

**DIVERSITY OF GROUND DWELLING SPIDERS IN SOUTH  
WAYANAD FOREST DIVISION**

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**(16-02MS-002)**

**DISSERTATION**

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**POOKODE, WAYANAD, KERALA, INDIA**

**DECLARATION**

I hereby declare that this dissertation titled “**Diversity of Ground Dwelling Spiders in South Wayanad Forest Division**” is a bonafide record of research work done by me during the course of my Master’s research program and that the dissertation has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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Certified that this dissertation, titled “**Diversity of Ground Dwelling Spiders in South Wayanad Forest Division**” is a bonafide record of research work done independently by **Aperna Mohan K. M (16-02MS-002)** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, associate ship or fellowship to her.

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We, the undersigned members of the advisory committee of **Aperna Mohan K. M (16-02MS-002)** a candidate for the degree of Master of Science in Wildlife Studies, agree that the dissertation entitled, “**Diversity of Ground Dwelling Spiders in South Wayanad Forest Division**” may be submitted by **Aperna Mohan K. M (16-02MS-002)** in partial fulfillment of the requirement for the degree.

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**EXTERNAL EXAMINER**

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# **INTRODUCTION**

## 1. INTRODUCTION

Spiders are Arthropods which are considered as the largest order of Arachnids evolved around 400 million years ago and seventh largest group of species in the world (Chetia and Kalita, 2012). The sub-orders of the order Araneae are Mesothelae with one family, Orthognatha/Mygalomorphae includes 15 families and Labidognatha/ Araenomorphae with 112 families. Mesothele and Mygalomorphae consist of primitive spiders and Araenomorphae are modern spiders. Mygalomorphae and Araenomrphae spiders are reported in India. (Sebastian and Peter, 2009).

Arachnids are characterized by the presence of jointed appendages and a chitinous exoskeleton, the body is divided in to two distinct regions the cephalothorax with four pairs of segmented legs and abdomen. Spiders are unique in the sense which can be easily differentiated from other arachnids due to the presence of the pedicel, a narrow stalk like structure which connects the cephalothorax and abdomen, which is fused form in other arachnids. Spider also has silk producing organ called spinnerets in the abdominal region. All spiders are venomous but few are harmful to humans.

Spiders are generalist predators and they are abundant and inhabited almost all ecosystems and play a significant role in ecological equilibrium at the same time they are very sensitive to habitat loss, environmental changes and climatic variations. Generally, they prefer on temperature and humidity which limit them to areas within the range of their “physiological tolerances” which make them ideal candidates for land conservation studies (Riechert and Gillespie, 1986). Due to their small sized body and short generation time it can be considered as a good biological indicator to study the ecosystem changes and habitat modifications (Kremen *et al.*1993) but they are getting only less concern and are highly ignored in conservation based studies. According to world spider

catalog 2016, Natural History Museum of Bern listed 46,386 spider species belonging to 4027 genera and 113 families.

India has rich spider diversity but the knowledge on Indian spiders is less. (Jose, *et.al.* 2018) A total of 1686 species belonging to 438 genera and 61 families were reported from India (WSC, 2015). Spiders are very important in ecological studies but in India spiders are poorly studied arthropod groups (Palem *et al.* 2016).

The importances of spiders are not only limited to ecological and biological aspects but also it has tremendous commercial importance. Silk of spider is a fibrous protein which contains amino acids, glycine, alanine and serine. Due to high strength, flexibility and light weight properties spider silk is used in many industries such as manufacturing of air craft, bullet-proof jackets, ropes, biodegradable bottles etc. It is also used in medical field for making bandages, surgical threads, artificial tendons or ligaments and supports for weak blood vessels etc. Spider venom has also its significance, it is a complex mixture of neurotoxic peptides, proteins and low molecular mass organic molecules. However spider venom is used in the neuro muscular and cardiac treatment. Even though apart from the above mentioned values spiders are not getting any proper attention in conservational status often they are ignored when other “charismatic” species are highly protected. (Sebastian and Peter, 2009)

Ground dwelling spiders are those species that are seen in ground, grasses, rocks, crevices, leaf litters, under wooden logs etc. They are mobile arthropods, small and abundant and show high degree of niche overlapping. Except few species most of the ground dwelling spiders do not build webs. Based on their foraging strategy some of this are very active hunters, in which they chase the prey and hunt them, some are sit and wait hunters and some are web spinners (Uetz *et al.* 1999).

Western Ghats is one of the most recognized biodiversity hotspot with endemic species of flora and fauna. Spiders are less charismatic species and the

study based on spiders are comparatively less due to the lack of experts, spider study from India and Western Ghats remain few (Sudhikumar *et al.* 2005)

The major objectives of the study are:

- To assess species richness and diversity of ground dwelling spiders in forest areas and plantations of South Wayanad Forest Division
- To determine the environmental and biological factors that influence species composition
- To check endemism and affinities in spiders of South Wayanad Forest Division towards any other region

# **REVIEW OF LITERATURE**

## **2. REVIEW OF LITERATURE**

### **2.1. DIVERSITY OF SPIDERS**

#### **2.1.1. Global studies on spider species diversity**

Ghafoor and Mahmood (2011) studied the population dynamics of spider species in paddy and sugar cane cultivation from Gujranwala district of Pakistan. They reported 22 species belonging to seven families and 10 genera. The Lycosidae was found as the most dominant family with maximum species and Oxyopidae was the least common family with minimum number of species.

Koneri and Nangoy (2017) studied the spider diversity and species composition at different habitat in Sahendaruman Mountain such as secondary forest, shrub and plantation area from, Sangihe Islands, North Sulawesi, Indonesia and they recorded 117 species from 15 family and 62 genera. Out of the 15 families *Nephilidae* was seen only at the shrub whereas *Pholcidae* found only at the secondary forest and the other 13 families were common in three habitats. Species diversity was high in the secondary forest (34.98 %) and low in the shrub (32.27 %). The study revealed that there was no significant difference between secondary forest and plantation area in the case of species diversity, abundance, species richness and evenness.

Chathuranga and Ranawana (2018) studied the spider fauna of upper Hanthana Mountain Area, Central Srilanka and reported 84 species belonging to 18 families. Araneidae (28.17%) Salticidae (15.49%) and Tetragnathidae (11.28%) were the most abundant families with higher number of species.

#### **2.1.2. Spider diversity studies from India**

Siliwal *et al.* (2005) published an updated checklist of Indian spiders using Platnick's "The World Spider Catalog" and other publications in Indian region and they revealed 40 new species which are not included in the catalog. Further

Thikader's list was compared and described 59 families with 1442 species and they recommended 51 species for taxonomic verification.

Quasin and Uniyal (2011) studied the diversity of spider on the three high altitude regions in the Nanda Devi Biosphere, Uttarakhand based on microclimatic change. The study reported 244 species from 108 genera and 34 families. They found that diversity of species decreased with increase in altitude due to the sensitiveness of some species to several environmental factors. In the case of ground dwelling spiders, they noticed a hump shaped decline in graphical representation of the data along with altitude which shows species richness and diversity were abundant at the middle region than higher and lower elevation.

Keswani *et al.* (2012) published the updated checklist of spider fauna of India with a total number of 1686 species from 438 genera and 60 families.

Wankhade and Manwar (2013) conducted study at Sawanga-Vithoba lake in the district of Amravati, Maharashtra, India. A total of 42 species from 14 families were reported. They divided the species based on guild structure in to different functional group in which orb web weavers were maximum in number of species (54%) followed by foliage runner (24%), ground runner and ambushers (8%) and scattered line weaver (6%).

