

Diversity and Distribution of Spiders in Southwestern Nigeria

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Abstract

The study of diversity and distribution of spiders was carried out at Obafemi Awolowo University, Southwestern Nigeria, in wet and dry seasons between October 2012 and April 2014. Spiders were collected from five different sampling sites in the study area: cultivated land, open field, hill area, house dwelling and aquatic habitat. We found 1824 individuals belonging to 19 different spider families in the study area. 9 families of spiders were present in the hill habitat; 12 families of spiders were present in the open field habitat; 6 families of spiders were present in house habitat; 9 families of spider were present in aquatic habitat. All the 19 families of spiders were present in cultivated habitat. Therefore, cultivated habitat hosted the largest number of spider families in the area of study while house dwellers hosted the least number of spider families. Spiders are evenly distributed among the five habitats in this study and the fifth habitat, teaching and research farm representing cultivated area has the highest distribution of spider species. All the species recorded in Southwestern Nigeria were found in this habitat. In conclusion, 19 different spider families are recorded in Obafemi Awolowo University, Nigeria, during this study. These have enriched the collection of spider in Natural History Museum, Obafemi Awolowo University, Southwestern Nigeria.

Keywords

Spider, Families, Habitats, Southwestern, Nigeria

1. Introduction

Spiders belong to the class Arachnida and like all arachnids, spiders have just two body parts, a cephalothorax and an abdomen. The abdomen is soft and unsegmented while the cephalothorax is harder and includes the eight legs that characterize spiders. Arachnids lack wings and antennae [1]. Most arachnids are carnivorous, typically

preying on insects and other terrestrial organisms. Arachnids provide an important service, keeping insect populations under control [2]. Spiders have helped in biological control of insects; without spiders some insects would have reached pest proportions. Members of the order Araneae mainly prey on insects. However, spiders can only consume liquids, as they lack chewing mouthparts. They use chelicerae, pointed appendages at the front of the cephalothorax, to grasp prey and inject venom. Digestive juices break the food down into liquid, which can then be ingested by the spider [1]. The vast majority of spiders are terrestrial, although a few specialized species live under water. The class Arachnida includes a diverse group of arthropods: spiders, scorpions, ticks, mites, harvestmen, and their relatives. Araneae is the largest entirely carnivorous group of animals on the planet. Scientists have described over 75,000 species of arachnids with many more undescribed.

The knowledge gained from the study of spiders diversity is highly essential in integrated pest management based on the fact that spiders differ in hunting strategies, habitat preferences, and active periods. Under normal condition, spiders in an agricultural ecosystem with one or more species will attack a given pest [3]. Also, different spiders feed on different insects at different times of the day, so a loss in community diversity of spiders can result in some prey species being released from predation pressure [4]. Spider diversity, distribution and insectivorous feeding habits of spider are suspected of playing an important role in the balance of nature [5]-[7]. Also, spiders are found to be the most abundant invertebrate that have imposed the greatest threat on insect species [8] [9]. Ferguson *et al.* [10] and Whitmore *et al.* [11] reported that spiders had also been found to have great potential to serve as biological control agent against crop pests.

Spiders are obligate predators of herbivorous insects and they are capable of reducing insect populations that may not be limited by competition and food availability in some agroecosystems [12] [13]. Several studies have shown that insect populations significantly increase when released from predation by spiders. Spiders as predators, are not attached to a particular plant species as a food source, therefore vegetation structure is an important determinant of spider community attributes. In Nigeria however, there are relatively low data on diversities of spider and there is a need for further study on the richness of diversity of spider. Ayansola [14] studied diversity of foliage spiders in two contrasting habitats in rain forest zone of Southwestern Nigeria and his study suggested possible effect of habitat characteristics on the occurrence and diversity of foliage spider species. This present study of ours is therefore aimed at documenting the distribution and diversity of spiders in five different habitats with a view to estimate the influence of habitat structure on diversity of spider in the area of study. This is the first known report on the diversity and distribution of spider's fauna covering five different habitats in Southwestern Nigeria. The information gained on the diversity and distribution of spiders elucidated in this study will play an important role in the management of spiders and related pests in the study area.

