RESEARCH ARTICLE

Spider diversity in different habitats at Jaintia Hills of Meghalaya

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ABSTRACT

Large scale destruction of the forest habitat along with the expansion of urban area may affect the distribution pattern of different spider species. Hence a study was conducted from January to April, 2017 to find out the distribution of spider in different habitats at Jowai area in Jaintia Hills of Meghalaya, India. For this, five numbers of quadrat each with 50m X 50m was plotted in forest, shrub habitats and five numbers of houses, and different techniques were followed. Once spider was sighted, they were photographed and then released immediately. Data was collected in three consecutive days alternately for 9 days per month during morning and evening hours. Data analysis was done using the Shannon-Wiener Diversity Index and Pielou's Evenness Index. Study found 24 species of spider belonging to 10 families in Jowai area of Meghalaya. Family Araenidae was represented by the highest number of spider. Web spider was dominant (45%) in comparison to other in terms of number. Species diversity was 2.17 and evenness was 0.7 which further indicates the abundance of different species in different habitats. Interestingly, more number of spiders was found in the forest area in comparison to shrubs and human habitation. This clearly indicates that conversion of the forest land into urban habitat leads into variation in distribution and abundance of spider in this area.

Key words : Spider, species diversity, Jowai, Jaintia Hills, Meghalaya.

INTRODUCTION

Spider belongs to the order Araneae occupying seventh position in the world on the basis of total species diversity (Sebastian and Peter, 2009). There are about 44,906 species of spider belonging to 3,935 genera and 114 families in the world (Plantick, 2013). About 1,686 species of spiders were recorded from India (Keswani *et al.*, 2012).

Spiders are cosmopolitan in distribution and locally abundant in terms of individuals and taxa. Their small body size allows them to maintain their community in small area. They are an integral part of ecosystem playing an important role in the structure of communities and food webs, both as an

individual numbers and as energy consumers. Ground dwelling food energy can be transmitted to higher level of food energy through spiders.

Spider has also an important role in the ecosystem maintenance. They are considered as the prospective biological control agents (Riechert and Bishop, 1990). They feed on small insect and in turn eaten by birds and other carnivores maintaining the trophic balance of nature.

Spiders also act as an indicator of health of the ecosystem (Churchill, 1997, 1998; Hore and Uniyal, 2008). Their species composition changes with the change in vegetation and subsequently the distribution and abundance of other species of insect, birds and mammals of an area.

Majority of the studies covered the evolution (Coddington and Levi, 1991; Oxford and Gillespie, 1998; Hauber, 2002; Hoese *et al*., 2006; Vaclav, 2006) and biology of the spider (Ford, 1977; Foelix, 1996; Oxford and Gillespie, 1998). Few studies covered the web construction mechanism (Wise, 1993; Tso *et al*., 2004, 2006, 2007). Some studies are also conducted on the distribution of spider in agro-ecosystem like irrigated rice ecosystem (Sebstian *et al*., 2005), cashew orchards (Raghavendra, 2001), tea ecosystem (Hazarika and Chakrobarti, 1998), coffee plantation (Kapoor, 2008) Soybean agro-ecosystem (Rypstra and Carter, 1995). Similarly, some studies were also conducted on the distribution of spider in the natural forest like Shola forest (Sudhikumar *et al*., 2005), mangrove forest (Sebastian *et al*., 2005), Terai vegetation (Upamanya and Uniyal, 2008) and semi-evergreen forest (Chetia and Kalita, 2012). The ecological role of spider was least studied covering spider as natural pest control (Nyffeler and Benz, 1987) and other ecological function (Tumbull, 1973; Wise, 1993). Studies are also there on the distribution of spider species in highly urban area like Kolkata and its vicinity area (Tikader and Biswas, 1981).