Dhali *et al.* (2016) published a check list on Mygalomorphae spiders from 17 different states and two union territories of India. They recorded 32 genera and 8 families with 111 species. Maximum species were reported from Tamil Nadu followed by Kerala and they reported higher spider diversity in Western Ghats.

Yadav *et al.* (2017) published preliminary check list of spiders in Gujarat, they reported 149 species from 99 genera and 28 families and updated the check list in to 415 species from 169 genera, in the total species reported 31 species are endemic to Gujarat, 150 species endemic to India and 26 species endemic to South Asia.

Kumari *et al.* (2017) studied the diversity and distribution of spiders in arid and semi-arid zones of Rajasthan. A total of 46 and 17 families were recorded during the study. Sampling was done in different areas such as wood land, marshy, pasture and caves/crevices/rocky areas. They reported maximum species from the wood land habitat (31.86%). Aranidae and Oxyopidae were the dominant families of this habitat. Minimum number of species (17.61%) were collected from rocks, crevices and caves. They noticed a relationship between canopy cover and number of species.

Halarankar and Pai (2018) compared the diversity of spiders from two different sites in Goa namely Akhada, St. Estevam, Goa, an island (Site-1) and Tivrem-Orgao, Marcela, Goa, a plantation area (Site-2) by comparing the distribution and ecology of spiders. They reported 29 species belonging to the 8 families and 19 genera from Site-1 and 30 species belonging to 7 families and 18 genera from Site-2. They reported seasonal variation, the species density and diversity.

### **2.1.3. Study of spider diversity from Western Ghats**

Kapoor (2008) made a comparative study on the effects of fragmented rain forests and coffee plantation on spider communities in Western Ghats. Total of 192 species were reported and noticed that species richness was fewer at high altitude sites and fragmented areas than in mid altitude and continuous forest sites.

Sudhikumar *et al.* (2008) studied on the affinities of spider species in Western Ghats towards African and South East Asian region. Their study revealed that among the 270 species, 138 genera and 39 families listed from Western Ghats of which 91 species and six genera were endemic to Western Ghats region, four genera showed connection with African region and 18 genera showed affinities towards South Asian region with 68 species.

Sebastian *et al.* (2012) conducted a study on the spider diversity of Western Ghats of India. They reported 275 species belonging to 139 genera from

39 families in total of 44 endemic species of Western Ghats and 45 species to Indo-Sri Lankan region.

#### **2.1.4. Diversity of spider studies from Kerala**

Jose (2005) conducted faunistic survey of spiders in Kerala during May 2000 to September 2004. Study was carried out in moist deciduous forest and ever green forest. He could find 418 species from 161 genera and 38 families, including 34 new species. He also described that some of the species showed affinities with Oriental and Palearctic region and updated 214 species to the total number of spiders in India. By zoogeographic analysis it was reported that 15 species were endemic to Kerala and 74 species to India and 40 species endemic to Indo Srilankan region.

Sebastian *et al.* (2005) documented spider fauna of Mangalavanam mangrove ecosystem and they reported 52 species from 40 genera and 16 families of which seven species were endemic to the Indian region.

Sudhikumar *et al.* (2005) recorded 72 spider species in 57 genera and 20 families from Mannavan shola forest, Kerala, in which they reported 15 species were endemic to Western Ghats and described two new species, *Oedignatha carli* (Corinnidae) and *Hyllus diardi* (Salticidae), and two genera, *Nerienne* (Linyphiidae) and *Coleosoma* (Theridiidae) along with first time report of 30 species from Kerala. It was the first study of spider fauna from Shola Forests in India.

Sudhikumar *et al.* (2005) conducted study on spiders in two different seasons of paddy cultivation in the agro ecosystem of Kuttanad, Kerala and they analyzed that water availability was dependent on differences in species composition in both seasons.

Adharsh and Nameer (2016) published a checklist of spider fauna from Chinnar Wildlife Sanctuary of Western Ghats. A total of 29 families with 101

species belonging to 65 genera were reported. Based on the seven analyzed feeding guilds, ground runners were the dominant guild with 26 species followed by 23 species were orb web weavers, stalkers with 14 species, 13 species of ambushers, 12 species were space web builders, 10 foliage runners and sheet web builders were the minimum (3 species).

Jose *et al.* (2018) studied the diversity of spider from Kavayi river basin, Kerala, 112 spider species belonging to 81 genera and 21 families were listed, in which orb web weavers (32%), stalkers (28%), ambushers (12%), ground runners (7%), foliage runners (6%), wandering sheet weavers (2%), and sheet web weavers (15%) were divided on the basis of functional groups or guilds.

#### **2.1.5. Spider diversity Studies from Wayanad district**

Dhali and Sureshan (2016) published a preliminary checklist of spiders from the paddy fields of Wayanad district, Kerala. A total of 41 genera and 11 families with 54 species were reported. They noticed that jumping spiders were the most diverse group and orb weavers were more spiders in Wayanad.

Jose (2010) conducted a pioneer study on the diversity of spider species in Wayanad plateau and recorded 82 species of spiders under 43 genera and 15 families.

Caleb *et al.* (2018) rediscovered a rare species (*Chrysilla volupe*) of jumping spider from Wayanad Wildlife Sanctuary after 150 years.

## **2.2. BIODIVERSITY STUDIES ON SPIDERS**

Marc and Canard (1997) stated that a single species may not be very efficient in controlling a precise pest, but a greater biodiversity increases the abilities of the species and controlling insect pest in a given ecosystem.

Sugumaran (2001) conducted a systematic study on biodiversity of spider in Western Ghats of Tamil Nadu, a total of 56 species were recorded from 18

families and he observed that species diversity richness and evenness was very high at mixed dry deciduous and moist deciduous forests and also noted that the species composition varied with different altitudes and vegetation pattern, altitude of 500-1500 m possessed maximum number of species diversity.

Uniyal and hore (2008) worked on the diversity and structure of spider assemblages in the conservation area, India and concluded that diversity of species increased with structural complexity of the habitat.

### 2.3. ECOLOGICAL STUDIES ON SPIDERS

Maelfait and Hendrickx (1997) conducted an assessment on anthropogenic effect on natural and semi natural habitats in Flanders (Belgium) using spiders as bio-indicators. They studied the effect of heavy metal pollution on spider species (*Pirata piraticus*) and noticed that the species was highly contaminated with Cd, Cu and Zn. The presence of Cd was the major stress factor which affected on Developmental instability and reproductive ability of the species.

Sabu *et al.* (2008) studied on the litter ant diversity in different elevations of Wayanad regions of Western Ghats in relation with biotic and abiotic factors and they could analyze the positive correlation between the abundance of ants and spiders.

Battirola *et al.* (2016) did an ecological study to describe the association between spider assemblage and canopies of *Vochysia divergens* (Vochysiaceae) in northern region of Brazilian Pantanal. They observed that phenology of the host plant and seasonal variations were the major reason for the amalgamation of each other, it showed that during the flood season, like other arthropods, ground dwelling spiders taken shelter on the canopies of *V. divergens* to escape from water rise and for foraging during high water periods.

Ossamy *et al.* (2016) assessed the environmental impact in Ashtoum el Gamil natural protected area Port Said, Egypt by using spiders as the potential

bio-indicators. Their studies revealed that spider species richness and diversity abundance were partially higher at disturbed sites than natural sites. They suggested that patchy disturbance increased the number of niches which made the species to stay at disturbed sites and away from the natural sites.

