

Distribution, Diversity and Ecology of Spider Species At Two Different Habitats



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Abstract

The study provides a checklist and the diversity of spiders from two different habitats namely Akhada, St. Estevam, Goa, India, an island (Site-1) and the other Tivrem-Orgao, Marcela, Goa, India, a plantation area (Site-2). The study period was for nine months from June 2016 to Feb 2017. The investigation revealed the presence of 29 spider species belonging to the 8 families and 19 genera at Site-1 and 30 spider species belonging to 7 families, 18 genera at site-2. The study on difference in the distribution and diversity of the spiders was carryout and was found to be influenced by the environmental parameters, habitat type, vegetation structure and anthropogenic activities.

Keywords: Spiders; Habitat; Diversity; Distribution; Ecology

Introduction

Spiders are ubiquitous in distribution, except for a few niches, such as Arctic and Antarctica. Almost every plant has its spider fauna, as do dead leaves, on the forest floor and on the trees during winter. They may be found at varied locations, such as under bark, beneath stones, below the fallen logs, among foliage, house dwellings, grass leaves, underground burrows etc [1]. Their success is reflected in the fact that, on our planet, there are about 45,700 recorded spider species and 114 families [2] and they could achieve this level of diversity due to their higher adaptive value apart from morphological and behavioral uniqueness [2]. They possess a pair of neurotoxin poison glands in their cephalothoraxes, which can be used as medicine and non polluting pesticide. Spiders are also known as wandering spiders, ambushing spiders, web-building spiders, commons all spiders etc., and depending upon the nature. Like most of the biological species deforestation, habitat loss due to intensive agriculture and human settlement are the major threat for spider survival.

Recordings of spider diversity was done more than a century ago, [3-20] Stoliczka, Thorell, Cambridge, Simon, Pocock and Sherriffs, Bonnet from various parts of the world. In Indian context [21-34] studied 18 families, 34 genera, 56 species from Gujarat, India. While Sudhikumar et al. [35-39] recorded spiders from Kerala, India. Quasin, Uniyal [40] surveyed Milam Valley Nanda Devi Biosphere Reserve, western Himalayas; Archana [41] surveyed Toranmal Sanctuary, Maharashtra, Chetia, Kalita [42] worked on spiders of Assam. Keswani et al. [43] reported that, India has 1685 spider species belonging to 438 genera and 60 families.

Goa is a tiny state on the Western Coast of India, has an area of 3,702 sq. km. enjoys a tropical climate with moderate temperatures ranging from 21°C-31°C, with monsoon during the months of June to September, post monsoon during October and November winter during December to February and summer from March till May, with an annual precipitation of around 3000mm. as Further, as it falls in transition zone between the Northern and Southern western Ghats, has a unique biodiversity pattern. In Goa, the pioneering work in documenting spider diversity in Goa was carried out by Borkar et al., Bastavade and Borkar [44] during which, they recorded 39 species of spiders from the entire state. In 2017, Pandit and Pai reported 74 spiders' species, belonging to 17 families from Taleigao plateau in Goa. As the work on spider diversity seems to be fragmented and incomplete, the present work on survey for spiders at two different habitats namely an Island viz., Akhada, St Estevam Island and plantation habitat at Tivre-Orgao Marcel, Goa, was undertaken.

Materials and Methods

The study included weekly all out survey as well, seasonal studies from spreading over nine months from June 2016 to February 2017. Methods suggested by Warghat et al. [45-50] viz., hand picking, sweep net, inverted umbrella, kerchief method, pitfall trapping, litter sampling were undertaken. The specimen was collected by weekly quadrat and visual search methods from June to February. Temperature and humidity were measured by Byfuss clock, and photographs were taken from Nikon digital camera as well Samsung Galaxy S duos II

mobile phone. The specimens were preserved in 70% alcohol. Further, identified by following “Handbook Indian Spiders” and “Spiders of India” by Sebastian and Peter [37]. The data was subjected for various relevant indices such as Shannon diversity index, Species richness, Species dominance, Species density, Community Similarity (Sorenson’s coefficient) (Figures 1 & 2).