Diversity of spider in India is well documented by several researchers (Tikader, 1980; Siliwal *et al*., 2005; Keswani *et al*., 2012). However, site specific distribution and diversity of spider well studied in South India (Raghavendra, 2001; Sebastian *et al*., 2005; Kapoor, 2008). Some studies are also there in Northeast India covering Sikkim (Tikader, 1970; Biswas and Biswas, 2003), Tripura (Biswas and Majumder, 2000a), Manipur (Biswas and Biswas, 2004), Mizoram (Biswas and Biswas, 2007), Arunachal Pradesh (Biswas and Biswas, 2006), Assam (Chetia and Kalita, 2012; Singh *et al*., 2012; Singh and Borkotoki, 2014) and Meghalaya (Barman, 1975, 1979; Biswas and Majumder, 1995, 2000b). Informations are also there about the diversity of spider in Andaman and Nicobar islands of India (Tikader, 1977).

In recent years, the developmental activities results a change in the land use and land cover. This leads into large scale destruction and encroachment of the forest habitat. As a result, spider population is declining day by day due to urbanization (Ramakrishnaiah *et al.*, 2014). Hence, a site specific study of the diversity of spider has great importance to draw a holistic approach in the habitat restoration and conservation of species in the future. So a study was conducted between January and April, 2017 in Jowai area of Meghalaya to find out the distribution of spider in different habitats.

MATERIALS AND METHODS

Study area

Jowai is the headquarters of West Jaintia Hills district in the state of Meghalaya, India. It is located in between 92.2089°E longitude and 20.4509°N latitude at the height of 1,380 m above the sea level. It is located on a plateau surrounded on three sides by the Myntdu river bordering Bangladesh to the south (about 50 km from the Indo-Bangladesh border).

The heavy and long monsoon supports the luxuriant forest of pines over the district. The principal forest produces are timber, bamboo, medicinal herbs and plants, Orchids of different species like Blue Yanda (*Yanda coerulea*), ladies slipper (*Paphiopedilum insigne*), Golden shower (*Cymbidium elegans*), Golden yellow-flower dendrobium (*Dendrobium chrysanthum*), Jewel orchids *Anoectochilus sikkimensis*, etc. are found in the forests.

Methods

(a) Sampling

Three different habitats namely forest, shrub and human residential area were selected for this study. Five number of quadrats each with 50m X 50m was

plotted in forest, shrub habitat and five number of houses was selected as sample location for recording the distribution of spider in different habitat in Jowai area of Meghalaya. Survey was conducted in three consecutive days alternately for 9 days per month during morning (6.00-8.00am) and evening hours (3.00-5.00pm) between January and April, 2017.

During survey, following four different techniques (Coddington *et al*., 1991; Toti *et al*., 2000) were used for locating spider in different habitats.

(i) *Aerial hand collection* : The spiders were searched from the knee height to the top of the vegetation cover and collected by a sweep net having diameter of 36 cm.

(ii) *Ground hand collection* : Spiders were searched on the surface of the ground, rock and plants below the knee level.

(iii) *Beat sheet method* : A light coloured cloth was kept under the vegetation and then the vegetation was shaken robustly to collect the spider.

(iv) *Household goods* : All the hideout areas inside the houses were thoroughly searched to locate the spider.

Once spider was sighted, photographs were taken at the field site for species identification and then released immediately in the same habitat.

(b) Data analysis

Data analysis were done using Biodiversity Pro 2 to calculate the species diversity and evenness indices by the following methods.

(i) Shannon-Wiener Diversity Index (Shannon and Wiener ,1949)

$$H = -\Sigma\, pi \ln pi$$

Where, H= Shannon-Wiener Diversity Index
pi = the relative abundance of each group of organism

(ii) Pielou's Evenness Index (Pielou, 1966)

$$J' = H/ H\, max$$

Where, J'= Pielou evenness index
H= The observed value of Shannon index
H max= lnS
S= Total number of species

RESULTS

A total of 24 species of spider belonging to 10 families were found during the survey period in Jowai area of Meghalaya. However, 2 species among them were not identified (Table-1). Family Araenidae was represented by the highest number (5 species) of spider followed by Tetragnathidae and Thomisidae (3 species each), Nephilidae, Oxyopidae, Lycosidae and Theridiidae (2 species each) and Hersilidae, Salticidae and Theraphosidae (1 species each).