Palem *et al.* (2017) studied about the spider fauna in Eastern Ghats of Southern Andhra Pradesh. They revealed that anthropogenic disturbances affected the spider fauna which was the potential bio indicator of every ecosystem.

Stokmane and Spuņģis (2016) described about the species richness, diversity and community organization of spider in the Apšuciems calcareous fen, Latvia based on the vegetation and it concluded that vegetation height was negatively influenced on the spider diversity and vegetation with mosaic pattern increased spider diversity than single patches.

Pandit and Pai (2017) studied in the Taleigao Plateau, Goa, India. They found that areas with high temperature and humidity have more number of micro niches, which was favorable for species density and richness.

Schowalter (2017) studied on the arthropod diversity and their functional importance in old growth forest. The Study described that spiders are one of the major predators in the forest floor along with other arthropod species.

#### 2.4. STUDIES ON GROUND DWELLING SPIDERS

Uetz and Bultman (1982) observed that spider density is more depended on litter depth than litter structure and nutrition content.

Uetz (1991) noticed that litter characteristics and elevation were also important criteria for determining spider community composition.

Weeks and Holtzer (2000) conducted a study on ground dwelling spiders in steep grass ecosystem. They suggested that species-specific responses to variations in habitat structure are important in structuring the overall spider

community and this sort of species level knowledge was necessary to predict habitat and seasonal distributions of ground-dwelling spiders in grassland ecosystems.

Wagner *et al.* (2003) studied the spatial hierarchy of forest floor spiders with litter depth and observed that the cursorial species occupy in the upper layer and the web building in the middle and lower region. They observed that the size of the species decreases with increasing litter depth and also noticed that various abiotic factors influence the species distribution along with litter depth.

Castro and wise (2009) studied about the influence of fine wood debris on spider community. It was the first experiment to study the effect of fine wood debris on ground dwelling arthropods in an unharmed forest floor and they found that the abundance of spider density was higher in few genera by the influence of fine wood debris.

Steffen and Draney (2009) studied on ground dwelling spiders in oak in degraded Oak Woodland at the Chicago Botanic Garden, Cook County, Illinois and they tried to describe the relationship between litter density and non-native spider plentiness with native spider diversity.

Buchholz (2010) studied about the ground spider assemblages in inland sand ecosystem of central Europe. The study aimed to derive conservation and management strategies in inland ecosystem by using ground spider species as an indicator key species correlated with environmental factors and habitat structure.

Rodrigues *et al.* (2010) conducted a comparative study of ground spider assemblages in eucalyptus plantation and grass land in the Pampa biome, southern Brazil. They noticed that comparing the spiders in eucalyptus plantations most of the species were able to escape from predators by getting shelter and substrate due to high litter density and in the grasslands they are easily exposed to predators but the heterogeneity of species was high in grassland ecosystem because of diversity of plant.

Sac and Li (2012) surveyed on leaf litter spiders from three National parks in Northern Vietnam. They revealed that diversity of species was high in multi layered vegetation compared to simple layered vegetation.

Mallis and Hurd (2005) conducted sampling of ground dwelling spiders in south eastern Virginia to study the habitat specialization of species.

Raychaudhuri and Saha (2017) studied on leaf litter and ground dwelling spider diversity of Dooars, West Bengal.

# **MATERIALS AND METHODS**

### **3. MATERIALS AND METHODS**

#### **3.1. STUDY AREA**

The present study was conducted for three months from April-June 2018 in the area of South Wayanad forest division which is the part of Nilgiri Biosphere, connected with Western Ghats and Deccan Plateau from the southern tip. The area is rich in its biodiversity and habitat with splendid number of flora and fauna. The whole district has an average annual rain fall of 300 mm, the highest rain fall areas of Wayanad are Lakkidi, Meppady and Vythiri having an average rainfall of 3000-4000 mm per year. There was decreasing trend of rainfall in the recent years but during the study time rainfall was comparatively too high and resulted for flooding and land sliding in most areas of Wayanad. The district also having the high relative humidity it may goes up to 95 per cent with high velocity of wind during south west monsoon and it cause severe cold in the high altitude regions.

Forests of Wayanad is divided in to three major divisions. Wildlife Sanctuary (344.44 km<sup>2</sup>), Wayanad North (214.29 km<sup>2</sup>) and Wayanad South Forest Divisions (325.339 km<sup>2</sup>). Brahmagiri (1608m), Banasura peak (2073 m), Chembara peak (2100 m) are the main highest peaks, which are surrounded by rain forests in South Wayanad Forest Divison. Forests in the South Wayanad Forest Division includes Meppadi, Kalpetta and Chedeletth Forest Ranges which is bordered by Peruvannamuzhi and Thamarasseri Ranges of Kozhikode district and Vazhikkadavu Range of Malappuram District to the south. Nagarhole TR, Bandipur TR and Wayanad WWS makes boundary to the north east and south east part of the Division in Chedeletth Range. A small part of Meppadi Range makes border with Gudalur Reserved Forest of Nilgiri district to the southeast.

### 3.2. SAMPLING METHOD

The study was carried out in three regions of South Wayanad Forest Division from April 2018 to June 2018. Sampling was done through visual encounter and hand picking method. The hand collection method in which the species were directly collected from ground, field by making quadrat. A total of 60 quadrats was made in three habitat types (Semi-evergreen, Moist deciduous and Plantations) with 20 quadrats per habitat of size 5x5m. An interval distance of 50m were given between successive quadrat. Each sample quadrat was thoroughly searched, and habitat variables such as canopy cover (%), litter cover (%), grass cover (%), litter depth, temperature, humidity, soil moisture, and human disturbance were noted. Spiders photographs were taken for species identification. Further species with that were not identified in the field were only collected and preserved in 70% ethanol. Spider species were identified of literatures (Pocock, 1993; Thikader and Biswas 1981; Thikader, 1987) and species with ambiguous identification, experts working in spiders were contacted for confirmation of species identification.

### 3.3. STATISTICAL ANALYSIS

Basic statistics *viz.* arithmetic mean, standard deviation and standard error were calculated for all the replicative variables and are given as  $X \pm 1SD$  or  $X \pm SE$ . Statistical analysis was performed by using Windows based statistical package *viz.* Microsoft Excel, PAST (Hammer *et al.* 2001) and SPSS (IBM SPSS Inc., Chicago, Illinois, USA). Checklist of the observed spiders were made and percentage composition of each families were calculated and represented as bar diagram. The diversity indices such as Simpson and Shannon-Wiener index of spiders species from each habitat were analysed with the help of software PAST.

Environmental factors such as canopy cover, litter cover, litter depth, grass cover, soil temperature and humidity that influence spider abundance were tested

using multiple regression. Linearity was examined by plotting the relationship between response variable (number of detections) and each predictor variable (abundance and size) using Lowess Plot. To investigate multi collinearity between the environmental covariates, a correlation analysis was conducted before using multiple regressions to assess the relationships between the response variable and predictor variables, thereby providing valid parameter estimates and p values.

Dominance: 1-Simpson index. Ranges from 0 (all taxa are equally present) to 1 (one taxon dominates the community completely)

Diversity indices Shannon index and Simpson diversity index were used to calculate both abundance and evenness of species.

$$H = - \sum_{j=1}^S P_i \ln P_i$$

In the Shannon index ( $H$ ),  $P_i$  is the proportion of individuals,  $\ln$  is the natural log,  $\Sigma$  is the sum of the calculations and  $S$  is the number of species.

$$(D) = \frac{1}{\sum_{i=1}^S p_i^2}$$

In the Simpson index ( $D$ ),  $P_i$  is the proportion,  $\Sigma$  is still the sum of the calculations and  $S$  is the number of species.

