

Keywords: Spider species, Salticidae, Nesticidae, Oxyopidae, Gnaphosidae, Araneidae, Sparassidae

INTRODUCTION

Nigeria measures 1,200 km from east to west and 1,050 km from north to south. The country's topography ranges from lowlands along the coast and in the lower Niger valley to high plateaus in the north and mountains along the eastern border. Much of the country is laced with productive rivers. Nigeria's ecology varies from tropical forest in the south to dry savanna in the far north, and drought induced desert in the farthest north, yielding a diverse mix of plant and animal life. According to Platnick (1999), spiders appear to be good subjects for studying biodiversity patterns. Their distribution and occurrence are strongly influenced by habitat structure and vegetation parameters (Buddle *et al.,* 2000; de Souza and Martins, 2004). The Nigerian vegetation zones are illustrated in Figure 1.

Nigeria is divided into six geopolitical zones with three zones each to both the north and southern Nigeria. Due to the prevailing tropical climate conditions, the vegetation is divided into four types (tropical rainforest including the Mangrove, Guinea Savannah, Sudan savannah and Sahel savannah). Alpine climate or highland/mountain climate, are also found on highland regions in Nigeria.

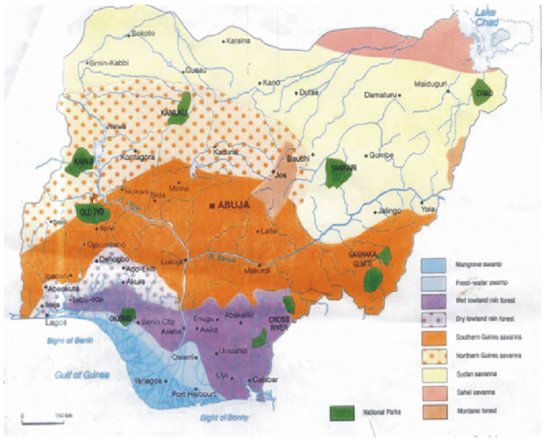

Figure 1: The map of Nigeria showing the different vegetation across the country (Source: FGN, 2002)

Some of these highlands include Adamawa highlands in the north-east, Mambilla Plateau, Jos plateau, both in the North central. It is also important to note that due to the prevailing effects of Sahara desert on the extreme north, the northern tip of Nigeria is already experiencing desertification. However, from the tropical rainforest to desert through grasslands and urban centres, etc., spiders are found to inhabit all terrestrial habitats may be due to their large populations and diversities. Platnick (2005) stated that spiders form one of the largest groups of invertebrate animals nearing 40,000 known species. According to the world spider catalog, the figure stands at 47,476 presently. These species are distributed worldwide, according to Dippenaar-Schoeman and Jocque (1997), spiders occur in all continents except Antarctica, and are found in every conceivable terrestrial habitat, including caves, snow-covered tundra, high mountains and intertidal zones. One species, *Argyroneta aquatica*, has even adopted an aquatic lifestyle.

Based on the facts mentioned above, it is believed that spiders inhabit all the terrestrial landscapes of Nigeria, across the six geopolitical zones. Most of the zones are covered by at least two vegetation types except the south-south that is mostly rainforest. With similarities in plant cover in some zones, similar, spider populations are expected and also diversity in population is also expected due to diversity in vegetation cover in some other zones. Unfortunately, no spider collection or studies ever reported from the north-west zone with more states and landmass. While, only *Hersilia caudate* in the family Hersiliidae has been collected from the north-east. This one time collection was done by E. S. Ross and K. Lorenzo in 1966 at Damaturu (Foord *et al*., 2011).

The lack of recent information on Nigeria spiders necessitated both the need for new collections and collation of the very few data on Nigeria spiders in order to build an up to date and comprehensive data on Nigeria spiders. Hence, the present study on the spiders of Nigeria intended to show the exact taxonomical groups represented in Nigeria and their distributions. It will also serve as the first national inventory on the Nigeria spider fauna.