2. Materials and Methods

2.1. The Study Area

The study was carried out on the campus of Obafemi Awolowo University (7°31'N and 4°31'E). The university is located at Ile-Ife in Osun State of Nigeria as shown in **Figure 1**. The survey covered five different habitats in Southwestern Nigeria, the first habitat, hill I representing hill collection and it was depicted as A in **Figure 2**, The second habitat, open field was depicted as B in **Figure 2**. The third habitat, hall of residence representing house dwellers and it was depicted as C in **Figure 2**. The fourth habitat, dam representing aquatic habitat and it was depicted as D in **Figure 2**. The fifth habitat, teaching and research farm representing cultivated area was depicted as E in **Figure 2**. The university is in the lowland forest zone according to [15], semi-deciduous moist forest [16] and [17] described as Guinea-Congolian forest, drier type. The dry nature of the Ile-Ife forest is demonstrated by the fact that wherever the soil is shallow, as on the slopes of inselbergs, humid savanna vegetation develops [18]. The university campus occupies an area of 5600 hectares of which the built-up, central campus and the university farms occupy 3349 hectares. As at 1985, regrowth forest, most of it around two (hills I and II) of the three inselbergs on the northwestern corner of the central campus, occupied an estimated 1234 hectares.

The largest patch of forest is around hill I and it is within the biological gardens. Most of the forest is no more than fifty years old except for the top of hill I where shallow soils must have limited farming in the past [19]. The university area is underlain by metamorphic rocks of the precambrian basement complex. The rocks consist of banded gneiss and migmatite, quartzites, quartz, mica schists and related rocks [20]. The soils are moderately to strongly leached and have low to medium humus content, weakly acid to neutral surface layers and

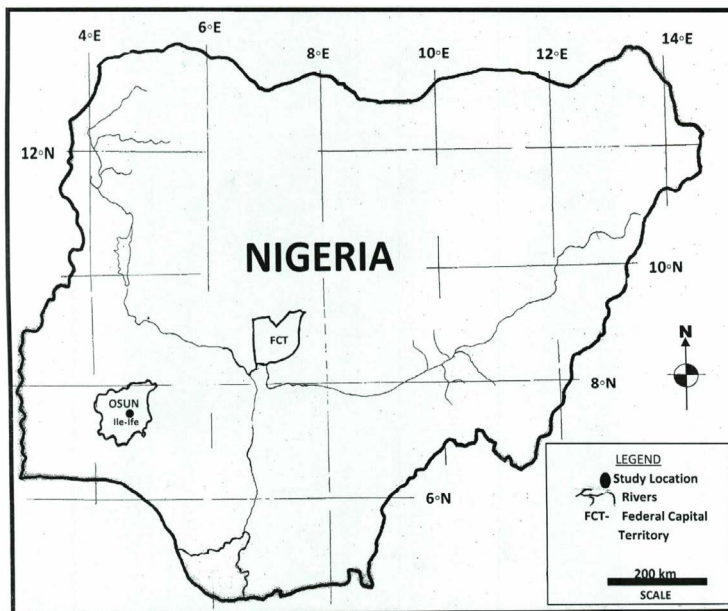


Figure 1. Map of Nigeria showing the study area.