Shannon diversity divided by the logarithm of number of taxa. This measures the evenness with which individuals are divided among the taxa present.

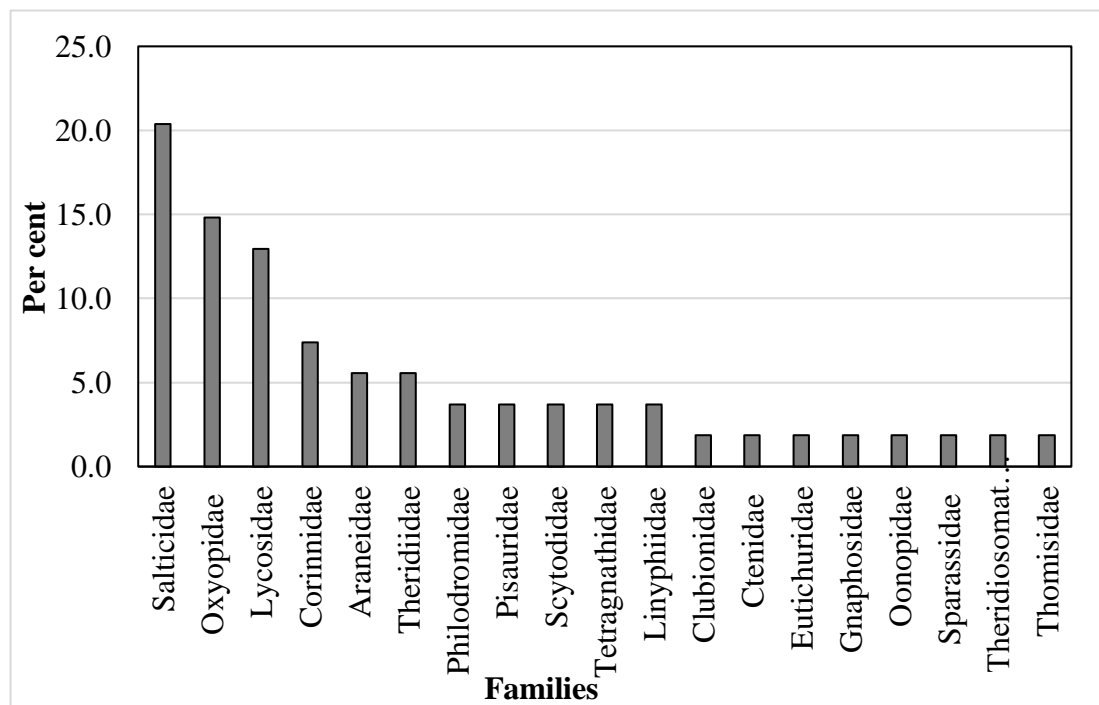
# RESULTS

## 4. RESULTS

### 4.1. SPIDER SPECIES COMPOSITION

Spider species composition and diversity were studied in the Semi-evergreen, Moist deciduous forest and plantations of South Wayanad Forest Division from April 2018 to June 2018. There were 54 species belonging to 19 families were recorded. Among different families Salticidae had the highest per cent (20.37%), followed by Oxyopidae and Lycosidae with 14.8% and 11.11% respectively. Corinnidae, Araneidae and Theridiidae had more than five per cent species composition. Spider families such as Clubionidae, Ctenidae, Eutichuridae, Gnaphosidae, Oonopidae, Sparassidae, Theriodiosomatidae and Thomisidae had least per cent composition with 1.85% each respectively.

Figure 1 Per cent composition of spiders belongs to different families in three habitat of South Wayanad Forest division



#### 4.2. SPIDER DIVERSITY

Number of species varied among habitat with the highest number of species recorded in the Semi-evergreen forest (32). The number of individuals recorded were higher in the Semi-evergreen forest followed by moist deciduous forest and plantation. Dominance was higher in the MDF and plantations with a few species dominating these regions. Both diversity indices Simpson and Shannon diversity indices were higher in the Semi-evergreen forest. Evenness of species composition was highest in the plantation. Overall species diversity was 3.59. Thus diversity, richness and abundance was higher in the Semi-evergreen forest followed by Moist deciduous and Plantation.

Table 1 Spider species dominance, diversity and evenness in three habitat of South Wayanad Forest division

Parameters	Semi Evergreen	Moist Deciduous Forest	Plantation	Overall
Number of species	<b>32</b>	20	19	54
Individuals	<b>123</b>	68	53	244
Dominance (D)	0.05	<b>0.07</b>	<b>0.07</b>	0.04
Simpson index	<b>0.95</b>	0.93	0.93	0.96
Shannon (H')	<b>3.20</b>	2.80	2.78	3.59
Evenness	0.76	0.83	<b>0.85</b>	0.67

#### 4.3. ABUNDANCE OF SPIDERS

A total of 54 species and 244 individuals were recorded during the study period. Among different species, certain species were more abundant such as *Hasarius adansoni*, *Polyboea zonaformis*, *Hippasa agelenoides*, *Tibellus elongates* and *Ctenus cochinchensis* were recorded with higher number (>10 individuals). Species such as *Neriene sundaiica*, *Pardosa mysorensis*, *Pardos sp.*, *Oxyopes bharatae*, *O. birmanicus*, *Dendrolycosa gitae*, *Chalcotropis pennata* and *Scytodes fusca* were recorded with medium abundance (<10 individuals).

There were five species of spiders are endemic to Western Ghats, they are *Ctenus cochinensis*, *Hippasa agelenoides*, *Oxyopes bhadatae*, *Tibellus elongates* and *Stenaelurillus lesserti*. Further there were six species of spiders are endemic to South Asia viz., *Gea subarmata*, *Parawixia dehaani*, *Nerienne sundaica*, *Oxyopes birmanicus* and *Tylorida ventralis*. In total there were 11 species of spiders recorded were endemic to this region. About 20.3% of spiders recorded in the sample area are endemic species to Western Ghats (9.23%) and South Asia (11.1%).

Table 2 List of spider species recorded in the Meppadi Range of South Wayand Forest Division

S. No.	Family	Species	No. of Individuals	Remarks
1	<b>Araneidae</b>	<i>Gea</i> sp.	2	
2		<i>Gea subarmata</i> Thorell, 1890	4	**
3		<i>Parawixia dehaani</i> Doleschall, 1859	1	**
4	<b>Clubionidae</b>	<i>Clubiona</i> sp.	2	
5	<b>Corinnidae</b>	<i>Apochinomma</i> sp.	1	
6		<i>Cambalida deorsa</i> Murthappa et al., 2016	4	
7		<i>Castianeira</i> sp.	1	
8		<i>Corinnomma</i> sp.	2	
9		<i>Ctenus cochinensis</i> Gravely, 1931	10	*
10	<b>Eutichuridae</b>	<i>Cheiracanthium</i> sp.	1	
11	<b>Gnaphosidae</b>	<i>Gnaphosa</i> sp.	2	
12	<b>Linyphiidae</b>	<i>Linyphia</i> sp.	1	
13		<i>Nerienne sundaica</i> (Simon, 1905)	6	**
14	<b>Lycosidae</b>	<i>Hippasa agelenoides</i> Simon, 1884	12	*
15		<i>Lycosa</i> sp.	4	
16		<i>Lycosa tista</i>	4	
17		<i>Pardosa mysorensis</i> Tikader & Mukerji, 1971	7	
18		<i>Pardosa pseudoannulata</i> Bösenberg & Strand, 1906	3	**
19		<i>Pardosa</i> sp.	8	
20		<i>Pardosa sumatrana</i> Thorell, 1890	3	
21		<b>Oonopidae</b>	<i>Opopaea</i> sp.	1
22	<b>Oxyopidae</b>	<i>Hamataliwa foveata</i> Tang & Li, 2012	2	
23		<i>Hamataliwa</i> sp.	1	
24		<i>Hamadruas</i> sp.	2	

