Journal of Forestry Research and Management. Vol. 19(1).9-17; 2022, ISSN 0189-8418

www.jfrm.org.ng

ASSESSMENT OF SPIDERS SPECIES DIVERSITY IN TWO ECOLOGICAL ZONES OF OGUN STATE, NIGERIA

Odejayi, A.O.[1,] Lawal, O. A.[1], Mustafa, M.O.[2], Aina, S.O. [1], Aremu, A. E[2]. Okpanach, M.A[2]. and Oyewusi, E.O[2].

[1]Olabisi Onabanjo University, Ago-iwoye, Ogun State, Nigeria.
[2]Forestry Research Institute of Nigeria, Federal College of Forest Resources Management, Ishiagu, Ebonyi State, Nigeria.
mustafamusiliyu@yahoo.com

ABSTRACT

Spiders are ubiquitous. They are a group of organisms that indicate biodiversity quality of a site since they can be sampled in a standardized way to yield useful indices for comparing natural ecosystems spatially and temporally. This work assessed and compared spider populations in Ago-Iwoye in rainforest ecosystem and Ayetoro having Derived Savannah vegetation both in Ogun State of Nigeria. Seven study sites chosen by Systematic Random Sampling (odd method) in each ecosystem were used for the study. In each sampling area, 60m x 120m land area was marked and sampled, spider collection techniques were hand picking, use of sweep netting and Pitfall trap. Digital Counter counted the spider specimens collected and preserved in each zone, field recording was done. Adult spiders were identified to species level using identification manual and World Spider Catalog. Species richness was estimated for the two vegetation zones using non-parametric species estimator. Spider species diversity was assessed by Simpson Diversity Index and Species Richness. Results revealed that fifteen spider families and six species present in derived savannah were absent rainforest. Also eight species found in rainforest were absent in the derived savannah. Furthermore, nine species identified in residential areas across both regions were absent in the other habitats sampled. For species richness, 71 species were encountered in the rainforest but 68 species were found in Derived Savannah. Comparatively, total species richness was lower in the residential areas than grassland, fallow bush and agro-ecosystem. In conclusion, Araneidae had the highest species richness, followed by Salticidae and reduction in residential spider population might be as a result of frequent disturbance and killing. Tree planting, spider education and further spider studies in the two zones were recommended.

Keywords: Spider, biodiversity, ecosystems, Species diversity, Species richness

Introduction

Spiders are practically everywhere, they live on nearly everywhere and are part of every imaginable ecosystem and are predators and preys to a multitude of other animals (De Marino, 2021). World Animal Foundation, (2021) documented that more than 43,000 spider species have been identified, adding that some are carnivorous feeding on insects, mice, small birds and other large animals. Spiders are an important food source for a variety of birds, lizards, wasps and some small desert mammals (De Marino, 2021).

Spiders are obligate carnivores and this makes them exceptional arthropods because of their complete dependence on predation as a trophic strategy, they have been reported to be the dominant predators and stabilizers of the invertebrate community in natural and agricultural ecosystems (Perveen *et al*., 2012).

Common habitats for outdoors spiders include rocks, retaining walls, cracks in soil

Journal of Forestry Research and Management. Vol. 19(1).9-17; 2022, ISSN 0189-8418
www.jfrm.org.ng

or concrete, around foundations (especially those with tall grass adjacent), in window wells, in stack of lumber, firewood, bricks, rocks, boards, under timber or other items that have been left undisturbed for long period (Perveen *et al.*, 2012). Species diversity and their richness studies provide an idea about ecosystem stability: greater figures for the two predict higher resources availability and these may cause ecosystems to function more efficiently and productively (Shah, 2014).

In the same premise, Nigeria has very rich diversity of spider species, however, there is paucity of information about the diversity and abundance of spiders in South-west Nigeria. The paucity is traceable to dearth of taxonomic experts to identify Spider species correctly to either family or species level. There is a wrong perception that all spiders are poisonous and difficult to handle, as a result of this belief, the study is not given optimum research priority. This study therefore investigated the species diversity in Rainforest and Derived Savannah ecosystems of Ogun State, Nigeria.