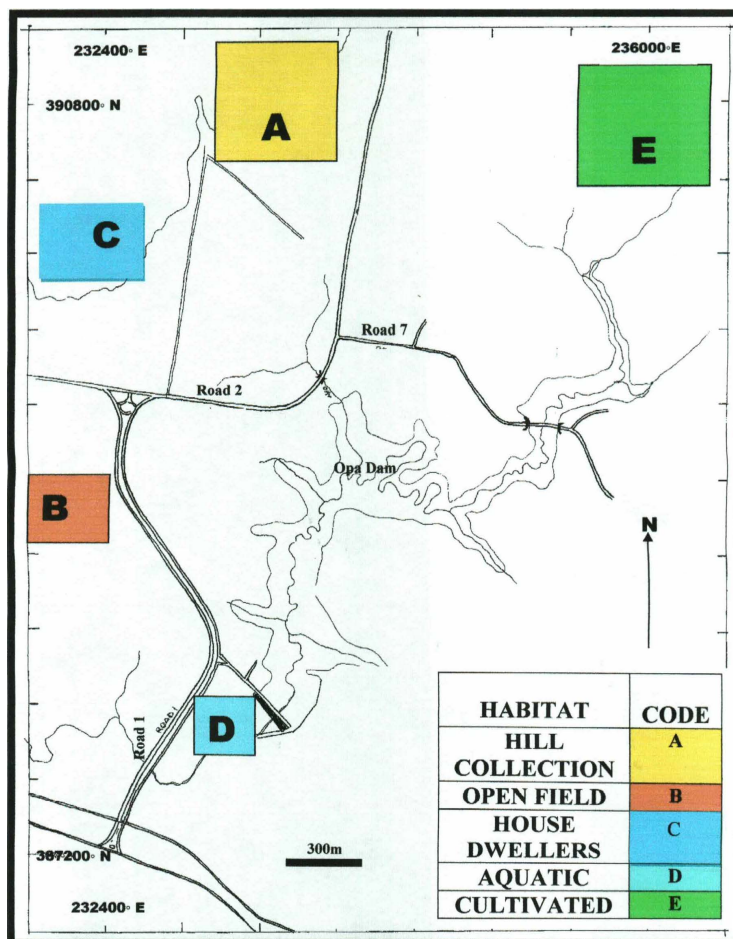


Figure 2. Map of Obafemi Awolowo University layout, Southwestern Nigeria showing collection locations.

moderately to strongly acid sub-soils [20]. The climate of the area is humid tropical with distinct dry and wet seasons. The wet season starts from around mid-March to late October and the rainfall pattern is bi-modal with peak periods in July and September. The dry season runs from November to March but a short dry spell usually occurs in August. The mean annual rainfall is about 1400 mm. The mean maximum temperature of 33°C is recorded between February and March while the mean minimum temperature (27°C) is recorded between July and September.

2.2. Collection Methods

Two different methods of spider collection were used during this study.

1) Handpick method—the specimen were collected by searching under rocks, logs, crevices, and other ground debris; searching thoroughly under loose bark of dead trees and stumps; and examining interior and exterior surfaces of buildings.

2) Sweep net method—sweep net was used where the spider cannot be reached by hand. Standard sweep net (38 cm diameter) is used for collection of spiders where hand cannot be reached. The study was carried out in wet and dry seasons between October, 2012–April, 2013. The specimens found in these habitats were captured and gently picked by hand and transferred to vials containing 70% ethyl alcohol.

2.3. Preservation

Spider collected were kept in 70% - 80% alcohol for wet preservation in a glass specimen tubes with water-tight stoppers [21]. Alcohol prevents spiders from drying out and anatomical parts such as trichobothria, claws, and the setae on the legs, are more easily observed in wet preserved specimens.

2.4. Identification

All collected spiders were placed in small dishes and submerged in alcohol for critical examination. An illuminated Loupe (led light of a little magnifying lens) 20×/21 MM was used to view the arrangement of the eyes and was traced out by hand as rough sketch using existing taxonomic keys. The specimen were identified and described to family level following the species description (**Plate 1**) and keys found in taxonomic literature [22]. The described and identified specimens were listed in alphabetical order for convenience. For convenience, this study followed the currently accepted names as listed in the World spider catalog, version 12.5 [23], African Spiders Identification Manual and Bug Guide US. Representative specimens of collected species were preserve wet and deposited in the Natural History Museum, Obafemi Awolowo University, Southwestern Nigeria.