25		<i>Oxyopes bharatae</i> Gajbe, 1999	8	*
26		<i>Oxyopes birmanicus</i> Thorell, 1887	6	**
27		<i>Oxyopes javanus</i> Thorell, 1887	5	
28		<i>Oxyopes pankaji</i> Gajbe & Gajbe, 2000	4	
29		<i>Oxyopes</i> sp.	7	
30	<b>Philodromidae</b>	<i>Thanatus</i> sp.	5	
31		<i>Tibellus elongatus</i> Tikader, 1960	11	*
32	<b>Pisauridae</b>	<i>Dendrolycosa gitae</i> Tikader, 1970	8	
33		<i>Polyboea zonaformis</i> (Wang, 1993)	23	
34	<b>Salticidae</b>	<i>Carrhotus</i> sp.	2	
35		<i>Chalcotropis pennata</i> Simon, 1902	9	
36		<i>Epeus</i> sp.	1	
37		<i>Evarcha</i> sp.	3	
38		<i>Hasarius adansoni</i> (Audouin, 1826)	26	
39		<i>Marengo</i> sp.	2	
40		<i>Phintella</i> sp.	1	
41		<i>Stenaelurillus albus</i> Sebastian et al., 2015	2	
42		<i>Stenaelurillus lesserti</i> Reimoser, 1934	5	*
43		<i>Stenaelurillus</i> sp.	1	
44		<i>Thyene bivittata</i> Xie & Peng, 1995	4	
45	<b>Scytodidae</b>	<i>Scytodes fusca</i> Walckenaer, 1837	6	
46		<i>Scytodes thoracica</i> Latreille, 1802	1	
47	<b>Sparassidae</b>	<i>Heteropoda venatoria</i> Strand, 1907	3	
48	<b>Tetragnathidae</b>	<i>Leucauge decorata</i> Blackwall, 1864	5	
49		<i>Tylorida ventralis</i> Thorell, 1877	3	**
50	<b>Theridiidae</b>	<i>Phycosoma</i> sp.	4	
51		<i>Theridion</i> sp.	2	
52		<i>Theridula</i> sp.	1	
53	<b>Theridiosomatidae</b>	<i>Wendilgarda</i> sp.	1	
54	<b>Thomisidae</b>	<i>Xysticus</i> sp.	1	
			244	

\*- Endemic species; \*\*- Species distributed in South-East Asia

#### 4.4. FACTORS INFLUENCING THE SPECIES ABUNDANCE

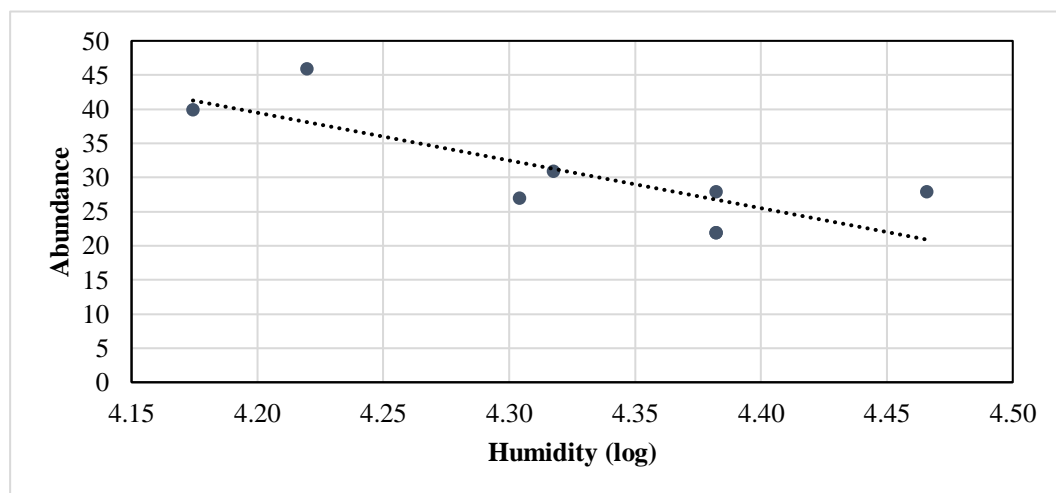
The factors that influence species abundance were regressed with environmental variables such as canopy cover, litter cover, litter depth, grass

cover, soil temperature and humidity. Among different factors, variables such as soil temperature, humidity and litter depth had significant influence on the species abundance (Table-3). The best model was selected by step-wise procedure by adding variables. The model of was highly significant and explained 92% of variability of species abundance ( $R^2= 0.917$ ;  $F=11$ ;  $df=3$ ;  $p<0.05$ ). Among these variables humidity had primary influence, followed by soil temperature and litter depth. Soil temperature and litter depth are only marginally significant. Thus the abundance of spiders in the study area is highly negatively influenced by the humidity.

Table 3 Results of multiple regression that explains the factors that influence species richness of spiders in three habitat of South Wayanad Forest division

Model	Parameters	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	ANOVA
		B	Std. Error	Beta			
Abundance of spiders ( $R^2=0.917$ )	(Constant)	932.997	237.045		3.936	0.029	F=11.0; df=3; p<0.05
	Soil temperature (log)	-88.726	33.693	-1.028	-2.633	0.078	
	Humidity (%)	-140.729	31.155	-1.604	-4.517	0.020	
	Litter depth (log)	-2.741	1.066	-0.531	-2.572	0.082	

Figure. 3. Relation between the humidity and abundance of spiders in three habitat of South Wayanad Forest division

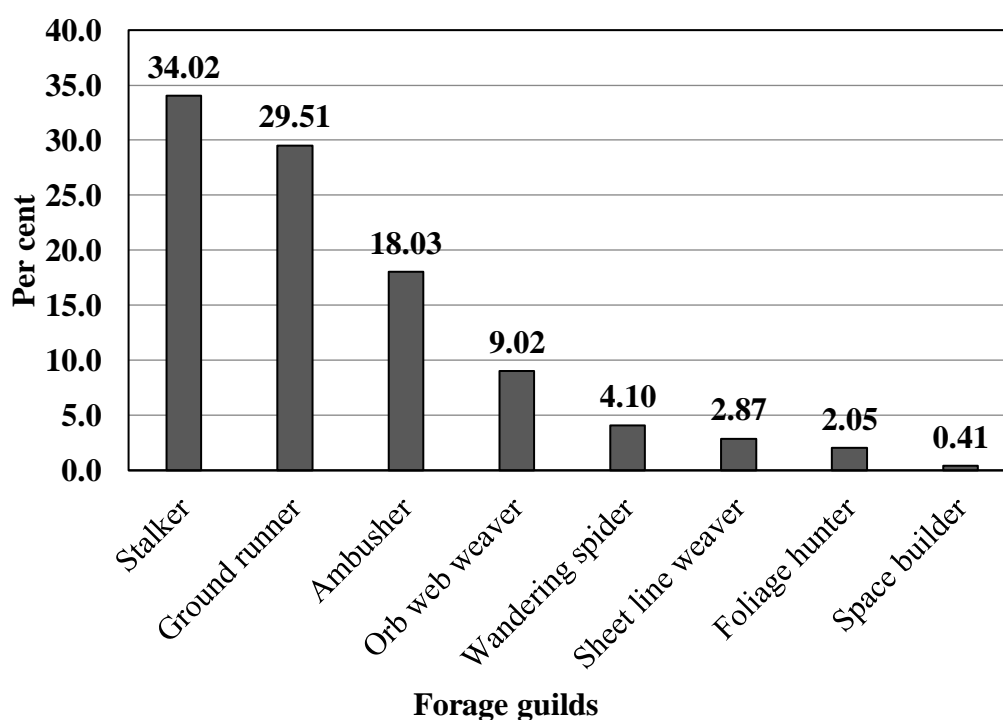


Multiple regression revealed that humidity had strong negative influence on the abundance of spiders in the study area. Increase in humidity resulted in the reduced abundance of spiders as shown in the figure-3. Humidity ranges from 65% to 87%, since the range of variance was low it was converted in to log scale that clearly indicate the negative influence of humidity on the spider abundance (Fig.3).