Materials and Methods

Study Areas

The study areas were two ecological zones between March 2013 and March 2015in Ogun State: Rainforest (Olabisi Onabanjo University (OOU), Ago-Iwoye campus (Lat. 3° 54´ N - 3° 55´ N and Long. 6° 55´ E - 6° 56´ E) and Derived Savannah (OOU College of Agricultural Sciences (CAS) Ayetoro Campus (Lat. 7° 23´ and Long. 3° 04). Sample collection sites were chosen using Systematic Random Sampling (Salkind, 2012).

In the rainforest zone, the collection sites were OOU main campus, Abobi and Legumo (both in Ago Iwoye) and five villages in Ijebu-North Local Government area: Mamu, Aba Paanu, Oke Arowa, Laagan and Okenugbo. In the derived savannah zone, CAS Campus, Idagba , Igbo Aje, Isa-Ope, Idi-Ori and Arun were chosen as sampling sites (Figure 1).

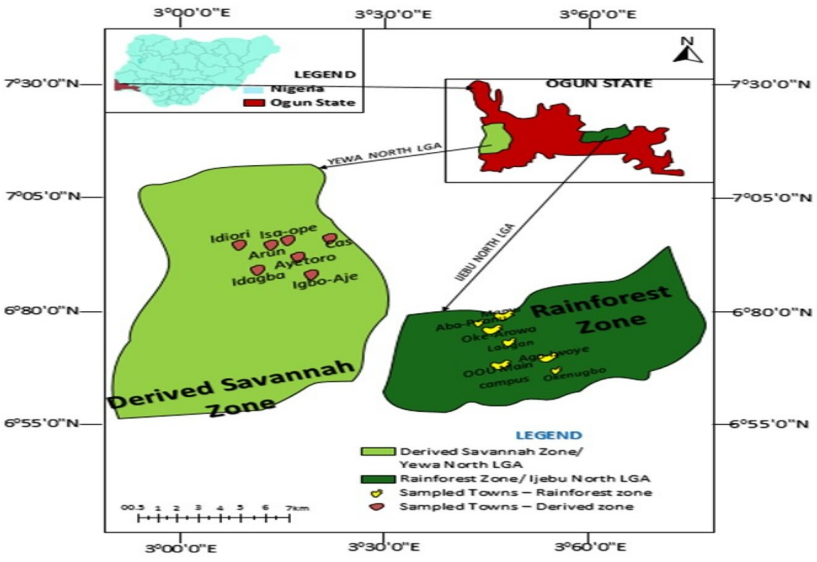

Figure 1: Study Areas and their Geographical Locations

Methods

In each of the sampling areas, 60m x 120m land area were marked and sampled, using the three (3) adopted sampling techniques for spider collection: Hand picking (Tikader, 1987). Sweep netting (Upamanyu, 2009) and Pitfall trap (Churchill and Arthur, 1999). The digital counter was used to count the spider specimens collected in each of the sampled habitats. All the specimens collected were preserved in 70% ethyl alcohol with proper labelling, notably: locality, date and habitats for five days (Tikader, 1987). Precautionary measure was taken by putting on hand gloves, to avoid being stung by spiders during collection. Field recording was maintained throughout the study period.

The spider specimens collected were sorted into different groups based on their morphological characteristics. All immature spiders were identified to family level, while all adult ones were identified to species level using *African Spider*: an identification manual and World Spider Catalog Version 14.0 of 2013 in the Laboratory of the Department of Zoology, O.O.U. Ago-Iwoye with the assistance of Dr. Tony Russell-Smith of the Spider Research Society Laboratory, Kent, England. Diversity indices were obtained using ComEcoPac version 1.0 (Drozd, 2010). Spider species richness was estimated for the vegetation zones and their respective habitats by calculating the non-parametric species estimator Chao-1 using PAST software version 2.17c (Hammer *et al*., 2001). The diversity of spider species was assessed using Simpson (1949).