MATERIALS AND METHODS

Alongside both published and unpublished data on Nigeria spiders collected from arachnologists all over the world, data from 12 months field collections, carried out in Awka south-east zone in Nigeria. The collection took place between April 2012 and March 2013. The collection was done using three different sampling methods; pitfall trapping, sweep netting, beating and hand picking. The investigation was carried out in four different study sites inside Nnamdi Azikiwe University, Awka. The sites include cultivated farmland, fallow plot, marshy and forest habitats. Awka is the capital of Anambra State of Nigeria and located in the lowland rain forest zone of southern Nigeria (Keay, 1961; Charter, 1970). Awka is located between latitude 5° and 6° 25 and longitude 7°E and 8°E with the town stretching for 8 km in an east-west direction along the Enugu-Onitsha expressway and about 5 km in a north-south orientation. The town is about 12,007 hectares in dimension.

Sampling for spider was carried out in four different habitats; forest, fallow plot, cultivated plot and marshy plots once every month.

(a) Forest: The forest habitat is located behind the physical and biological science general laboratories. The forest lies between N6°15'13.3848 and E7°6'55.4473 and it represent a typical rainforest because of its ability to remain evergreen all through the year. With both canopy trees of different layers and epiphytes /climbers the forest is dense in structure.

(b) Fallow plot: The fallow plot lies between Anglican and Roman Catholic chapels and beyond. It stretches from Sir Emeka Offor road to the first study site (Farmland). It lies between N6°14'35.5632 and E7°7'26.868. The land has been fallow for few farming seasons and has undergone repeated bush burning in few occasions, but there was no incidence of bush burning throughout the study period.

(c) Farmland: The farmland is situated behind Anglican and Roman Catholic Chapels, off Sir Emeka Offor road. It lies between latitude N6°14'35.5632 and E7°7'28.1352. The farmland is directly behind the fallow plot and behind it is uncultivated and developed land. Cassava was the main crop on the farmland.

(d) Marshy land: The site is situated at the back of Law Faculty, in-between the Faculty of Law and new Art Faculty. This third study site stretches from the tarred road leading from Bank Avenue/Admin block to the student hostels and is subject to flooding most part of the year. It's located between N6°14'48.2568 and E7°6'55.5732. Bamboo tree was the dominant plant on this site.

The following persons provided data on Nigeria spiders; Tony Russell-Smith, Judy Jocque and Ansie Dippenaar-Schoeman, that constituted the secondary data used in this study.

Identification of the spiders: The identification was done at the Smithsonian National Museum of Natural History, Washington DC, United States of America.

Data Analysis: Data were entered into Microsoft® Excel 2007 (Microsoft Corporation) and percentages of the populations and distributions of the families calculated.

RESULTS AND DISCUSSION

Diversity and Distribution: A total of 238 species, 140 genera in 35 families was recorded in the present study and this represents the current spider biodiversity of Nigeria (Table 1). This is 2.4 % of the world spider compared to South Africa 4.8 % of the world fauna; 71 families, 471 genera and 2170 species according to Dippenaar-Schoeman *et al.* (2015). Nineteen (19) families, 40 genera and 24 species were caught during the sampling period in Awka. The families encountered include Araneidae, Clubionidae, Corinnidae, Ctenidae, Eutichuridae, Gnaphosidae, Lycosidae, Nesticidae, Oxyopidae, Pholcidae, Pisauridae, Salticidae, Sparassidae, Tetragnathidae, Theridiidae, Thomisidae, Uloboridae, and Zodariidae. Only three of these families from Awka were new to Nigeria. They are Gnaphosidae, Oxyopidae and Nesticidae, while 47.0 % of the total families from other parts of Nigeria were absent in Awka.

Though there have been few collections and studies of spiders of Nigeria origin, the northern zones have been the worst with north central slightly better than other two northern zones. There are fourteen families presently recorded from the north central zone. But it's more worrisome due to the fact that all these families and species representing north central came from Jos in Plateau State alone. This again showed how poorly sampled the north central is. This was not too different from the southern zones where only few locations were sampled.

In summary, 20 families from south-east, 25 from south-west, 11 from south-south, 13 families from north central and just one from north-east. According to Dippenaar-Schoeman *et al*. (2013), out of the 2026 known species in 71 families, South Africa has 1230 species in 62 families recorded from savannah biome.