Web spider constituted the highest (45%) followed by 13.6% for foliage dwelling spider, 9.1% each by plant dwelling spider, leaf dweller spider and ground dweller spider and 4.5% each by bark dwelling spider, tube dweller spider and jumping spider (Fig-1).

Table-1 : Different species of spider with respect to their families found in Jowai area, Meghalaya

Family	Species
Tetragnathidae	*Leucauge pondae*
	Tetragnatha mandibulata
	Leucauge decorata
Thomisidae	*Misumena vatia*
	Camaricus formosus
	Amyciaea forticeps
Hersilidae	*Hersilia savignyi*
Nephilidae	*Nephila pilipes*
	Herennia multipuncta
Araenidae	*Gastercantha kuhli*
	Cyrtophora feai
	Neoscona nautica
	Gasteracantha dalyi
	Neoscona mukerjei
Oxyopidae	*Oxyopes rufisternum*
	Oxyopes shweta
Salticidae	*Scytodes thoracica*
Lycocidae	*Hippasa sp*
	Lycosa mackenziei
Theraphosidae	*Morphospecies sp.*
Theridiidae	*Chrysso pulcherrima*
	Chrysso nigra
Unidentified	*2 species*

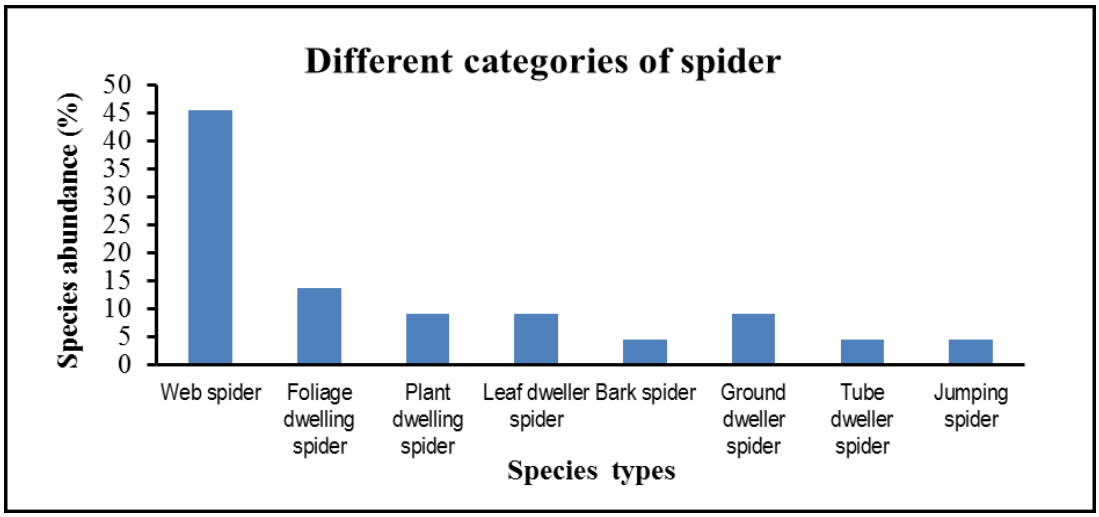

Fig-1 : Category wise distribution of spiders in Jowai area of Meghalaya**.**

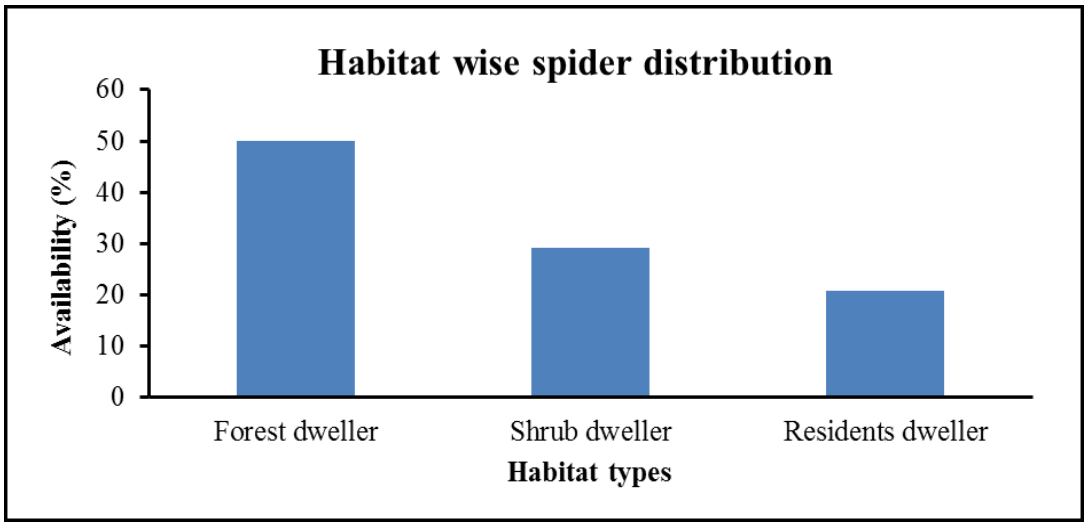

Fig-2: Habitat wise distribution of spiders in Jowai area of Meghalaya

Moreover, majority (50%) of the spider species were forest dweller followed by shrub dweller (29.2%) and resident dweller (20.8%) (Fig-2). Species diversity was found to be 2.17 and evenness 0.7 in our study area.

DISCUSSION

The present study found that there were 24 species of spider belonging to 10 families. Most often, the methodology followed during the survey may have some role on the number of species of spiders found in a particular area (Kapoor, 2006). Furthermore, the habitat characteristics also play a major role on the distribution and richness of spider in a given area. So the richness of spider varies with the habitat pattern. Sugumaran *et al.