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Distribution and Abundance of Spider Fauna in Zaria Local Government Area, North West, Nigeria

Isa, I., Ahmad A.I., Kamba, B. Aminuwa, Hyelamada
Department of Zoology, Faculty of Life Sciences, Ahmadu Bello University, Zaria, Nigeria

Abstract

Spiders are among the most diverse arthropod groups of organisms. This study investigated the distribution and abundance of spiders in five locations in Zaria Local Government Area of Kaduna State, Nigeria. The study was conducted for five months, from April to August, 2018. Samples were collected twice each month using vegetation beating, trapping using bottle and handpicking methods. The abundance of each species of spider identified was expressed in percentages while diversity was revealed using Shannon-Wiener diversity index. A total of 217 spiders were collected from all the study locations which belong to 14 families, 24 genera and 28 species. The study locations differ in terms of vegetation, topography and habitat structures. Family Lycosidae was found to be the dominant family which include four genera and five species, followed, by Agelenidae, Amaurobidae and Gnaphosidae which have a species proportion of 10.7% each and 3 species abundance. Area II (Tudun Serika) the most diverse, with 60 spiders collected in this area, belonging to 11 families, 18 genera and 19 species. Area IV was the least in terms of spider species diversity and abundance with only 12 spiders, belonging to four genera and four families. *Cesonia bilineata* had high dominance index of 1.315. There is need for proper documentation of spider species available in Nigeria.

Keywords: Spider, diversity, species, abundance, dominance, Nigeria.

INTRODUCTION

Spiders belong to the class Arachnida and order Araneae. Like all arachnids, spiders have just two body parts, a cephalothorax and an abdomen. The abdomen is soft and unsegmented while the cephalothorax is hard and includes the eight legs that characterize spiders. Arachnids lack wings and antennae (Oyeniyi and Oyeseyi, 2014). Spiders form a diverse group of invertebrates in many different ecosystem and they are known to be sensitive indicators of environmental change (Hodge and Vink, 2010). Spiders are one of the most diverse groups of organisms, occupying seventh position in the world in terms of species diversity. They consists of about 44,906 species belonging to 3,935 genera and 115 families worldwide (Anindita *et al.*, 2017). They are successful in terms of

*Correspondence email:
ibrothe1983@gmail.com

diversity and abundance, and achieved this success as a result of their higher adaptability, morphology and behavioural uniqueness which help them to inhabit virtually all habitats (Mithali and Pai, 2018).

Despite this numbers of spiders, their study has always remained largely neglected. Generally, Arachnids are important although, poorly studied group of arthropods (Mansoor *et al.*, 2015). Spiders are endemic to every continent except Antarctica. Being predators, they also control and regulate the population of other insects, such as house fly (Russell-Smith, 2009). Spiders are also easy to note and capture by relatively cheap deployable techniques (Dippenaar-Schoeman *et al*., 2015) but they differ significantly in habitat preferences, hunting strategies, active period and in their physiological tolerances. Thus, temperature and humidity are two important limiting factors for their microclimatic preferences (Dippenaar-Schoeman *et al*., 2015). The changes in vegetation parameters quality and disturbances of habitat are better monitored with the knowledge of spider diversity studies.

The diversity of spiders in the ecosystem is influenced by several factors (Larrivee and Buddle, 2010). The change of the ecosystem from a tropical forest to a plantation area and a settlement will affect the diversity of spiders living in the ecosystem. The decrease of the vegetation diversity in the tropical forest will lead to the decrease of the diversity of spiders. On the other hand, the structure and complexity of an ecosystem will also increase the abundance of spiders (Koneri and Nangoy, 2017). Several abiotic factors like seasonal changes and temperature as well as biotic factors like prey availability and their own guild-specific responses influence occurrence of spiders in different environments. Studies have been conducted to explore reasons for spider fauna variation and it was revealed that urbanization is one of the main causes of biodiversity loss in spiders, as they found that rural houses had higher species richness than urban houses (Sumangala, *et al.*, 2018). Spiders prefer habitats that are protected from heat, ease of place for attaching their web, a safe for the nest or web to avoid destruction as well as places that can maximize their time while searching for the prey (Koneri and Nangoy, 2017). Therefore, this study seeks to evaluate the species diversity and abundance of spiders in Ahmadu Bello University (ABU) main campus and its environs.

MATERIALS AND METHODS

Study Location

The study area was Zaria Local Government, Kaduna State, Nigeria. Zaria is located within the coordinates Latitude 11°08’55’’N and Longitude 7°71’99’’E in northern part of Nigeria (Aminu, 2014). The study was conducted in ABU Main Campus and its environs, which included five different locations within Zaria Local Government.