Table 1: Spider diversity of Nigeria, with total number of families, genera and species present in Nigeria

S/N	Family	Genus	Species	Zones
1	**Agelenidae**	1	1	SE,SW
2	**Araneidae**	10	26	NC,SS,SW,SE
3	**Atypidae**	1	1	SW
4	**Cithaeronidae**			SW
5	**Clubionidae**	1		SE,SW
6	**Corinnidae**	7	12	SW,SE,NC
7	**Ctenidae**	2	4	NC,SW,SE
8	**Cyatholipidae**			SW
9	**Erasidae**			SW
10	**Eutichuridae**	1	7	SE,SW,SS
11	**Lycosidae**	4	6	SW,SE,SS
12	**Gnaphosidae**	3	7	SE
13	**Hersiliidae**	1	3	NE,NC,SS
14	**Linyphiidae**	19	30	SW,SS
15	**Mimetidae**			SW
16	**Miturgidae**	1	1	NC
17	**Nesticidae**			SE
18	**Oecobiidae**	2	2	SW,NC
19	**Oonopidae**	4	3	SW
20	**Oxyopidae**	2		SE
21	**Philodromidae**	2	2	NC
22	**Pholcidae**	4	5	SE,SW,SS
23	**Pisauridae**	4	4	NC,SW,SE
24	**Salticidae**	38	83	SW,SE,SS,NC
25	**Selenopidae**	1	4	NC
26	**Sicariidae**	1	1	SE
27	**Sparassidae**	2	3	NC,SS,SE,SW
28	**Telemidae**	1	1	SW
29	**Tetragnathidae**	3	3	SS,SE,SW
30	**Theraphosidae**	3	3	SS
31	**Theridiidae**	7	5	SE,SW
32	**Thomisidae**	8	13	SE,SW,NC
33	**Uloboridae**	3	3	SW,SS,SE
34	**Zodariidae**	4	6	SE,SW,NC
Total		**140**	**238**	**5**

Three hundred and eight (308) of these 1230 spider species are endemic. Similarly, the zones with mostly savannah vegetation in Nigeria are the most dominant in terms of spider diversity. These zones with mostly savannah dominated vegetation also had the most number of endemic families.

South-east with 3 endemic families, south-west with 5 and north-central with 2 against a single endemic family from the south-south. Report of a total of 19 locations in 14 states, 5 out the 6 geopolitical zones sampled so far is presented (Table 2).

Table 2: Locations of spiders across the zones sampled in Nigeria

S/N	South-south	South-east	South-west	North-central	North-east	North-west
1	Oguta	Awka	Ibadan	Jos	Damaturu	
2	Benin city	Nsukka	Idanren	Zaria		
3	Calabar		Ile-ife	Mokwa		
4	Obudu		Oyo	Borgu		
5	Bamenda		Ondo			
6			Lagos			

Family Diversity: Atypidae, an endemic family from south-west was collected from a bush (grassland) in IITA Ibadan (Russell-Smith, 1981). Only two male were collected during the sampling. Dippenaar-Schoeman *et al*. (2013) stated that the African purse-web spiders (Atypidae) are very rare and two species are known from South Africa, from a few isolated localities. One species, *Calommata meridionalis* (Fourie *et al*., 2011) known from the grasslands and only male is known while the second species *C. transvaalica* occurs in savannah and both sexes are known. The Atypidae species of Nigeria is *Calommata simony* (Fourie *et al*. 2011) and only two male recorded from grassland also.

Cithaeronidae is a small family with just two genera, Inthaeron (Platnick, 1991) found in India and Cithaeron (Cambridge, 1872) found in Africa, Australia, India and Greece according to Jocque and Dippenaar-Schoeman (2006). This Cithaeronidae was found in south-west Nigeria, Ile-Ife precisely but unfortunately could not be identified beyond family level. The distribution of this small family in Nigeria suggests a great potential for greater spider diversity in Nigeria. Cyatholipidae and Erasidae like Cithaeronidae were found in Ife-Ife, and could not be identified beyond family level. Again like its distribution in South Africa, they were also found in the savannah regions of Nigeria. The other families found in Ile-Ife, South-western Nigeria is Mimetidae (pirate spider) which was not also identified beyond family level. Though a relatively small family with 12 genera and 156 species (Platnick, 2005), Mimetidae has a worldwide distribution and is represented by two genera, *Mimetus* (Hentz, 1832) and *Ero* (Koch, 1836) in the savannah biome of South Africa.

Most of the families reported from Ile-ife were from a study done by Oyewole and Oyelade (2014). Their inability to go beyond family identification was due to lack of expertise in spider taxonomy.