3. Results

We found 1824 individuals belonging to 19 different spider families in the study area. List of the names of 19 spider families found are given in **Table 1** and **Table 2**. The highest abundance and richness values were accounted in the family Araneidae (**Plate 2**) which represented 45% of the individuals collected. The fifth habitat, Teaching and Research farm representing cultivated area, hosted the highest number of spider family (**Table 1**). All the species recorded in Southwestern Nigeria were found in this habitat. Family Agelenidae (**Plate 3**), Araneidae (**Plate 2**), Linyphiidae (**Plate 4**) and Salticidae (**Plate 5**) were dominant in all habitats. Family Gasteracanthinae present in Habitat A, B, D & E. Family Eresidae, Mimetidae, Oecobiidae, Oxyobiidae, Pholcidae and Tetragnathidae interdwells in three different Habitats (**Table 2**). Family Cithaeronidae, Clubionidae, Pisauridae, Sparassidae and Thomisidae interdwells two different habitats. Family Corrinidae, Ctenidae and Cyatholipidae interdwells only one habitat. Spiders are evenly distributed among the five habitats in this study and the fifth habitat, Teaching and Research farm representing cultivated area has the highest distribution of spider species as shown in **Figure 3**.

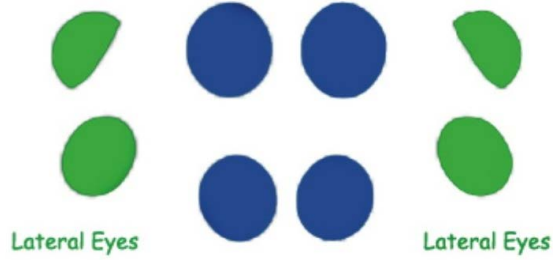
4. Discussion

The abundance of spider in all the habitats in the study area depend greatly upon the availability of prey which serves as food for the spider thus a spider population often reflects on the number of preys in a given area. Both habitats and landscape attribute affects spider species richness and composition. The high number of spider in the cultivated area suggests the effect of agricultural plant on spider. This is in accordance with [24].

Spider Eye Arrangement Terminology

Posterior Eyes Top Row

Median Eyes



Anterior Eyes Bottom Row

Plate 1. Taxonomic tools use for the study.

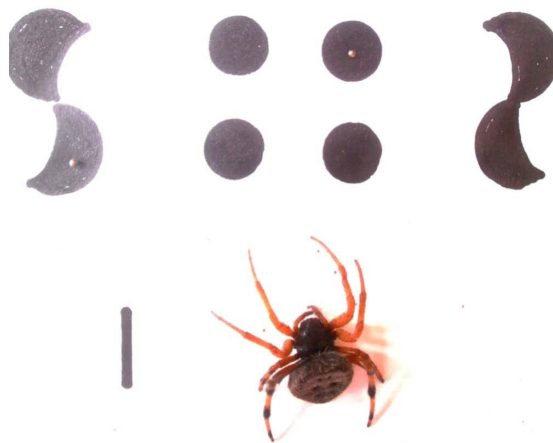


Plate 2. Showing Araneidae and its eye arrangement pattern (scale bar represent 1 cm).



Plate 3. Showing family Agelenidae with eye arrangement (scale bar represent 1 cm).

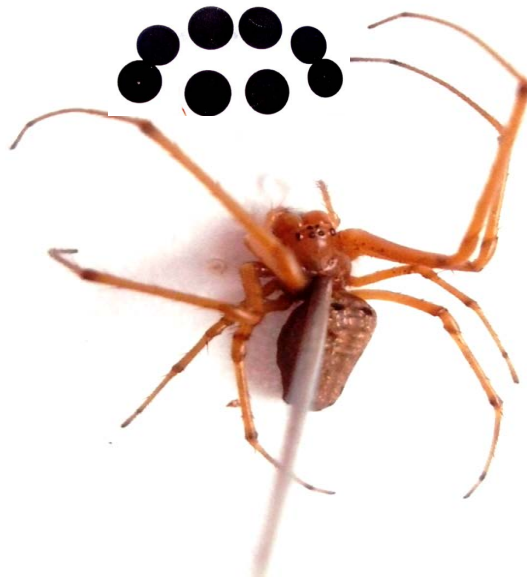


Plate 4. Showing family Linyphiidae and its eye pattern arrangement (scale bar represent 1 cm).