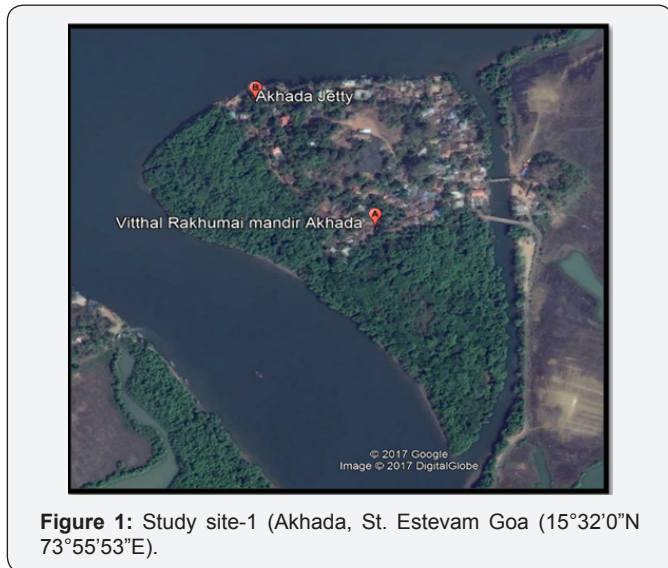


Figure 1: Study site-1 (Akhada, St. Estevam Goa (15°32'0"N 73°55'53"E).

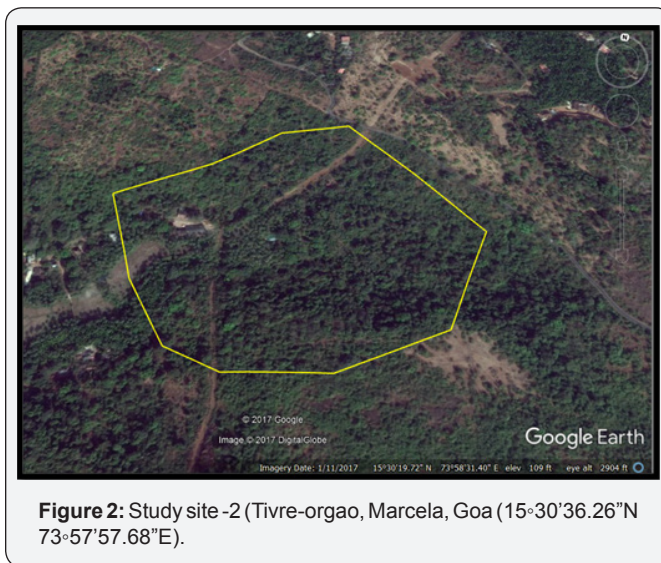


Figure 2: Study site-2 (Tivre-orgao, Marcela, Goa (15°30'36.26"N 73°57'57.68"E).

Results

At study site-1, the temperature ranged from 19°C to 27°C. and humidity ranged from 80% - 96%. Study site-2 recorded temperature between 18°C and 27°C. and humidity between 85% and 97% (Tables 1-4).

Table1: Check List of Spider Species Found at Study Site 1,2.

Family	Species Name	
	Study Site 1	Study Site 2
Araneidae	Cyrtophora citricola (Forsk, 1775)	Cyrtophora citricola (Forsk, 1775)
	Cyrtarachne keralayensis (Jose, 2005)	Cyrtarachne keralayensis (Jose, 2005)
	Cyclosa insulana	Cyclosa insulana (Costa)
	Argiope aemula (Walckenaer, 1842)	Eriovixia laglaizei (Simon, 1877)
	Neoscona sp	Neoscona mukerjei (Tikader, 1980)
	Argiope sp	Neoscona johni sp
	Gea anili (Jose, 2005)	Cyclosa sp
		Neoscona sp
Salticidae		Araneus sp
		Argiope sp
	Carrhotus viduus	Carrhotus viduus (Koch, 1846)
	Plexippus paykullii (Savigny and Audouin 1826)	Plexippus paykullii (Savigny and Audouin 1826)
	Plexippus petersi (Karsch, 1878)	Plexippus petersi (Karsch 1878)
	Hasarius adansoni (Audouin, 1826)	Hasarius adansoni (Audouin, 1826)
	Stenaelurillus albus	Stenaelurillus albus (Simon, 1900)
	Asemonea tenuipes (Cambridge, 1896)	Brettus albolimbatus (Simon, 1900)
	Phintella vittata (Koch, 1846)	Tamigalesus sp
	Telamonia dimidiata (Simon, 1899)	Telamonia dimidiata (Simon, 1899)
	Carrhotus sp	Brettus. sp
	Aelurillus sp.	
Brettus. sp.		