Oonopidae and Telemidae were the other families endemic to the south-west. Though some of the information on Nigeria spiders received from arachnologist outside Nigeria do not have the location on them as seen from Table 1, however it may be fair to assume that they are mainly from the south-west since most work on Nigeria spiders were done there. Only one (*Nephilia*) out of two genera found in grassland biome of South Africa were recorded from grassland/savannah vegetation of Nigeria. In the other hand, Oonopidae represented in four genera and species were all recorded from Ibadan, south-west Nigeria. All the *Antoonops iita* (Fannes and Jocque, 2008) in Nigeria were collected from riverine woodland, the rest were collected from the grassland. Jocque and Dippenaar-Schoeman (2006) in their observation of oonopids stated that they are free-living, nocturnal ground dwellers, found in a variety of habitats ranging from forests to deserts.

Only one species of Telemidae, *Cangoderces cameroonensis* (Baert, 1985) was recorded from Ibadan and interestingly, this family was not represented in either the grassland or savannah biomes of South Africa according to Dippenaar-Schoeman *et al*. (2013). Only two families are endemic to south-east zone of Nigeria and they are Nesticidae and Sicariidae. The fact that Nesticidae was not represented in either grassland or savannah biomes of South Africa confirmed why it was only present in the marshy habitat in Awka. Jocque and Dippenaar-Schoeman (2006) stated

that Nesticidae often inhabit dark places and are found in caves. This defines some of the features of the marshy habitat in Awka where this *Nesticella* sp. was collected. *Loxosceles reclusa* (Odo *et al.,* 2015) was the species of Sicariidae present in Nsukka, south-east Nigeria. The violin spider is a free-living ground dweller found under stone and bark.

Miturgidae, Philodromidae and Selenopidae were the endemic families of north-central and Jos precisely. As at 2007, Miturgidae was only found in Middle East, Australia, New Zealand, North and South America. *Syriscalongi caudate* (Lessert, 1929) could be the first record of Miturgidae from Africa. However, it is important to note that the genus *Cheiracanthium* which is common to Africa was originally in Miturgidae before it was moved to Eutichuridae. Philodromidae a worldwide family was represented in Nigeria by two genera and species, while Selenopidae was represented by four species in one genus, which has distribution in most continents of the world. These families are found exclusively in Jos.

Apart from one female *Hersiliacaudate* (Audouin, 1826) in the family Hersiliidae collected in one sampling attempt from Damaturu, north-east zone, no other sampling work was done there. Araneidae, Salticidae and Sparassidae were the most widely distributed families in Nigeria with distribution in the four out of the five zones where study had been done. According to Stefan *et al.* (2011), Salticidae is an important family that dominates in all ecosystems. It is a family with worldwide distribution with a wide variety of habitats. A total of 83 species in 38 genera constituting approximately 35 % of the whole spider species recorded from Nigeria. This was in line with Wesolowska and Russell-Smith (2011) which stated that the Salticidae is the most diverse spider family in the Afrotropical region with over 900 species described to date. However, only 250 species of jumping spider have been recorded from West Africa (Wesolowska and Russell-Smith, 2011). This is a dominant family in Nigeria. Araneidae was the third dominant family in terms of species diversity after Linyphiidae, with 9 genera and 22 species. It also has a worldwide distribution, occupying a wide range of habitats. Sparassidae though has a relatively worldwide distribution and also widely distributed in Nigeria but was only represented in 2 genera and 3 species. These represent poor species diversity in Nigeria when compared to the other widely distributed families in Nigeria. With distribution in only two zones, Linyphiidae was the second most diverse family after Salticidae, 30 species in 19 genera. It has been reported by Scharff and Gudik-Sørensen (2006) that Linyphiidae occurs worldwide and is particularly well represented in the temperate and cooler regions of the northern hemisphere.

Out of 238 species recorded in Nigeria, only 40 species were not endemic to a particular zone. In agreement with Stefan *et al.* (2011), this high level of endemicity could partly result from the low inventory levels within and beyond the borders of these zones and Nigeria at large. Out of the 24 families represented by more than one species, four were all represented in one genus each. Eutichuridae is one of these four families with seven species in the genus *Cheiracanthium* (Koch, 1839) is primarily and old world genus, with many species found from northern Europe to Japan, from Southern Africa to India and Australia.