Sampling Site

The five sampling stations within Zaria, were Goruba, Tudun Sarki, Hayin Liman, Koreye, and ABU Main Campus. These areas were labeled Area I, II, III, IV and V respectively (Table 1).

Table 1: Spider Sampling Areas and the Coordinates of the Locations

Area	Name of the Location	Latitude	Longitude
I	Garuba	11°10`39.43``N	7°54`29.09``E
II	Tudun Sarki	11°13`18.05``N	7°65`80.01``E
III	Hayin Liman	11°11`48.65``N	7°63`50.51``E
IV	Koreye	11°15`42.05``N	7°65`32.09``E
V	ABU Main Campus	11°15`05``N	7°65`32.09``E

Source: Field Suvey

Area I – Goruba: This is an extremely dry area located in relatively higher elevation than the rest of the site. The common vegetation cover of the area comprises of shrubs and trees. Shrubs are the dominant vegetation (Bello and Musa, 2016).

Area II – Tudun Sarki: This area is located in relatively lower altitude and the vegetation of this area is more complex than that of area I. It comprises of grass, shrubs and trees. The trees dominate the vegetation of the area (Bello and Musa, 2016).

Area III – Hayin Liman: This area is more of open land and relatively dry area located on a plain land. Trees are less pronounced with few shrubs (Bello and Musa, 2016).

Area IV – Koreye: This area is located at the lowest altitude compared to the rest of the sampling areas. It is characterized by relative moisture with irrigation practices occurring in the area. Grasses, shrubs and trees are well represented in this area but shrubs dominate the vegetation (Bello and Musa, 2016).

Area V – ABU Main Campus: This is the Main Campus of ABU that is characterized by tall buildings interspersed by tall trees and grassland.

Sample Collection

Purposive sampling method was used for the selection of locations and habitat. Samples were collected twice each month for five months, from each site in each sampling visit starting from April to August, 2018. The samples were collected using bottles and handpicked with hand gloves. Size, sex and maturity were not considered during sampling of the spiders. Basically four different techni-ques were deployed to capture the specimen depending upon its habit and habitat.

Vegetation beating and bottle jar trapping: Empty Bama bottles measuring one litre were used to trap ground dwelling spiders chased out of their hide out using a stick to beat up the vegetation of the area to expose the spiders that hide within the vegetation of the environment and empty bottle was used to trap the escaping spiders. On every sampling day, spiders that are running away are trapped using the bottles and then handpicked into the white polythene bags.

Active Search and Hand picking: Spiders were searched thoroughly in each of the sampling location for the period of this study. It was carried out using visual search under rocks, logs, within crevices and underground debris which servds as spiders' hiding places. Searching thoroughly under barks of fallen trees and stumps were done and the spiders living in such niches were exposed and captured. Gloves were worn on hands to capture the spiders.

Aerial hand collection: The spiders were searched from the knee height to the top of the vegetation cover and handpicked according to the method of Anindita *et al.* (2017).

Household Goods: All hide outs of the spiders within human habitation were actively searched and collected.

Identification

Spiders collected were taken to the laboratory for identification using spider taxonomic keys of Wegner (2014) and Hussein *et al.* (2015). Dissection stereo-microscope microscope (×40 magnification) was used to view the diagnostic characteristics of the spiders. However, some species could not be identified. Spider specimens were stupefied using formalin and placed in a Petri dish and observed under the dissection stereo microscope.

Statistical Analyses

Abundance of spider species was expressed in percentages, while Shannon-wiener diversity index was used to evaluate the diversity of spider in the study area. Analysis was done using the equation; $H = \sum_{i=1}^{s} (Pi * \ln Pi)$ and evenness of diversity indicates the degree of homogeneity in abundance between species.

RESULTS

Distribution of Species

A total of 217 specimens of spiders were found across the study areas. Of these, 183 belong to 14 families and 24 genera. However, only 28 species were identified (Table 1).

Figure 1 summarizes the families identified and the number of species of spider belonging to each family. Family Lycosidae had numerically more abundant species (5; 17.8%) followed by family Agelenidae, Amaurobidae and Gnaphosidae with species composition of 3 each forming (10.1%). The family Anyphaenidae, Heteropodiidae, Philodromidae, Ctenidae, Sicariidae and Sparassidae were the least families with species composition of 1(3.5%).