Oxyopidae	Oxyopes birmanicus (Thorell, 1887)	Oxyopes birmanicus (Thorell, 1887)
	Oxyopes javanus (Thorell, 1887)	Oxyopes javanus (Thorell, 1887)
	Oxyopes superbus	
Tetragnathidae	Tetragnatha mandibulata (Walckenaer 1842)	Tetragnatha mandibulata (Walckenaer, 1842)
	Leucauge pondae (Tikader, 1970)	Tetragnatha javana (Thorell, 1890)
		Leucauge pondae (Tikader, 1970)
Nephilidae	Nephila pilipes (Fabricius, 1793)	Nephila pilipes (Fabricius, 1793)
		Nephila kuhli (Doleschall, 1859)
Thomisidae	Misumena vatis (Clerck)	
Sparassidae	Heteropoda nilgirina (Pocock, 1901)	Heteropoda nilgirina (Pocock, 1901)
Pisauridae	Heteropoda venatoria (Linnaeus, 1767)	
	Pisaura gitae (Tikader, 1970)	
Lycosidae		Hippasa agelenoides (Simon, 1884)
		Lycosa tista (Tikader, 1970)
		Pardosa sumatrana (Thorell, 1890)

Table 2: Sorenson's Coefficient of Site 1 and 2.

Seasons	Sorenson's Coefficient	
	Site-1	Site-2
Monsoon – Post monsoon	0.723	0.473
Post monsoon – winter	0.66	0.571
Monsoon - winter	0.25	0.214

Table 3: Sorenson's Coefficient between of both site 1, 2.

Season	Sorenson's Coefficient
Monsoon	0.68
Post monsoon	0.34
Winter	0.26

Table 4: Diversity Indices of Both Site 1,2.

Site	Akhada			Orgao		
	Mon	Post-Mon	Winter	Mon	Post-Mon	Winter
No of species	22	22	14	19	19	9
Total no spiders	559	150	349	548	341	477
Shannons index	2.236	2.744	1.582	2.111	2.426	1.379
H max	3.091	3.091	2.639	2.944	2.944	2.197
Equitability	0.723	0.88	0.599	0.717	0.824	0.62
Species richness	3.3195	4.1910	2.220	2.8542	3.1307	1.29
Species Density	380.272	87.20	202.96	336.19	209.20	292.63

At study site-1, a total of 1058 spiders, belonging to 8 families, 19 genera and 29 species, were recorded during the study period of nine months. Maximum numbers of spiders were observed during monsoon, while minimum numbers of spiders were observed during winter. But, spider diversity was maximum in post monsoon season (Shannon-Wiener diversity index 2.774) and minimum in winter (1.582). Among families observed, seven species were recorded from family Araneidae; ten species were recorded from family Salticidae, three from Oxyopidae and two each from Tetragnathidae and Sparassidae, one each from Nephidae, Thomisidae and Pisauridae. Overall Salticidae is dominant family by having ten species.

During monsoon and post monsoon season *Cyrtophora citricola* of family Araneidae was dominant having constituting

37.03% and 13.33 % of overall spider population respectively. During winter season *Pisaura gitae* was dominant constituting 47.85% of the population. The overall result indicates that, the density of the spider's decreases in post monsoon and increases in monsoon season. Whereas the diversity increases in post monsoon and is least during winter.

The species density decreases to almost 3.7 times from monsoon to post monsoon. This is presumably due to the destruction of the habitat by stubble burning as well burning of grasses which generally occur during November- December. This is the time when there were a very few spiders were observed at the burnt site. At study site-2, during the entire study period, as many as 1339 number of spiders, belonging to 7 families, 18 genera and 30 species were recorded. Maximum numbers

of spider specimen were observed during monsoon season, whereas the minimum number of spider was recorded during post monsoon.