#### 4.5. FORAGE GUILD

Spider species forage guild composition showed that they occupy eight different forage guilds. The majority of the spiders 81.6% of spiders were Stalkers, Ground runners and Ambushers (Fig.4). Orb-web spiders and wandering spiders were constituted 13.1% collectively. Other foraging guild spiders such as sheet-line weaver, foliage hunter and space builder were constituted less than 3% each.

Figure. 4. Per cent composition of the spiders occupying different forage guild in three habitat of South Wayanad Forest division



#### 4.6. ABUNDANCE OF SPIDERS IN DIFFERENT FORAGING GUILDS

There were eight foraging guilds of spiders, recorded in the Meppadi range of South Wayanad forest division. Maximum number of species were stalkers, followed by ground runner and Ambushing spiders. The number of foraging guilds varied with higher guilds in the MDF and plantation. There were only five foraging guilds recorded in the SEF. Hence though the species diversity and richness was higher in the SEF, the number of foraging guilds is less in the SEF.

Table 4 Relation between the foraging guild and habitat of the spider species in the Meppadi range of South Wayanad Forest Division

<b>Foraging Guild</b>	<b>Semi-Evergreen forest</b>	<b>Moist Deciduous Forest</b>	<b>Plantation</b>	<b>Total</b>
Stalker	41	25	17	83
Ground runner	49	14	9	72
Ambusher	26	13	5	44
Orb web weaver	5	6	11	22
Wandering spider		6	4	10
Sheet line weaver		3	4	7
Foliage hunter	2		3	5
Space builder		1		1
<b>Total</b>	<b>123</b>	<b>68</b>	<b>53</b>	<b>244</b>

**PLATES**



**A**



**B**

**Plate 1. Spider web**

**A. Spiderlings in a web, B. Funnel web spider**



**A**



**B**



**C**

**Plate 2. Family : Araneidae and corinnidae**

- A. *Gea subarmata* (Araneidae),**
- B. *Parawixia dehaani* (Araneidae),**
- C. *Castianeira zetes* (Corinnidae)**



**A**



**B**

**Plate 3. Family : Ctenidae and Linyphiidae**

**A. *Ctenus cochinensis* (Ctenidae )**

**B. *Neriene sundaica* (Linyphiidae)**



A



B



C

**Plate 4. Family : Lycosidae**

**A. *Hippasa agelenoides* (Lycosidae)**

**B. *Pardosa mysorensis* (Lycosidae)**

**C. *Pardosa sumatrana* (Lycosidae)**



A



B



C

**Plate 5. Family: Oxyopidae**

**A. *Oxyopes birmanicus* (Oxyopidae)**

**B. *Oxyopes javanus* (Oxyopidae)**

**C. *Hamataliwa* sp. (Oxyopidae)**



A



B



C

**Plate 6. Family: Pisauridae, Salticidae and Sparassidae**

**A. *Dendrolycosa gitae* (Pisauridae)**

**B. *Hasarius adansoni* (Salticidae)**

**C. *Heteropoda venatoria* (Sparassidae )**



A



B

**Plate 7. Family. Tetragnathidae**

A. *Leucauge decorata* (Tetragnathidae)

B. *Tylorida ventralis* (Tetragnathidae)

# **DISCUSSION**

## 5. DISCUSSION

### 5.1. SPIDER SPECIES COMPOSITION

Spider species composition, diversity, and environmental factors influencing abundance in the different habitats of South Wayanad forest division (SWFD) were studied from April 2018 to June 2018. A total of 54 species belonging to 19 families were recorded. Among different families Salticidae had the highest per cent 20.37% followed by Oxyopidae and Lycosidae and with 14.8% and 11.1% respectively. The number of recorded in the study area was less than the similar study conducted in the Mannavan Shola, Kerala where they have recorded 72 species of spiders. The species composition also varied with family Araneidae was dominant (Sudhikumar *et al.*, 2005). The number of species recorded was higher (51 species) than the Mangrove forest in Mangalavanam with dominant spiders are orb weavers and stalkers. Earlier studies conducted in the paddy fields of Wayanad district reported similar number of species (54 species) under 41 genera and 11 families with dominance of Salticidae, Thomisidae and Araneidae (Dhali and Sureshan, 2016). Though the number of species recorded were similar in the present study, they belong to 19 different families showed higher taxonomic distinctions in the natural forest areas such as Semi-evergreen and Moist deciduous forest.

### 5.2. SPIDER DIVERSITY

Both diversity indices Simpson and Shannon diversity indices were higher in the Semi-evergreen forest. Similarly, higher species diversity was reported in dry-mixed deciduous forest and least in the scrub jungle (2.40) (Sugumaran, 2001). Semi-evergreen forest with higher habitat heterogeneity, canopy cover, litter cover could have resulted in the higher spider species diversity in the study area. Evenness of species composition was highest in the plantation. Similar kind of species evenness was recorded with evenness was low in the evergreen forest (0.85) and higher in deciduous forest (0.97) in Tamil Nadu (Sugumaran, 2001).

India is a megadiverse country with several species of spiders, a total of 1,686 species of spiders of 438 genera and 61 families were recorded (WSC, 2015). In the present study 3.2% of spiders distributed in India were recorded. The short duration of study and limited sampling effort would have resulted in the lower per cent of spider species.

### 5.3. ABUNDANCE OF SPIDERS

A total of 54 species and 244 individuals were recorded during the study period. Among different species, certain species were more abundant such as *Hasarius adansoni*, *Polyboea zonaformis*, *Hippasa agelenoides*, *Tibellus elongates* and *Ctenus cochinchensis* were recorded with higher number (>10 individuals). Species such as *Nerienne sundaiica*, *Pardosa mysorensis*, *Pardosa sp.*, *Oxyopes bharratae*, *O. birmanicus*, *Dendrolycosa gitae*, *Chalcotropis pennata* and *Scytodes fusca* were recorded with medium abundance (<10 individuals).

Studies have shown that primitive spiders are distributed in South India with nearly 72% of endemic species (Dhali and Sureshan, 2016). There were five species of spiders, endemic to Western Ghats, they are *Ctenus cochinchensis*, *Hippasa agelenoides*, *Oxyopes bharratae*, *Tibellus elongates* and *Stenaelurillus lesserti*. Further there were six species of spiders, endemic to South Asia. Thus a total of 20.3% of spiders recorded in the sample area were endemic to Western Ghats and South Asia.