Plate 5. Showing family Salticidae and its eye arrangement pattern (scale bar represent 1 cm).

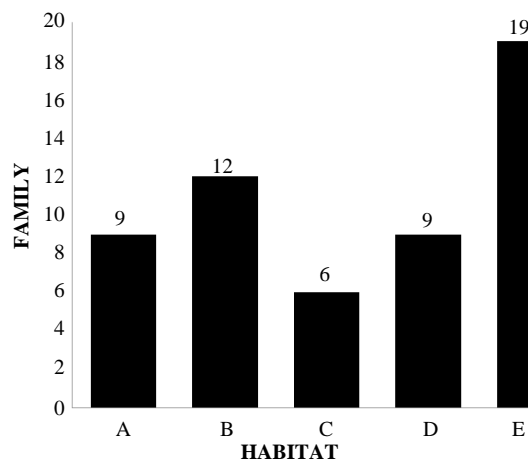


Figure 3. Bar chart measuring spider family distribution in the study area.

Table 1. Distribution of spider families in different habitats within the study area.

S/N	Habitats	Families
1	Hill dwellers	Agelenidae, Araneidae, Eresidae, Gasteracanthinae, Linyphiidae, Oxyopidae, Pholcidae, Salticidae, Sparassidae.
2	Open field dwellers	Agelenidae, Araneidae, Cithaeronidae, Clubionidae, Eresidae, Gasteracanthinae, Linyphiidae, Mimetidae, Oecobiidae, Oxyopidae, Salticidae, Tetragnathidae.
3	House dwellers	Agelenidae, Araneidae, Linyphiidae, Oecobiidae, Pholcidae, Salticidae.
4	Aquatic dwellers	Agelenidae, Araneidae, Gasteracanthinae, Linyphiidae, Mimetidae, Pisauridae, Salticidae, Tetragnathidae, Thomisidae.
5	Cultivated dwellers	Agelenidae, Araneidae, Cithaeronidae, Clubionidae, Corrinidae, Ctenidae, Cyatholipidae, Eresidae, Gasteracanthinae, Linyphiidae, Mimetidae, Oecobiidae, Oxyopidae, Pholcidae, Pisauridae, Salticidae, Sparassidae, Tetragnathidae, Thomisidae.

Table 2. Inter-dwelling of spider family in the study area.

S/N	Family	Habitats					Total
		A	B	C	D	E	
1	Agelenidae	X	X	X	X	X	5
2	Araneidae	X	X	X	X	X	5
3	Cithaeronidae		X			X	2
4	Clubionidae		X			X	2
5	Corrinidae					X	1
6	Ctenidae					X	1
7	Cyatholipidae					X	1
8	Eresidae	X	X			X	3
9	Gasteracanthinidae	X	X		X	X	4
10	Linyphiidae	X	X	X	X	X	5
11	Mimetidae		X		X	X	3
12	Oecobiidae		X	X		X	3
13	Oxyopidae	X	X			X	3
14	Pholcidae	X		X		X	3
15	Pisauridae				X	X	2
16	Salticidae	X	X	X	X	X	5
17	Sparassidae	X				X	2
18	Tetragnathidae		X		X	X	3
19	Thomisidae				X	X	2
Total		9	12	6	9	19	55

A: hill habitat; B: open field habitat; C: house habitat; D: aquatic habitat; E: cultivated.