* (2007) reported 38 species belonging to 13 families in horticulture crops at Yercaud Hills in Selem district of Tamil Nadu, India. They found 28 species belonging to 12 families in coffee plantations followed by 13 species (7 families) in fruit trees, 12 species (7 families) in grasses and shrubs, 10 species (7 families) in pepper crops and 9 species (5 families) in flowering crops. However, Kazim *et al* (2014) recorded 80 species belonging to 21 families in agriculture field. This figure perhaps stands the higher in comparison to the number of spider reported in horticulture area (Raghavendra, 2001; Kapoor, 2008). On the other hand, much more studies were conducted at the forest habitat. The study conducted in Nanda Devi Biosphere Reserve, Dehradun, Uttarakhand found 244 species of spider belonging to 33 families (Quasin, 2011), 104 species belongs to 18 families

from Salbardi forest (Satpura range) of Maharastra (Deshmukh and Raut, 2014) and 115 species of spiders belongs to 13 families from the Indian part of Sundarban Biosphere Reserve, West Bengal (Dhali *et al.,* 2016). Further, the study conducted by Ramakrishnaiah *et al.* (2014) reported 2,351 individuals from four different places at Bangalore where 524 spiders were found from semi urban regions, 1,355 spiders from Bangalore Rural, 197 spiders from Bangalore urban and 275 spiders from Rajaji Nagar Industrial Area. Similarly, the study conducted by Rain *et al.* (2016) reported 116 species belonging to 11 families in Jahangirnagar University campus at Bangladesh. This clearly indicates that the distribution of spider varied with the geographical region.