Species Diversity Assessment

Spider species identified from the fifteen (15) families encountered during the study is presented in Table 1. Six (6) spider species (*Araneus* species, *Gasteracanthinae* Indet, *Ocyale neatalanta, Miturgidae* Indet., *Evarcha* species and *Runcinia* species) present in the derived savannah were not recorded in the rainforest region. On the other hand, eight (8) species (*Gansteracanthinae, Hersilia savignyi, Hersilia* species, *Pardosa* species, *Peucetia* species, *Evarcha dotata* and *Menemerus* species) present in the rainforest were absent in the derived savannah. Immature spiders were only recorded in the rainforest zone. Except for *Ocyale neatalanta*, which was present across the grassland, fallow bush, agro-ecosystem and the residential areas, the composition of spider species in the residential areas of both the rainforest and derived savannah was observed to be distinct.

Therefore, all the other nine (9) species of spiders identified in the residential areas across the rainforest and derived savannah regions during the study were absent in the other habitats sampled (grassland, agro-ecosystem and fallow bush). On the other hand, *Cyrtophora citricola, Gasteracantha curvispina, Gasteracantha sanguinolenta, Gasteracantha* species, *Isoxya testudinaria, Neoscona* species, *Hippasa lamtoensis, Hogna* species, *Pardosa injucunda, Oxyopes* species, *Synema* species and *Thomisus spiculosus* were recorded across the grassland, fallow bush and agro-ecosystem of both the rainforest and the derived savannah.

Results

Table 1: Diversity of spiders and distribution within the study areas

Family	Species	Rainforest				Derived savannah			
		GL	FB	AE	RD	GL	FB	AE	RD
Hersiliidae	*Hersiliidae indet*	+	-	+	-	-	-	+	-
	Hersilia species	-	-	+	-	-	-	-	-

Journal of Forestry Research and Management. Vol. 19(1).9-17; 2022, ISSN 0189-8418

www.jfrm.org.ng

Family	Species	Rainforest				Derived savannah			
		GL	FB	AE	RD	GL	FB	AE	RD
Amblypygi	*Damos* species	-	-	-	+	-	-	-	+
Araneidae	*Acrosomoides linnaei*	+	+	+	-	-	+	-	-
	Aetrocantha falkensteini	+	+	+	-	-	+	+	-
	Afracantha camerunensis	-	-	+	-	+	+	-	-
	Araneidae indet	+	-	+	-	+	+	+	-
	Araneus apricorum	+	-	+	-	-	+	+	-
	Araneus species	-	-	-	-	-	-	+	-
	Argiope flavipalpis	+	+	+	-	+	+	+	-
	Argiope species	+	-	-	-	+	+	-	-
	Cyclosa species	+	+	+	-	-	-	+	-
	Cyrtophora citricola	+	+	+	-	+	+	+	-
	Gansteracanthinae	+	-	-	-	-	-	-	-
	Gasteracantha curvispina	+	+	+	-	+	+	+	-
	Gasteracantha sanguinolenta	+	+	+	-	+	+	+	-
	Gasteracantha species	+	+	+	-	+	+	+	-
	Gasteracanthinae indet	-	-	-	-	-	+	+	-
	Isoxya semiflava	+	-	+	-	-	+	+	-
	Isoxya testudinaria	+	+	+	-	+	+	+	-
	Neoscona moreli	-	+	+	-	-	+	-	-
	Neoscona penicilipes	+	+	+	-	-	+	+	-
	Neoscona rapta	+	+	+	-	-	+	+	-
	Neoscona species	+	+	+	-	+	+	+	-
	Neoscona triangular	+	+	+	-	+	-	+	-
	Neoscona vigilans	-	+	+	-	-	-	+	-
Lycosidae	*Foveosa infuscata*	+	+	+	-	-	+	+	-
	Hippasa lamtoensis	+	+	+	-	+	+	+	-
	Hippasa species	+	+	+	-	-	+	+	-
	Hogna species	+	+	+	-	+	+	+	-
	Lycosidae indet.	+	-	-	-	-	-	-	-
	Ocyale neatalanta	+	+	+	-	-	-	+	+
	Ocyale pilosa	+	-	-	-	+	-	+	-
	Ocyale species	+	-	+	-	+	+	+	-
	Pardosa injucunda	+	+	+	-	+	+	+	-
	Pardosa species	+	-	-	-	-	-	-	-
Miturgidae	*Cheiracanthium aculeatum*	+	+	+	-	-	+	-	-
	Cheiracanthium afracanum	-	+	+	-	-	-	+	-
	Miturgidae indet.	-	-	-	-	-	+	-	-
Nephilidae	*Nephila* species	-	+	+	-	-	-	+	-
	Nephilengys cruentata	-	+	+	-	-	-	+	-
Opiliones	*Opiliones* species	-	+	+	-	-	+	-	-
Oxyopidae	*Hamataliwa* species	-	+	+	-	+	-	+	-