All the spiders families found in this study have 8 eyes with various patterns of arrangements. Cave spiders which live in the dark have no or any eyesight is not found in this study. Spiders have 2 types of eyes; the main and the secondary eyes, the main eyes are the middle and the largest of the 8 eyes and most of spider in this study possesses it. The eyes of spider differ greatly between the families. Spider who hunt without a web like wolf spiders (lycosidae), lynx spider (oxyopidae) and jumping spiders (salticidae) has well developed eyesight. Jumping spiders are very prominent and can see as humans because it has various eye patterns. There are so

many spiders that give various nasty bites comparable to the stinging of a wasp. Most of the venom injected with these bites causes cell death and give rise to a wound that does not heal properly and becomes easily infected, such spiders are not found in the course of this study.

In hill habitat, nine families of spider are found which are mainly jumping spiders, very fast, tiny and not easy to collect, this may be due to the method of collections adopted for the study. The families of spider collected also may be affected by the landscape of the area. Open field habitat collection covers grassland with low vegetation; the numbers of families collected are twelve families which are tiny, fast not easy to collect due to the method of collection used in the study. House dwellers collection covers some hall of residence in OAU such as Postgraduate hall, Mozambique hall, Angola hall, Awolowo hall, Alumni hall and Moremi hall. The least number of families was found in this habitat, this may be due to regular removal of spider and its web by people living in that environment. It has been observed that human activities tend to create gradients of disturbance with accompanying changes in community structure [25], and was also reported by [14]. In Aquatic habitat, nine families of spider were collected around and inside water. The abundance of spider in this habitat may not be determined due to accessibility. Cultivated habitat has the highest diversity of spider as shown in **Figure 3**. This is in accordance with the findings of Whitmore *et al.* [11] that Spider has also been found to have great potential to serve as biological control agent against crop pests in cultivated habitat. The collection in this habitat covers tick plantation, plantain plantation, cocoa plantation, citrus plantation and some food crop such as cassava and maize. Nineteen families were collected in this habitat. The abundance of spider in this habitat shows the richness of prey which serves as food for the spiders, [24]. This can also be attributed to presence of diverse plant which may serves as host plant for different insect, thus invite more preys to this habitat. It conforms to the study of Marshall [2] that showed that provide an important service of keeping insect populations under control in a diverse plant environment. The highest spider diversity recorded in cultivated habitat is as a result of good habitat management put into practice by the farmers and it is in accordance with the work of Tsai *et al.* [26].

High number of spider family recorded in cultivated and open field habitats reflects vegetation complexity which spider rely on for their life cycle, either for finding food, building retreats or for web building. The structure of the vegetation has been reported by Whitmore *et al.* [11] to influence the diversity of spiders found in the habitat with complex vegetation. This indicates that structural diversity of the vegetation may influence the spider diversity. Studies of Tews *et al.* [27], Pinkus-Rendón *et al.* [28], Jiménez-Valverde & Lobo [29] have demonstrated that a correlation exists between the structural complexity of habitats and species diversity. This means that spider diversity generally increases when a greater variety of habitat types are present as it was found in the cultivated and open field habitats. The third habitat, hall of residence representing house dwellers that has the least number of spider family showed little or no variation in physical structure. Tsai *et al.* [26] put it forward that the physical structure of environments has an important influence on the habitat preferences of spider species, especially web-building species [9]. This could explain the larger spider richness and diversity observed in cultivated habitat where vegetation seems more diverse. Also, people perception of spider as human enemy could be a factor decreasing spider diversity in hostels, given that in general, as disturbance increases the spider species richness decreases [28] [30].

5. Conclusion and Recommendation

Nineteen different families of spider are represented in Obafemi Awolowo University, Southwestern Nigeria during this study. Nine families were found in hill habitat; twelve families were found in open field habitat; six families were found in house dwelling habitat; nine families were found in Aquatic habitat; and nineteen families were found in Cultivated habitat. These have enriched the collection of spiders in Natural History Museum, Obafemi Awolowo University, Nigeria. There is a need of studies that will probe further to cover more localities and use better sampling techniques in future. We, therefore, recommend studies that will investigate spiders' diversity at state by state level in Nigeria.

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