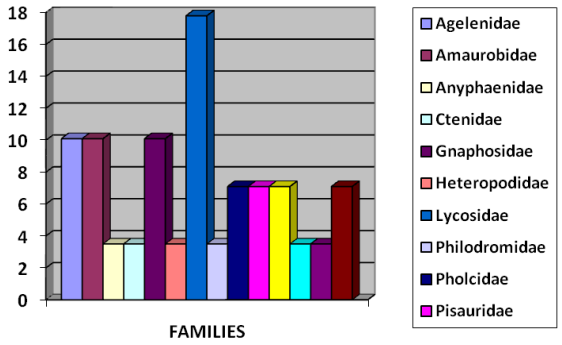

Figure 1: Percentage composition of spider species of each family

Table 1 shows relative species composition and abundance of spider in the five locations. *Cesonia bilineata* with Shannon's index value (1.315) was found to be evenly distributed in four study locations followed by *Salticus scenicus* (1.277). *Tigrosa helluo* had the highest number of species (38; 20.7%) followed by *Eratigena agrestis* (Plate 2) species (24;13.1%) while *Latrodectus geometricus, Amaurobius ferox, Loxosceles recluse, Latrodectus mectans, Callobius bennetti, Philodromus praelustris, Dolomedes triton, Schizocosa ocreata, and Olios giganteus* were the lowest species (1;0.55%). *Tigrosa helluo* (Plate 1) was the most predominant species in area V comprising of 26 individuals.

Table 1: Relative species composition and abundance of spider in five locations

Species	Goruba	Tudun Sarki	Hayin Liman	Koreye	ABU Main Campus	Total	Diversity index
Coras medicinalis	1	0	0	0	1	2(1.1)	0.6931
Pholcus phalangloides	1	5	0	0	0	6(3.3)	0.4506
Agelenopsis Pennsylvanica	2	3	0	0	9	14(7.7)	0.8921
Eratigena agrestis	9	9	1	0	5	24(13.1)	1.195
Schizocosa mcooki	2	1	0	0	0	3(1.6)	0.6365
Rabidosa rabida	1	5	10	0	1	17(9.3)	1.005
Tigrosa helluo	3	4	5	0	26	38(20.7)	0.9639
Olios giganteus	1	0	0	0	0	1(0.55)	0
Ctenus hibernalis	1	1	0	0	0	2(1.1)	0.6931
Cesonia bilineata	3	1	3	3	0	10(5.5)	1.314
Herpyllus ecclesiasticus	7	3	0	0	1	11(6.0)	0.86
Salticus scenicus	1	1	2	0	3	7(3.8)	1.277
Tegenaria domestica	0	1	0	0	1	2(1.1)	0.6931
Drassyllus pusillus	0	2	0	0	0	2(1.1)	0
Rabidosa punctulata	0	13	0	0	0	13(7.1)	0
Schizocosa ocreata	0	1	0	0	0	1(0.55)	0
Dolomedes triton	0	0	1	0	0	1(0.55)	0
Callobius bennetti	0	1	0	0	0	1(0.55)	0
Philodromus praelustris	0	1	0	0	0	1(0.55)	0
Latrodectus mectans	0	1	0	0	0	1(0.55)	0
Physocyclus globosus	0	0	5	3	0	8(4.4)	0.5032
Loxosceles recluse	0	1	0	0	0	1(0.55)	0
Amaurobius ferox	0	0	1	0	0	1(0.55)	0
Hibana gracilis	0	0	1	0	1	2(1.1)	0.6931
Dolomedes tenebrosus	0	1	0	0	4	5(2.7)	0.5004
Phidippus audix	0	0	0	5	1	6(3.3)	0.4506
Heteropoda venatoria	0	0	0	2	0	2(1.1)	0
Latrodectus geometricus	0	0	0	0	1	1(0.55)	0
Total	32	55	29	13	54	183	

Plate I*: Tigrosa helluo*

Plate II: *Eratigena agrestis*

Plate III: *Callobius bennetti*

Plate IV: *Amaurobius ferox*

Plate VI; *Coras medicinalis*

Plate VII; *Pholcus globosus*

Plate VIII; *Dolomedes tenebrosus*

Plate IX: *Ctenus hibernalis*

Table 2 shows the monthly variation and diversity of spider families. There were higher number of spider families (66) and high Shannon-wiener index (1.852) was recorded in the month of July followed by August (63). However, in the month of May (12) there were low number of spiders with Shannon-wiener index of 1.075, however, the spiders were evenly distributed (0.908) in June.