Conclusion: The outcome of this pioneer work on the first inventory on Nigeria spiders has shown that only very little information is available on Nigeria spiders due to very few work done on it in Nigeria. This poor information on Nigeria spider could be attributed to lack of interest on spiders by researchers. According to Butt and Beg (2011), fewer discoveries were made on invertebrate because researchers see it as a less important organism. It also provide the exact and current species richness and distribution of spiders in Nigeria as shown in table 1. This inventory has also revealed that there are so many habitat types in Nigeria that are yet to be surveyed with their high potentials for greater diversity including the prospect of new species. Odo *et al.* (2015) in their work on checklist of spider fauna in Nsukka, south-eastern Nigeria concluded that university of Nigeria Nsukka is a good habitat for spiders as a result of habitat

characteristics and diverse geographical features. It is worthy of note that this study in Nsukka is the first and only work on spiders in the whole of south-eastern Nigeria before the present study. The result of this work has opened up the need for a consistent nationwide survey to establish a better picture of Nigeria spider and their distribution across different habitats in different zones. Spiders inhabit the ground, underground tunnels system, under stones and near water. Some spiders live on the seaside where they are sunken into the sea twice a day. Freshwater is also the territory for many species including the water spider (Karren, 2002). This will not only help to provide the true data on Nigeria spider fauna but will be of great benefit to the conservation managers.

ACKNOWLEDGEMENTS

We are grateful to Hannah Wood (National Museum of Natural History, Washington DC, USA) for allowing us work on this material. Tony Russell-Smith, Rudy Jocque and Ansie Dippenaar-Schoeman for supplying us secondary data on Nigeria spiders. Special thanks to Uche Nnadozie, Chibuike Obi, Emmanuel Nwankwo, Arthur Obi for their help during the field collection.

REFERENCES

AUDOUIN, V. (1826). Explication sommairedes planches d'arachnides de l'Egypte et de la Syrie publiées. *In: Description de l'Egypte, Histoire Naturelle*, 404 illustrations t7, f8, Paris, France.

BAERT, L. (1985). Telemidae, Mysmenidae and Ochyroceratidae from Cameroon (Araneae). Scientific report of the Belgian Mount-Cameroon expeditions 1981 and 1983. *Biologisch Jaarboek-Dodonaea (Belgium),* 53: 44 – 57.

BUDDLE, C. M., SPENCE, J. R. and LANGOR, D. W. (2000).Succession of boreal forest spider assemblages following wildfire and harvesting. *Ecography*, 23(4): 424 – 436.

BUTT, A. and BEG, M. A. (2001). Description of two new species of spiders of the families Clubionidae and Oxyopidae from Pakistan. *Pakistan Journal of Zoology*, 33: 35 – 37.

CAMBRIDGE, O. P. (1872). General list of the spiders of Palestina and Syria: with descriptions of numerous new species and characters of two new genera. *Proceedings of the Zoological Society of London*, 40(1): 212 – 354.

CHARTER, J. R. (1970). *Vegetation Ecological Zones*. Federal Department of Forest Research, Ibadan, Nigeria.

DESOUZA, A. L. T. and MARTINS, R. P. (2004) Distribution of plant dwelling spiders: inflorescences versus vegetative branches. *Austral Ecology*, 29(3): 342 – 349.

DIPPENAAR-SCHOEMAN, A. S. and JOCQUÉ, R. (1997). *African Spiders, an Identification Manual*. Biosystematics Division, ARC-Plant Protection Research Institute, Pretoria.

DIPPENAAR-SCHOEMAN, A. S., FOORD, S. H. and HADDAD, C. R. (2013).*Spiders of the Savanna Biome of South Africa.* University of Venda and ARC–Plant Protection Research Institute, Pretoria.

DIPPENAAR-SCHOEMAN, A. S., HADDAD, C. R., FOORD, S. H., LYLE, R., LOTZ, L. N. and MARAIS, P. (2015). South African National Survey of Arachnida (SANSA): review of current knowledge, constraints and future needs for documenting spider diversity (Arachnida: Araneae). *Transactions of the Royal Society of South Africa*, 70(3): 245 – 275.

FANNES, W. and JOCQUE, R. (2008). Ultrastructure of antoonops, a new, ant-mimicking genus of Afrotropical Oonopidae (Araneae) with complex internal genitalia. *American Museum Novitates,* 3614: 1 – 30.