Family	Species	Rainforest				Derived savannah			
		GL	FB	AE	RD	GL	FB	AE	RD
	Oxyopes elongata	-	+	-	-	-	+	+	-
	Oxyopes species	+	+	+	-	+	+	+	-
	Peucetia longipes	-	+	+	-	-	-	+	-
	Peucetia species	+	-	-	-	-	-	-	-
Pholcidae	Pholcidae indet.	-	-	-	+	-	-	-	+
	Pholcus species	-	-	-	+	-	-	-	+
Pisauridae	*Perenethis* species	-	-	+	-	-	+	+	-
	Pisaura species	-	+	-	-	+	-	-	-
	Pisuaridae indet	-	+	-	-	+	+	+	-
Salticidae	*Evarcha dotata*	-	+	+	-	-	-	-	-
	Evarcha species	-	-	-	-	-	+	-	-
	Menemerus bivittatus	-	-	-	+	-	-	-	+
	Menemerus species	-	-	-	+	-	-	-	-
	Natta horizontalis	-	+	+	-	-	-	+	-
	Plexippus paykulli	-	-	-	+	-	-	-	+
	Plexippus species	-	-	-	+	-	-	-	+
	Thiratoscirtus mirabilis	-	-	+	-	-	+	+	-
	Thyene bucculenta	-	+	+	-	-	+	-	-
	Thyene coccineovittata	-	-	+	-	-	-	+	-
	Thyene inflata	+	-	+	-	+	+	+	-
	Thyene species	+	-	+	-	-	+	+	-
Selenopidae	*Selenops annulatus*	-	-	-	+	-	-	-	+
Sparassidae	*Rhitymna* species	-	+	+	-	-	-	+	-
Tetragnathidae	*Leucauge decorata*	-	+	+	-	+	+	-	-
	Leucauge species	+	-	+	-	+	+	+	-
Thomisidae	*Runcinia depressa*	-	+	+	-	+	+	-	-
	Runcinia species	-	-	-	-	-	-	+	-
	Synema species	+	+	+	-	+	+	+	-
	Thomisidae indet	+	+	+	-	-	-	+	-
	Thomisus spiculosus	+	+	+	-	+	+	+	-
	Thomisus species	+	+	+	-	+	+	-	-

RF = Rainforest; DS = Derived savannah; GL = Grassland; FB = Fallow bush; AE = Agro-ecosystem; RD = Residential; + = Present; - = Absent

Species Richness

A total of seventy-one (71) spider species were encountered in the rainforest region while sixty-eight (68) spider species were encountered in the derived savannah. Comparing the habitats of both the rainforest and the derived savannah, total species richness was observed to be lower in the residential areas than in the grassland, fallow bush and the agro-ecosystem. Among the families identified across the grassland, fallow bush, agro-ecosystem and residential areas of both the rainforest and the derived savannah, Araneidae had the highest number of species. This was followed by the Salticidae, Lycosidae, Thomisidae and Oxyopidae respectively. Spiders of the

Selenopidae, Pholcidae and Amblypygi families were only present in the residential areas of both the rainforest and the derived savannah but absent in the other habitats evaluated. In the rainforest region, only the Salticidae was present in all the habitats (grassland, fallow bush, agro-ecosystem and residential areas); the Araneidae and Salticidae had their highest species richness in the agro-ecosystem while the Lycosidae was higher in the grassland habitats. The species richness of Oxyopidae and the Pisuaridae families were higher in the fallow bush. In the derived savannah however, Salticidae and Lycosidae families were the only spider families present across the different habitats. Higher species richness was recorded for Araneidae in the fallow bush, while those of the Lycosidae and Oxyopidae were higher in the agro-ecosystem (Table 2).