### 5.4. FACTORS INFLUENCING THE SPECIES ABUNDANCE

Environmental factors such as soil temperature, humidity and litter depth had significant influence on the species abundance. The model was highly significant and explained 92% of variability of species abundance ( $R^2=0.917$ ;  $F=11$ ;  $df=3$ ;  $p<0.05$ ). Among these variables humidity had primary influence, followed by soil temperature and litter depth. Spiders are sensitive to environmental factors earlier studies in Himalayan mountain revealed that altitude and humidity influence on the spider abundance (Quasin and Uniyal, 2011).

Further spatial heterogeneity, competition, predation and habitat influenced on spider abundance (Rosenweig, 1995). On contrary rather than climatic factors spatial heterogeneity and vegetation influenced spider abundance (Hore and Uniyal, 2010) and prey capture success (Bradley, 1993). Thus there are multiple factors that influenced the spider abundance including environmental factors, prey availability and habitat structure. But in the present study, insect prey abundance, habitat structure were not measured, only the environmental variables such as canopy cover, litter cover, litter depth, grass cover, soil temperature and humidity were measured, among all these only humidity, soil temperature and litter depth influenced the spider abundance. Thus day time temperature variation, illegal forest tree cutting and fire in the deciduous forest area could have divesting effect on spiders in the study area. Control of forest fire, illegal forest clearing and maintaining tree canopy cover would sustain spider species diversity and abundance in South Wayanad Forest Divison.

#### 5.5. FORAGE GUILD

Spider species forage guild composition showed that they occupy eight different forage guilds. The majority of the spiders 81.6% of spiders were Stalkers, Ground runners and Ambushers. The number of forage guilds were higher in the present study than earlier+ report in the mangrove forest of Mangalavanam, Cochin (Sebasin *et al.* 2005). The review of spiders in the Western Ghats indicated Sheet web builders were the dominant forage guilds (Sebastin *et al.*, 2012). Studies done in central India have reported less number of forage guilds with dominant forage guilds as web builders and foliage runners (Wankhade and Manwar, 2013). Thus the forage guilds of spiders varied in different localities depending on vegetation, climatic factors and prey abundance.

## 5.6. ABUNDANCE OF SPIDERS IN DIFFERENT FORAGING GUILDS ACROSS HABITATS

Among different factors, habitat difference in the forage guilds were analysed. The number of foraging guilds varied with higher guilds in the MDF and plantation. There were only five foraging guilds were recorded in the SEF. Hence though the species diversity and richness was higher in the SEF, the number of foraging guilds is less in the SEF. Habitat variables such as canopy cover, litter depth, soil temperature and humidity had profound influence on the spider abundance. Further habitat structure determines species survival and abundance, thus there were difference in the forage guilds across habitats. Influence of habitat heterogeneity and vegetation factors on species abundance were reported earlier (Hore and Uniyal, 2010). Thus habitat structure in terms of herb and shrub density, height that provide support for spider to build nest and hide influence spider forage guild structure.

# **SUMMARY**

## 6. SUMMARY

Ground dwelling spider species composition, diversity, abundance and environmental factors influencing it were studied in three habitats of South Wayanad Forest Division from April 2018 to June 2018. Spider species abundance and diversity was estimated using plot method of size 5m<sup>2</sup>, a total of 60 quadrats were laid in all three habitat types, photographs of spiders were taken for identification. A total of 54 species belonging to 19 families were recorded. Among different spider species recorded, five species were endemic to Western Ghats and six species endemic to South Asia. The majority of the spiders were belonging to Salticidae, Lycosidae and Oxyopidae. Certain species of spiders were more abundant such as *Hasarius adansoni*, *Polyboea zonaformis*, *Hippasa agelenoides*, *Tibellus elongates* and *Ctenus cochinchensis*.

Spider species diversity, richness and abundance varied among habitats with higher diversity in the Semi-evergreen forest followed by Moist deciduous and plantation. Dominance was higher in the MDF and plantations with a few species dominating these regions.

The environmental factors such as canopy cover, litter cover, litter depth, grass cover, soil temperature and humidity that influence species abundance were investigated using multiple regression. Among different factors, variables such as soil temperature, humidity and litter depth had significant influence on the species abundance that explained 92% of variability ( $R^2=0.917$ ;  $F=11$ ;  $df=3$ ;  $p<0.05$ ). Among these variables humidity had primary influence followed by soil temperature and litter depth.

Spider species forage guild composition showed that they occupy eight different forage guilds, the majority of spiders 81.6% of spiders were Stalkers, Ground runners and Ambushers. The number of foraging guilds varied with higher guilds in the MDF and plantation..

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# **ABSTRACT**

**DIVERSITY OF GROUND DWELLING SPIDERS IN SOUTH  
WAYANAD FOREST DIVISION**

**APERNA MOHAN K M**

**(16-02MS-002)**

**Abstract of Dissertation Submitted in Partial Fulfillment of the Requirement  
for the degree of**

**MASTER OF SCIENCE**

**(Wildlife Studies)**

**Faculty of Veterinary and Animal Sciences**

**Kerala Veterinary and Animal Sciences University**

**2018**

**CENTRE FOR WILDLIFE STUDIES**

**COLLEGE OF VETERINARY AND ANIMAL SCIENCES**

**POOKODE, WAYANAD, KERALA, INDIA**

## ABSTRACT

Ground dwelling spider species composition, diversity, abundance and environmental factors influencing it were studied in three habitats of South Wayanad Forest Division from April 2018 to June 2018. Spider species abundance and diversity was estimated using plot method of size 5m<sup>2</sup>, a total of 60 quadrats were laid in all three habitat types, photographs of spiders were taken for identification. A total of 54 species belonging to 19 families were recorded. Among different spider species recorded, five species were endemic to Western Ghats and six species endemic to South Asia. The majority of the spiders were belonging to Salticidae, Lycosidae and Oxyopidae. Certain species of spiders were more abundant such as *Hasarius adansoni*, *Polyboea zonaformis*, *Hippasa agelenoides*, *Tibellus elongates* and *Ctenus cochinensis*.

Spider species diversity, richness and abundance varied among habitats with higher diversity in the Semi-evergreen forest followed by Moist deciduous and plantation. Dominance was higher in the MDF and plantations with a few species dominating these regions.

The environmental factors such as canopy cover, litter cover, litter depth, grass cover, soil temperature and humidity that influence species abundance were investigated using multiple regression. Among different factors, variables such as soil temperature, humidity and litter depth had significant influence on the species abundance that explained 92% of variability ( $R^2=0.917$ ;  $F=11$ ;  $df=3$ ;  $p<0.05$ ). Among these variables humidity had primary influence followed by soil temperature and litter depth.

Spider species forage guild composition showed that they occupy eight different forage guilds, the majority of spiders 81.6% of spiders were Stalkers, Ground runners and Ambushers. The number of foraging guilds varied with higher guilds in the MDF and plantation. Thus present study on spiders provided baseline information on spiders in the South Wayanad Forest Division and

influence of environmental factors on spider abundance that is essential for the management.

# **APPENDICES**

**KERALA VETERINARY AND ANIMAL SCIENCES UNIVERSITY**

Faculty of College of Veterinary and Animal Sciences

**PROGRAMME OF RESEARCH WORK FOR THESIS FOR MASTERS  
DEGREE**

(Vide Rule 25(b) of Post Graduate Regulations 1988)

**1. Title of Dissertation**

16-02MS-002

Diversity of ground dwelling spiders  
in South Wayanad Forest Division,  
Kerala, India

**4a. Name of the Major Advisor  
(Guide)**

Dr. Abdul Azeez C.P.