Among families encountered during the study period, ten species were recorded from family Araneidae, eight species were from family Salticidae, three species each from Tetragnathidae and Lycosidae and two from each Oxyopidae and Nephilidae. Overall Araneidae was dominant family having ten species. During monsoon season *Cyrtophora citricola* of family Araneidae was dominant constituting 38.53%. During post monsoon and winter season *Eriovixia laglaizei* dominates the population by 26.11% and 47.85% respectively. Spider diversity was highest post monsoon season (Shannon-Wiener diversity index 2.426) and lowest in winter (1.379).

The overall results indicate that, the density of the spider's decreases in post monsoon and are increases in monsoon season. Whereas the diversity increases in post monsoon and is decreases in winter. While comparing two habitats, it was revealed that, Site-1 had more number of spider species compared to site-2, but the species density was more in site-2, than in site-1. Among the species of spiders that were recorded at site-1, out of 29 species 7 species viz., *Argiope amemula*, *Asemonea tenuipes*, *Phintella vittata*, *Carrhotus sp*, *Aelurillus sp*, *Misumena vatis*, *Pisaura gita*, *P. gitae* were exclusive to the area. Out of 30 species observed at site-2, eight of these species viz., *Eriovixia laglaizei*, *Neoscona mukerjei*, *Cyclosa sp*, *Nephila kuhli*, *Tetragnatha javana*, *Hippasa agelenoides*, *Lycosa tista*, *Pardosa sumatrana* were found to be limited to the site

Discussion

The study was intended to provide a checklist of two habitats and to compare its distribution and ecology of spiders. The nine months weekly surveys showed that, the habitat structure and vegetation complexity determines the presence of spider species, their richness and composition as reported by Valverde and Lobo [51-52]. The habitat heterogeneity hypothesis by Tews et al. [53], states that, the more complex habitat, more niches are available; therefore the higher the species richness. This was confirmed by the present studies too. Further, Uetz, Greenstone, Green [54-56] reported that, the diversity of web constructing spider is correlated significantly with the height of vegetation, while ground dwelling spiders are correlated with the amount of litter. In the similar lines, in present studies too members of Araneidae, which are known to construct web were in larger number during monsoon as the vegetation was higher during monsoon. Similarly ground dwelling spider's species belonging to Salticidae, and Lycosidae were in higher number in winter, wherein leaf litter was more.

Preference of the habitat of spider species is known to be influenced by the physical organization of environmental parameters as they are very sensitive to changes in the habitat arrangement and microclimate [57-60]. The presence and abundance of individuals belonging to specific families will also

depend on the physical characteristics of the vegetation [61], which is proved by the members of the Family Nephilidae in the present studies.

Distribution and occurrence of spiders are influenced by habitat structure and vegetation parameters, alteration of the habitat by anthropogenic activities can cause degradation of habitat and even cause local extinction of the species [62], which results in the suppression of the number of spiders [63]. Species richness is used to assess the quality of the habitat, abundance and species richness of spiders are higher in not heavily manipulated systems [64], which is supported by the present findings, where in reduction in spider diversity was observed as and when there are anthropogenic activities such as burning of stubble/ grass.

Bultman and Uetz [65] in 1982 revealed that the spider abundance is also influenced by the environmental parameters which in turn results in change in spider species diversity and seasonal abundance. In the present context, where the studies were carried out at in two different ecosystems, the results provide additional evidence for the findings of Bultman and Uetz. Generally, temperature and humidity are important limiting factors for microclimatic preferences by spiders as they have varying ranges of physiological tolerances. Therefore, the variation in diversity of spider species among three seasons is expected to be due to difference in temperature, rainfall, humidity and other physical factors of the environment. Different pattern of activities of individual spider and morphology of spider community also influences the variation in seasonal abundance of spider [66-68]. In conclusion it can be said that as the spiders are integral part in the pest management, knowledge on their diversity, distribution pattern, seasonal variation will not only influences the pest population but also of great importance in monitoring the changes of vegetation parameters quality and disturbances of habitat.

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