Table 2: Spider species richness in the different study areas

Families	RF					DS				
	GL	FB	AE	RD	Total	GL	FB	AE	RD	Total
Amblypygi	0	0	0	1	1	0	0	0	1	1
Araneidae	18	15	19	0	21	11	19	18	0	23
Hersiliidae	1	1	3	0	3	0	0	1	0	1
Lycosidae	10	6	7	0	10	5	6	8	1	8
Miturgidae	1	2	2	0	2	0	2	1	0	3
Nephilidae	0	2	2	0	2	0	0	2	0	2
Opiliones	0	1	1	0	1	0	1	0	0	1
Oxyopidae	2	4	3	0	5	2	2	4	0	4
Pholcidae	0	0	0	3	3	0	0	0	2	2
Pisauridae	0	2	1	0	3	2	2	2	0	3
Salticidae	2	3	7	4	11	1	5	5	3	10
Selenopidae	0	0	0	1	1	0	0	0	1	1
Sparassidae	0	1	1	0	1	0	0	1	0	1
Tetragnathidae	1	0	1	0	2	2	2	1	0	2
Thomisidae	4	4	4	0	5	4	4	4	0	6

RF = Rainforest; DS = Derived savannah; GL = Grassland; FB = Fallow bush; AE = Agro-ecosystem; RD = Residential

Diversity Indices of Spider Species Encountered in the Study Area

The diversity of spider species as assessed by Margalef species richness, Shannon Weinner function and Simpson index did not significantly differ between the rainforest and derived savannah (3). The derived savannah region had more dominant species (2 species; abundance of dominant species = 2295 individuals) than the rainforest (1 dominant species and 1741 in abundance). On the other hand, the rainforest recorded three (3) numbers of singletons while no (0) singleton was recorded in the derived savannah (3). Similarly, diversity of spider species in the rainforest region was evenly distributed (Evenness = 0.7314) with a higher estimated species richness (Chao-1 = 72.5, observed = 71) compared to the derived savannah (Evenness = 0.7244; Chao-1 = 68, observed = 68). One doubleton and tripleton each were however observed in both the derived savannah and

the rainforest; comparatively, the different habitats in the rainforest region: fallow bush, grassland, agro-ecosystem and residential areas had more dominant species with three (3) dominant species (1561 species abundance) than grassland (1234 abundance species) than agro-ecosystem (1036 species abundance) than residential areas (238 in abundance)

Spider species diversity between the different habitats of the rainforest using the Margalef species richness, Simpson index and Shannon Weinner function revealed that diversity was higher in the agro-ecosystem. This was followed by the fallow bush, grassland and the residential habitats respectively. The agro-ecosystem was also observed to be more evenly distributed (Evenness = 0.8104) than other habitats. However, the grassland had a higher estimated species richness (Chao-1 = 42, observed = 39) while the other habitats recorded the same estimated (Chao-1) and observed species richness.

The derived savannah on the other hand recorded more number of dominant species in the fallow bush (4 dominant species; 1480 in abundance). Only one dominant species was observed in the grassland and the agro-ecosystem habitats respectively while no dominant species was recorded in the residential areas (Table 3).