Table 2: Monthly Variation and diversity of Spiders Families

Spiders Families	April	May	June	July	August	Total
Agelenidae	1	1	3	11	17	33
Amaurobidae	0	0	0	3	1	4
Anyphaenidae	0	0	0	2	0	2
Ctenidae	0	0	0	2	0	2
Gnaphosidae	1	1	3	16	18	39
Heteropodiidae	0	0	0	0	1	1
Lycosidae	6	7	8	**21**	19	**61**
Philodromidae	0	0	0	0	1	1
Pholcidae	7	3	3	2	2	17
Pisauridae	0	0	3	0	0	3
Salticidae	4	0	3	6	2	15
Sicariidae	0	0	0	0	1	1
Sparassidae	0	0	0	2	0	2
Theridiidae	0	0	0	1	1	2
Total	19	12	23	66	63	183
Shannon_H	1.370	**1.075**	1.696	1.852	1.621	1.864
Evenness_e^H/S	0.787	0.733	0.908	0.638	**0.506**	0.461

DISCUSSION

This study showed higher number of families of spider and disagreed with the study conducted by Ejikeme, *et al.* (2015) at the University of Nigeria, Nsukka where a total number of 7 species, 4 families and 6 genera were identified. The population of the family Araneidae, Agelenidae, Theridiidae and Sicariidae was higher in the Eastern part compared to the northern part of Nigeria. This could be due to the differences in food (insects) availability, weather condition, vegetation of the place, topography of area and habitat characteristics (Ejikeme, *et al.*, 2015). In northern part of Nigeria, there are distinct dry and rainy season. Therefore, various seasonal plants start to flourish and large number of insect fauna flourishes after the onset of rain that will serve as food to spiders (Deshmukh and Raut, 2014).

Families Sparrasidae, Clubionidae and Zodariidae had lower diversity and abundance in this study. These variations could be as a result of the differences in ecological habitat and geographical area. Spider availability may be affected by the presence of insects and climatic factor (Ejikeme, *et. al.,* 2015). In the inventory of Nwankwo and Ewuim (2019), they acknowledged that, families of the species recorded in this study were reported in Jos, Mokwa, Oguta, Benin, Nsuka, Awka, Ibadan and Ile-Ife. The individual diversity values of all the families identified in this study were evaluated using Shannon index. Family Lycosidae has the highest number of species. This study disagreed with the study carried out at Kashmir Himalaya where distribution and community diversity of spider in a wildlife sanctuary revealed family Araneidae was the dominant family of all the 18 families recorded (Mansoor *et al.,* (2015).

Family Araneidae was not observed throughout this study possibly due to the differences in the climatic condition, vegetation structure and prey availability where Himalaya is located in the cold temperate zone of the world.

The result of the abundance of spiders in Gulmarg forest in Kashmir Himalaya showed that there was a linear decrease in the number of spiders sampled across the sampling sites with increase in high altitude and a decrease in family diversity with increasing high altitude of the study sites. The negative value of spiders in the study area may be attributed to the fact that spiders are sensitive to a slight change in environment especially vegetation, topography and the declination pattern may also be related to more severe environmental conditions and landscape of the study area (Mansoor *et al.,* 2015).

Also, the results showed the influence of habitat structure and vegetation parameters on the distribution and abundance of the spiders. This is in agreement with the study by Mithali and Pai (2018) on the distribution, diversity and ecology of spiders at two different habitats in Goa University, India, who found that the occurrence of spiders are influenced by habitat structure and vegetation parameters. Alteration of habitats through anthropogenic activities can cause degradation of habitat and even cause local extinction of the species, which may result in the suppression of the number of spiders. In addition, the variation of the spiders observed in the different habitat could be due to several environmental factors such as spatial heterogeneity, competition, predation and environmental stability. On the other hand, savanna grassland has large number of microhabitats which help spiders to escape their predators. It could also be due the availability of food in that vegetation (Mansoor *et al.,* 2015).

Shannon index H, shows diversity and higher number of spider from June to

August, as compared to April and May. This is in agreement with the work of Hsieh and Linsenmair (2012) who reported August to October as the most suitable months for many spiders compared to other months. However, the diversity estimate obtained from data of those months alone is an underestimate as it cannot yield a reliable inference, hence the need for sufficient data.