**2a. Title of departmental/KVASU  
research project of which this  
forms a part**

**4b. Designation**

Assistant Professor,

Department of Gynaecology and  
Obstetrics

Nil

Kerala Veterinary and Animal  
Sciences University,

**2b. Code No. if any, and order by  
which the departmental/KVASU  
research project is approved**

Pookode – 673 576

Wayanad.

Nil

**5. Objectives**

- To assess species richness and diversity of ground dwelling spiders in forest areas and plantations of South Wayanad Forest Division.

**3a. Name of the student**

Aperna Mohan K. M.

**3b. Admission No.**

- To determine the environmental and biological factors that influence species composition.

## **6. Practical and Scientific utility**

Spiders are an important group of generalist predators in the world. They are the largest order of Arachnids and rank seventh in the total species diversity among all the other groups of organisms (Sebastin, 2009). The present knowledge on the spiders of Western Ghats remains confined to the works of Pocock (1900), Hirst (1909), Gravely (1935), and Sinha (1951). Recently Smith (2004), Sugumaran *et al.*, (2005), Jose *et al.* (2006) and Wankhade *et al.*, (2012) tried to document the diversity of spider fauna in and around Western Ghats. Western Ghats is one among the 34 'Biodiversity Hotspots' of the world (Mittermeier *et al.*, 2008). Major contributions to Indian Arachnology were made by Pocock and Tikader who were responsible for bringing spider studies to the notice of other researchers (Siliwal *et al.*, 2005). Considering the importance of spiders in the natural suppression of many insect pests and as bio-indicators,

urgent efforts are needed to understand their diversity. Spiders globally include about 47,099 described species in 4,073 genera and 113 families. Spiders form one of the most diverse groups of organisms existing in India. Previous conservation efforts in India have focused on the larger vertebrates while invertebrates were largely ignored. There is now a growing need to conserve all species and not only the larger vertebrates. Documentation of spider fauna is more important because they play a significant role in the regulation of insects and other invertebrate populations in most ecosystems. A comprehensive data on diversity and distribution of spiders from Kerala region is sparse as compared to other regions of the country. India is having 1,686 species of spiders belonging to 60 families and 438 genera, which constitutes 3.6% of world's spider population. Very little work has been done on spider diversity of Kerala.

Ground dwelling and ground wandering spiders which lives on ground are one of major groups of

spiders and are seen in all habitat. Spiders are ecological indicators to evaluate the nature conservation value and the biodiversity of particular sites or to evaluate the effects of changes in habitat structure brought about by nature-management measures (Selden, 1998). The proposed study will provide baseline information on ground dwelling spider species composition and diversity in South Wayanad Forest Division.

### **7. Important publications on which the study is based**

Sudhikumar *et al.*, (2005) studied the species composition and seasonal variation of spiders in Kuttand, Kerala. Spider abundance was sampled using quadrat method. They reported 94 species of spiders in agroecosystems.

Siliwal and Molur (2009) re-described, distribution and status of the Karwar Large Burrowing Spider *Thrigmopoeus truculentus* from Karnataka.

Halarankar and Pai (2018) studied distribution, diversity and ecological aspects of spiders in the selected

habitats of Goa for a period of nine months. They reported that spider diversity was influenced by habitat, vegetation structure and anthropogenic activities.

Dennis *et al.*, (2015) studied the effect of livestock grazing on spider species richness and diversity in the Sub-montane habitats in the Southern Highlands of Scotland. Grazing management benefits spiders and reported benefit to foods webs in sub-montane ecosystem.

There were only few studies from Kerala especially from the protected areas Joseph et al.<sup>11</sup> reported 20 species of spiders from Periyar Tiger Reserve.

### **8. Outline of the technical programme**

#### **i. Study area**

South Wayanad Forest Division (SWFD) is a part of Western Ghats. The total area of the division is 325.3km<sup>2</sup> and lies between North latitude 11°26' to 12°00' and East longitude 75° 75' to 76° 56'. The altitude varies between 600 and 2100 m and the evergreen forests of

Wayanad are considered as the highest rainfall regions of Kerala and South India. The annual rainfall ranges from 3000-4000 mm. The area is characterized by high relative humidity 95% during the South West Monsoon. Administrative divisions of the SWFD are Kalpetta, Mepady and Chedeled ranges. This division is dominated by pockets of evergreen and semi evergreen vegetation and moist deciduous forest, with the high elevation areas characterized by shola-grassland ecosystem. The mid-level plateau of the district is the most densely populated area which covers a major part of the land and the natural vegetation of these areas have been replaced by coffee, tea, eucalyptus, banana and rubber plantations. There were no studies on spiders in the study area, hence the present study was designed to estimate spider species richness diversity.

## **ii. Species richness and diversity**

Ground dwelling spider species richness will be estimated by visual encounter method.

The study area will be divided into smaller grids of by dividing the study into four square kilometer grids. Further the area will be stratified into different strata based on vegetation type. Randomly the number of grids will be selected and transect length of one kilometer will be laid. Two sample plots of 5m<sup>2</sup> will be laid at every 200m in a transect line.

In each sample quadrant will be thoroughly searched, individual spiders photographs, habitat variables such as canopy cover (%), litter cover (%), grass cover (%), litter depth, temperature, humidity, soil moisture, pH and human disturbance will be collected.

## **9. Main items of observations to be made**

1. Spider species richness and diversity in the South Wayanad Forest Division.
2. Effect of ecological components on species richness and diversity of spiders
3. To check endemism and affinities in spiders of South Wayanad Forest Division towards any other region

**10. Facilities**

**10a. Existing:** Camera, Digital  
Compass

**10b. Additional facilities required:**

Field guide, Macro lens

**11. Duration of study:** One semester

**12. Financial estimate:**

S. No.	Materials	Cost (Rs)
1	Forest tracker wages	2,000
2	Reference book	2,000
3	Equipments	1,500
4	Miscellaneous	1,000
	<b>Total</b>	<b>6,500</b>

**13. Signature of student****14. Signature of Major Advisor**

Place:

Date:

**15. Name, designation and signature of members of the Advisory Committee****1. Dr. Abdul Azeez C.P.**

Assistant Professor,  
Department of Gynaecology and  
Obstetrics  
Kerala Veterinary and Animal  
Sciences University,  
Pookode, Wayanad – 673 576

**2. Dr. Muhasin Asaf V.N.**

Department of Animal breeding and  
Genetics,  
College of Veterinary and Animal  
Sciences,  
Pookode, Wayanad.

**3. Dr. George Chandy**

Officer in-Charge  
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College of Veterinary and Animal  
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**Appendix 1****Reference**

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## **Appendix II**

### **Semester IV**

1. Field Observations
2. Data Collection and Analysis
3. Interpretation of Results
4. Dissertation Writing

## **CERTIFICATE**

Certified that the research project has been formulated observing the stipulations laid down under the Prevention of Cruelty to Animals Act (Amendment, 1998)

Place

**Dr. Abdul Azeez C.P.**

Date

Guide

## **CURRICULUM VITAE**

**Name of Candidate** : Aperna Mohan K M

**Date of Birth** : 05/051993

**Place of Birth** : Kerala

**Marital Status** : Unmarried

**Major Field of Specialization** : Wildlife Science

**Permanent Address** : Kannanthara House  
Cherpu west,  
Thrissur

**Educational Status** : BSc. Botany, B.Ed

**Professional Experience** : NIL

**Number of Publication Made** : NIL

**Membership in Professional Bodies** : NIL