Table 3: Diversity indices of the spider species identified in the study areas

Diversity parameter	Rainforest				Derived Savannah					
	GL	FB	AE	RD	GL	FB	AE	RD	RF	DS
Species richness (S)	39	43	53	9	27	43	47	8	71	68
Abundance	7709	6491	8428	2807	1967	5542	6322	1698	25435	15529
S_D	2	3	2	1	1	4	1	0	1	2
N_D	1234	1561	1036	238	110	1480	369	0	1741	2295
Singleton F_1	4	1	1	0	2	1	1	0	3	0
Doubletons F_2	1	2	0	0	1	1	2	0	1	1
Tripletons F_3	0	1	1	0	1	0	1	0	1	1
Simpson (1-D)	0.7710	0.8428	0.9225	0.7935	0.6868	0.8055	0.9117	0.7928	0.8896	0.8888
Shannon (H)	2.3220	2.4910	3.2180	1.7550	1.8530	2.4670	3.0020	1.6830	3.1180	3.0570
Evenness	0.6337	0.6623	0.8104	0.7989	0.5623	0.6559	0.7798	0.8094	0.7314	0.7244
Species richness	4.2460	4.7850	5.7530	1.0080	3.4280	4.8720	5.2560	0.9412	6.9010	6.9430
Equitability (J)	0.6337	0.6623	0.8104	0.7989	0.5623	0.6559	0.7798	0.8094	0.7314	0.7244
Fisher alpha	5.3640	6.1800	7.5520	1.1540	4.4270	6.3490	6.8880	1.0880	8.9250	9.1420
Chao-1	42	43	53	9	27.5	43	47	8	72.5	68

SD = Number of dominant species; ND = Abundance of dominant species; Chao-1 = Species richness estimator; RF = Rainforest; DS = Derived savannah; GL = Grassland; FB = Fallow bush; AE = Agro-ecosystem; RD = Residential

Discussion

Diversity of Spiders within the Study Area

This study recorded higher spider diversity (15 families) than the earlier reports of either Ayansola, (2012) or Oyewole and Oyelade, (2014) who identified 10 and 12 families respectively from Ile-Ife. Though these earlier authors worked over a smaller area, their works were entirely within the rainforest. The present study provides the diversity records from both rainforest and derived savannah zones.

The diversity of spiders in the study areas (Rainforest and Derived savannah) might have been aided by the varieties of plants presence in the study area. Ried and Miller, (1989) reported that, diversity generally increases when a greater variety of habitat types are present. This could have explained the low diversity (4 families) found in the residential houses in the study area, where human activities, such as; frequent house cleaning, spider removal and indiscriminate killing might contribute to the low diversity.

This is in agreement with the findings of Oyewole and Oyelade, (2014) who explained that, the low abundance of house spider at Ile Ife was due to regular removal of spiders and its webs by people living in that environment. Gunnarsson, (1990) and Ayansola, (2012) both in a separate research reported that, human activities tend to create gradients of disturbance with accompanying changes in community structure. Since it had been established that vegetation plays vital role in the diversity of spider fauna, this might be the reason for having vast number of web making and hunting spiders in the study area, as herbaceous, shrubs and trees would provide support for their existence.

Species Richness and Diversity Index of the Spiders within the Study Area

From this study, Araneidae had the highest species richness, followed by Salticidae and Lycosidae in all the sampled habitats of the study areas (excluding residential). This finding is not different from the finding of Tahir *et al*. (2015) who reported higher richness of Araneidae, Salticidae and Lycosidae from a *Citrus* orchard in Pakistan.

While the families of Selenopidae, Pholcidae and Amblypygi were encountered, only in the residential habitat of the study areas, their reduction in the residential might be as a result of frequent disturbance and killing. Gunnarsson, (1990) and Ayansola, (2012) in a separate research reported that, human activities tend to create gradients of disturbance with accompanying changes in community structure. Agro-ecosystem accounted for the highest richness of family Araneidae in rainforest and fallow bush in derived savannah.

Conclusion and Recommendation

The research has shown that spider species diversity varies greatly in the study area and they were much more diverse than those found in the residential area. The spider's species richness in the study area had been greatly enhanced by the type of vegetation structure of the study area, while the human activities such as; indiscriminate killing, use of insecticide etc, greatly affected the spiders in the residential habitat. There are similarities among the spiders in the study area, this might be due to the proximity of the locations sampled. People should be educated to be spider friendly, in that they also contribute in balancing ecosystem. It is recommended that:

i. Tree planting should be encouraged in the residential environment, to aid spider diversity.
ii. Studies to investigate spiders' diversity at state level and later the entire country should be done.
iii. There should be further studies on the molecular diversity of spiders, to broaden the knowledge of spider diversity in the two zones.