CONCLUSION

At the end of the present study, a total of 217 spiders were encountered at all the study locations with 187 identified to species level. A total of 28 species, belonging to 24 genera and 14 families were identified and recorded in this study. Family Lycosidae was found to be the most abundant family, with species proportion of 17.8%. *Cesonia bilineata* with the diversity index of 1.315 shows dominance of all the species identified. The month of July showed higher diversity (1.852) of spider, however, they are more evenly distributed (0.98) in June. This study revealed that Zaria Local Government Area is rich in spider biodiversity. Therefore, there is a need to explore data on spider's abundance and distribution in Nigeria. Sufficient sampling is important in order to study biodiversity and make proper conservation decisions.

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REFERENCES

Aminu, Z. (2014). Assessment of Soil Degradation in Zaria Area, Kaduna State, Nigeria. Unpublished Ph.D thesis, Department of Geography, Ahmadu Bello University, Zaria

Anindita, B., Mahadev, C. and Prabal, S. (2017). Spider diversity in different habitats at Jaintia Hills of Meghalay. *International Journal of Life Sciences*, 5 (4):613-619.

Bello, H. and Musa, A.O. (2016). Species Composition and Structure of *Isobelina* Woodland of Shika, Zaria, Nigeria. *Journal of Agriculture and Ecology Research International*, 5(1):1-9.

Deshmukh, U.S. and Raut, N.M. (2014). Seasonal Diversity and Status of Spiders (Arachnida: Araneae) in Salbardi forest (Satpura Range), Maharashtra, India. *Journal of Entomology and Zoology Studies*, 2 (5): 278-281.

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). 70(3):1-31.

Ejikeme, O.G., Agwu, E.J., Ekeh F.N., Ekechukwu, E.N., Ossai, N.IK, Osita, E.C., Madu, J., Victor,E., and Fidelis, U. (2015). Checklist of Spider Fauna in Nsukka, Southeastern, Nigeria. *Academic Journal of Biotechnology*, 3(5): 069-078.

Hodge, S. and Vink, C. (2010). An Evolution of *Lycosa hilaris* as Bioindicator of Organophosphate Insecticides Contamination. *New Zealand Plant Protection*, 53:226-229.

Hsieh, Y-L. and Linsenmair, K.E. (2012). Seasonal dynamics of arboreal spider diversity in a temperate forest. *Ecology and Evolution*, 2(4): 768-777.

Hussien, E.H.M., Mahmoud, A.A. and Obuid-Allah, A.H. (2015). A Key for Identification of Spiders at Qena Governorate, Upper Egypt. *American Journal of Life Sciences*. Special Issue: *New Horizons in Basic and Applied Zoological Research*, 3(6):13-23.

Koneri, N. and Nangoy, M.J. (2017). The distribution and diversity of spiders in Sahendaruman Mountain; *Applied Ecology and Environmental Research*, 15(3): 797-808.

Larrivee, M. and Muposhi, V.K. (2010). Scale Dependence of Tree Trunk Spider Diversity

Patterns in Vertical and Horizontal Space. *Ecoscience*, 17(4):400-410.

Mansoor, A.L., Idrees, Y.D. and Bhat G.A. (2015). A study on ecological distribution and community diversity of spiders in Gulmarg Wildlife Sanctuary of Kashmir Himalaya*: Journal of Ecology and the Natural Environment*, 7(3):81-86.

Mithali, M.H. and Pai, I.K. (2018). Distribution, diversity and ecology of spider species at two different habitats. *International Journal of Environmental Sciences and Natural Resources*, 8(5):162-167.

Murphy, F.M. and Murphy, J.A. (2000). An Introduction to the Spiders of South East Asia. Malaysian Nature Society, Kuala Lumpur, 625.

Nwankwo, O.D. and Ewuim, S.C. (2019). The First National Inventory of Spiders (Araneae) in Nigeria. *Animal Research International*, 16(1): 3247-3254

Oyeniyi, A.O. and Oyeseyi, J.O. (2014). Diversity and distribution of spiders in Southwestern Nigeria. *Natural Resources*, 5: 926-935.

Russell-Smith, A., Jocqué, R. and Alderweireldt, M. (2009). A revision of the African wolf spider genus *Amblyothele simon* (Araneae, Lycosidae, Piratinae*). A life caught in a spider's web*,16: 149-180.

Sumangala, R., Srikanth, S.K., Ashwini, V., Rekha, K.N. and Shenoy, K.B. (2018). Spider diversity on Mangalore University Campus. *Journal of Entomology and Zoology Studies*, 6(2): 3186-3194.

Wegner, G.S. (2014). Spider Identification Guide. BASF Corporation. All rights reserved. Pp. 1-60.

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