Different author reported different family as the richest one in different region. Our study identified the family Araenidae as the dominant in comparison to other families. Some previous studies reported similar kind of findings. Quasin (2011) reported Araneidae as the dominant family (18%) followed by Salticidae and Thomisidae (11.5%), Theridiidae (8.6%), Linyphiidae (7.4%), Uloboridae and Tetragnathidae (4.5%), and Gnaphosidae, Oxyopidae, Sparassidae and Lycosidae (4.1%) in Nanda Devi Biosphere Reserve, Dehradun, Uttarakhand. On the other hand, some studies also reported Salticidae as the dominant family. Kazim *et al* (2014) reported family Salticidae as the most common family that represents the highest species diversity while Araneidae is second largest in species diversity and rest of the families has equal quantity. Deshmukh and Raut (2014) also found Salticidae as the most abundant (19.23%) followed by Aranidae (18.26%), Thomisidae (12.05%), Oxyopidae (8.65%), Lycosidae (7.69%), Gnaphosidae (6.73%), Philodromidae (4.76%), Eresidae (3.84%), Tetragnathidae (3.84%), Pholcidae (2.88%), Theridiidae (2.88%), Clubionidae (1.92%) and Uloboridae (1.92%). The least species diversity was recorded in the families of Hersilidae, Miturgidae, Nephilidae, Scytodidae and Sparacidae with 0.96% in each family. Study conducted in Jahangirnagar University campus at Bangladesh also reported Salticidae as the dominant family (Rain *et al*., 2016). However, the study conducted by Ghazanfar *et al.* (2016) found Lycosidae as the most dominant family in Pakistan. So it clearly indicates that there is site specific variation in spider distribution pattern. This may be because of micro habitat types which have some role in species distribution pattern.

Reports are also available on the species diversity and evenness from various localities of the world. Henderson (2007) reported the Simpson diversity index and evenness index which were 0.966 and 0.264 respectively in Lick Creek Park at Texas that indicated low diversity and evenness. On the other hand, Rain *et al.* (2016) reported the Shannon-Wiener index for diversity of 2.18 and Pielou's evenness index of 0.91 in Jahangirnagar University campus at Bangladesh. Deshmukh and Raut (2014) reported the Shannon index, Simpson index and Margalef Richness index as 1.06, 0.103 and 8.4 respectively in Salbardi forest (Satpura range) Maharastra. However, our finding of species diversity (2.17) and evenness (0.7) indicates an abundance of different species in different habitats. This may be because of the study conducted in different habitats. Similar results were also reported in previous studies conducted in different macro-habitat (Sugumaran *et al*., 2007).

Study further revealed that the web spider was dominant in the study area followed by foliage dwelling spider. Previous studies carried out by different researcher forwarded different opinions. Study conducted by Howlader *et al.* (2016) reported the presence of highest number of jumping spiders (36.21%) followed by the orb web spiders (32.75%). The lowest record was found in zunk web spiders which comprises 0.86% of the guild structure. Similar trend of having the highest number (dominant) of jumping spider was reported in Jahangirnagar University campus at Bangladesh (Rain *et. al*., 2016). On the other hand, Anis and Premila (2016) reported that 53.85% of the total spiders in the paddy fields in Thiruvananthapuram district of Kerala state were of hunter while remaining 46.15% were web builders. This indicates that habitat variation may have major role on the distribution and diversity of different kinds of spider.

CONCLUSION

Our study confirmed the presence of more number of spider species in forest habitat in comparison to shrub and human dwelling habitat. This may be because, the natural and undisturbed forest consisting of high plant diversity that forms a complex structure which supports more number of animals including spiders (Uetz, 1991). But if the natural forest become fragmented or land use pattern changes, certain

factors act as barrier in the dispersal and abundance of species (Bonte *et al*., 2004). This may results in less number of spider in human modified landscape like urban area, orchard area etc. This further indicates an impact of urbanization in the variation of distribution pattern of spider across their habitat.

Conflicts of interest: The authors stated that no conflicts of interest.

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