References

Ayansola, A.A. (2012). Diversity of foliage spiders in two contrasting habitats in the Rain forest zone of south western Nigeria. Entomology unit, Natural Museum, Obafemi Awolowo University, Ile-Ife, Nigeria. *Biodiversity Journal*. 3:131-136.

Churchill, T.B. and Arthur, J.M. (1999). Measuring spider richness: effects of

different sampling methods and spatial and temporal scales. *Journal of Insect Conservation*, 3 : 287–295 DOI:10.1023/A:1009638706789.

De Marino, N. (2021). The Importance of Spiders to an Ecosystem. Pets on Mom. Me Available online at https://www.animals.mom.com/importance-spiders. Retrieved 15- 8-2021 at 1.28 pm.

Drozd, P. (2010). Comm Ecology Parameter Calculator (ComEcoPaC) Version 1. University of Ostrava, Czech Republic

Gunnarsson, B. (1990) Vegetation Structure and the Abundance and Size Distribution of Spruce-Living Spiders. *Journal of Animal Ecology*. 59:743-752 http://dx.doi.org/ 10.2307/4892Retrieved 12-3-15 at 2.55 pm.

Hammer, O., Harper, D.A. and Ryan, P.D. (2001). PAST: Paleontological Statistics software package for education and data analysis. *Paleontologia Electronica* 4(1): 9.

Odejayi, A.O. (2015) Biodiversity of Spiders in Two Ecological Zones (Rainforest and Derived Savannah**)** of Ogun State, Nigeria Unpublished Ph. D. Thesis, Department of Zoology and Environmental Biology, Olabisi onabanjo University, Ago-iwoye, Ogun State. 160 pp.

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

Perveen, F., Jamal, A., Yasmin, S. and Khatak, K.U. (2012). Biodiversity of spiders' faunal in the frontier region, Peshawar, Pakistan. Journal of Entomology and Nematology. 4(3): 22-33.

Ried, W.V. and Miller, K.R. (1989). *Keeping options alive: A Scientific Basis for Conserving Biodiversity.* World Resources Institute, Washington D.C. 223.

Salkind, N. J. (2012). Systematic Random Sampling: Encyclopaedia of Research Design. ENCYCLOPAEDIA Available online at https//https:www.methods.sagepub.com/reference/... Retrieved 12-207-2014 at 1.09 pm

Shah, H. (2014) Why is Biodiversity Important? Who Cares? Global Issue. Available on-line at https://www.globalissues.org/artcles/170. .. Retrieved 23-8-2021 at 5.32 pm.

Simpson, E.H. (1949). Measurement of Diversity in Nature. Available at www.countrysideinfo.uk/simpsons.htm.... .Retrieved 14 August, 2014

Tahir, H. M., Naseem, I. N., Butt, A., Yaqoob, R., Mukhtar, M. K. and Samiullah, K. (2015). Seasonal Dynamics of Spiders and insect Pests in Citrus Orchards of District Sargodha, Pakistan, *Pakistan J. Zool.* 47(6) 1673-1681

Tikader, B.K. (1987). Handbook of Indian spiders. *Calcutta Zoological survey of India*. 251.

Upamanyu, H. (2009). "Diversity and Structure of Spider Assemblages in Terai Conservation Area", Ph.D. Thesis, Saurashtra University. – Retrieved on April 23rd, 2015. From http://etheses.saurashtrauniversity.edu /id/eprint/589

Wilders, D. (2016). The Ecological Importance of Spiders. Science Friday. Available online at http://www.science Friday.com/educational-i… Retrieved 15-8-2021 at 1.46 pm.

World Animal Foundation (2021). Spiders. Available online at https://www.worldanimalfoundation.com /..Retrieved 15-8-2021 at 1.33 pm.