FGN (2002). *Atlas of Nigeria.* Federal Government of Nigeria (FGN). Page 158. *In:* ADEKANMBI, O. H. and OGUNDIPE, O. (2009). Mangrove biodiversity in the restoration and sustainability of the Nigerian natural environment. *Journal of Ecology and Natural Environment*, 1(3): 064 – 072.

FOORD, S. F., DIPPENAAR-SCHOEMAN, A. S., HADDAD, C. R., LOTZ, L. N. and LYLE, R. (2011). The faunistic diversity of spiders (Arachnida: Araneae) of the Savanna Biome in South Africa. *Transactions of the Royal Society of South Africa*, 66(3): 170 – 201.

FOURIE, R., HADDAD, C. R. and JOCQUÉ, R. (2011). A revision of the purse-web spider genus *Calommata* Lucas, 1837 (Araneae, Atypidae) in the Afrotropical region. *ZooKeys*, 95: 1 – 28.

GERTSCH, W. J. and MULAIK, S. (1940). The spiders of Texas. I. *Bulletin of the American Museum of Natural History*, 77: 307 – 340.

HENTZ, N. M. (1832). On North American spiders. *Silliman's Journal of Science and Arts,* 21: 99 – 122.

JOCQUÉ, R. and DIPPENAAR-SCHOEMAN, A. S. (2006). *Spider Families of the World.* 2nd Edition, Royal Museum for Central Africa, Tervuren, Flemish Brabant, Belgium.

KARREN, J. B. (2002). Spiders. Utah University, Utah, USA.

KEAY, R. W. J. (1961). *An Outline of Nigerian Vegetation.* Federal Ministry of Information, Lagos, Nigeria.

KOCH, C. L. (1836). Deutsche crustacea, myriapoda, arachnida. *Fasc*, 1: 1836.

KOCH, C. L. (1839). Deutschlands crustaceen, myriapoden und arachniden. *Regensburg*, 5(25): 22.

LESSERT, R. (1929). Araignées du Congo recueillies au cours de l'expédition organisée par l'American Museum (1909 – 1915). *Troisi ème Partie Revue Suisse de Zoologie,* 36: 103 – 159.

ODO, G. E., AGWU, E. J., EKEH, F. N., EKECHUKWU, E. N., OSSAI, N. I., EZEA, C. O., MADU, J., ENEJE., V. and UGWU, F. (2015). Checklist of spider fauna in Nsukka, south-eastern, Nigeria. *Academia Journal of Biotechnology,* 3(5): 069 – 078.

OYEWOLE, O. A. and OYELADE, O. J. (2014). Diversity and distribution of spiders in southwestern Nigeria. *Natural Resources*, 5(15): 926 – 935.

PLATNICK, N. I. (1991). A revision of the ground spider family Cithaeronidae (Araneae, Gnaphosoidea). *American Museum Novitates*, 3018: 1 – 13.

PLATNICK, N. I. (1999). Dimensions of biodiversity: targeting mega diverse groups. Pages 33 – 52. *In:* CRACRAFT, J. and GRIFO, F. T. (Eds.). *The Living Planet in Crisis: Biodiversity Science and Policy.* Columbia University Press, New York.

PLATNICK, N. I. (2005). *The World Spider Catalog, Version 5.5*. http://research.amnh.org//entomology/spiders/catalog81-87/index.html

RUSSELL-SMITH, A. (1981). Seasonal activity and diversity of ground-living spiders in two African savanna habitats. *Bulletin of the British Arachnological Society*, 5(4): 145 – 154.

SCHARFF, N. and GUDIK-SØRENSEN, O. (2006). Catalogue of the spiders of Denmark (Araneae). *Entomologiske Meddelelser,* 74: 3 – 71.

STEFAN, C. J., MANFORD, A. G., BAIRD, D., YAMADA-HANFF, J., MAO, Y. and EMR, S. D. (2011). Osh proteins regulate phosphoinositide metabolism at ER-plasma membrane contact sites. *Cell,* 144(3): 389 – 401.

WESOLOWSKA, W. and RUSSELL-SMITH, A. (2011). Jumping spiders (Araneae: Salticidae) from Southern Nigeria. *Annales Zoologici,* 61(3): 553 – 619.