

Diversity Pattern of Spiders (Araneae) from Two Selected Sites of Mango Orchard, Amreli District, Gujarat, India

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ABSTRACT

Proposed work was conducted from June to November 2019 (06 months) with concerning taxonomy, species composition, feeding guild structure and diversity indices of vegetative crop stage of spiders in Mango orchards at two villages namely Morjar and Dudhala, Amreli district, Gujarat. Overall 166 individuals spiders represent 47 morphospecies of Araneomorph group belonging to 30 genera and 15 families; dominated by family Araneidae (74 individuals, 20 species) followed by Salticidae (39 individuals, 13 species) and Oxyopidae (22 individuals, 5 species). Guild structure analysis revealed seven feeding guilds, namely stalkers, orb-web builders, space-web builders, ambushers, foliage hunters, ground runners and sheet-web builders. Orb-web builders and stalkers were the most dominant feeding guilds representing 51.20% and 36.75% respectively. According to the Sorensen similarity index, the result at the level of species were 64% similar in both study sites during the study period. Ecological

indices like Simpson diversity (1-D and 1/D); Shannon diversity (H), and sheet-web builders. Orb-web builders and stalkers were the most dominant feeding guilds representing 51.20% and 36.75% respectively. According to the Sorensen similarity index, the result at the level of species were 64% similar in both study sites during the study period. Ecological indices like Simpson diversity (1-D and 1/D); Shannon diversity (H), Evenness index (e), Dominance (D) and Margalef richness index (d) were calculated. Diversity indices shown significant in Morjar site as compared to Dudhala site. It concluded that high diversity and species richness in Morjar site due to enough availability of food sources, good habitat structure, climatic factors and shelter to sustain. Evenness index (e), Dominance (D) and Margalef richness index (d) were calculated. Diversity indices shown significant in Morjar site as compared to Dudhala site. It concluded that high diversity and species richness in Morjar site due to enough availability of food sources, good habitat structure, climatic factors and shelter to sustain.

Keywords: Spider, Diversity, Guild, Ecological indices, Mango orchard.

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INTRODUCTION

Spiders are amongst the most omnipresent and

numerous predators in both agriculture and natural ecosystems. Bristow (1941) reported that the availability of spiders in any locality depends on the occurrence of the number of insects in an area, being exclusively predatory to regulate insect populations (Wise 1993). They are one of the predatory fauna found in agriculture fields which feeds on a wide range of insects pests and hence acts as a buffer to limit pest populations. Their importance in agro ecosystems contribute greatly to biodiversity and play a beneficial role in natural pest control (Marc et al. 1999). Spiders are always known to be effective predators. The role of spiders in the biogenesis of different agro-ecosystem and urban area has been studied since 1943 (Kagan 1943, Whitcomb and Bell 1964, Neyffler and Benz 1987, Dean et al. 1982, Trivedi and Dal 2019) and they have an important role in controlling pests. Globally, spiders include about 48,407 described species under 4,163 genera and 120 families (WSC 2020). India also has a very

rich diversity; represented by 1,686 species belonging to 438 genera of 60 families (Keswani et al. 2012). Checklist of spiders in Gujarat reveals a total of 415 species of spiders belong to 40 families and 169 genera updated by (Yadav et al. 2017).

India is the major Mango growing country, contributing nearly 46.74% of the world's area and 40.48% world's production respectively. Kesar Mango is grown in an approximate area of 20,000 hectares in the district of Amreli and Junagadh in the Saurashtra region of Gujarat with an estimated annual production of 2 lakh tonnes. Many pests are damaging the Mango crops and how the spiders and their presence of diverse species communities play a role in controlling the pest were least studied. Phartale et al. (2014) reported diversity and abundance of spiders in mango fields of Latur district, Maharashtra State. Similarly, no data are available for spider diversity from Mango orchard from Gujarat, India. So the work



Figure 1. A. Location of study area in Gujarat B. Location of Morjar village and Mango orchard site 1 C. Location of Dudhala village and Mango orchard site 2.

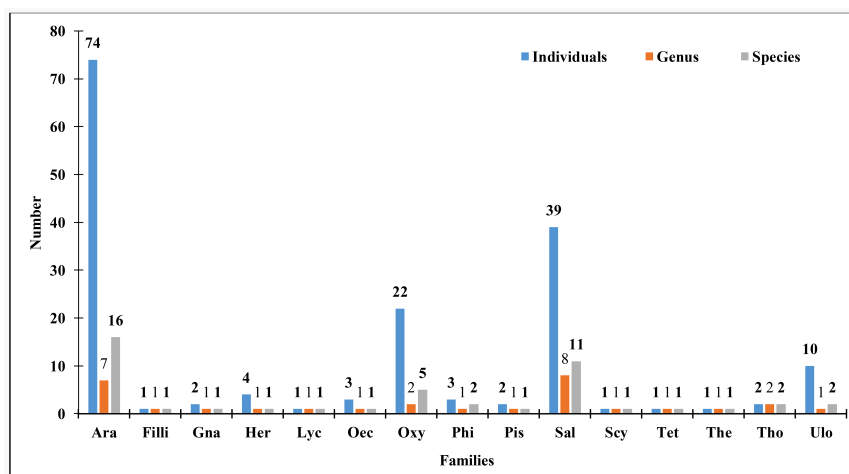


Figure 2. Familial status of Spider Population, Genus and Species of Study sites (Sampling unit N=72).

is aimed to explore the diversity pattern, composition, functional guild analysis, diversity indices and Sorensen similarity index of spiders from study sites.

Table 1. Checklist of spiders present in both study area (+ = Present, - = absent, S1 = Morjar site, S2 = Dudhala site).

Functional guild	Registration No.	Species Name	Sites	
			S1	S2
Orb-web builders	Family: Araneidae			
	SUBIOZ1	<i>Araneus mitificus</i> (Simon, 1886)	+	+
	SUBIOZ2	<i>Araneus</i> sp.	-	+
	SUBIOZ4	<i>Cyclosa spirifera</i> Simon, 1889	+	+
	SUBIOZ5	<i>Cyclosa</i> sp.1	+	-
	SUBIOZ6	<i>Cyclosa</i> sp.2	+	-
	SUBIOZ7	<i>Eriovixia excelsa</i> (Simon, 1889)	+	+
	SUBIOZ9	<i>Gasteracantha</i> sp.	+	-
	SUBIOZ10	<i>Gea subarmata</i> Thorell, 1890	+	-
	SUBIOZ11	<i>Larinia chloris</i> (Audouin, 1826)	+	-
	SUBIOZ12	<i>Neoscona achine</i> (Simon, 1906)	+	+
	SUBIOZ14	<i>Neoscona theisi</i> (Walckenaer, 1841)	+	+
	SUBIOZ15	<i>Neoscona vigilans</i> (Blackwall, 1865)	+	-
	SUBIOZ16	<i>Neoscona</i> sp. 1	+	+
	SUBIOZ17	<i>Neoscona</i> sp. 2	+	-
	SUBIOZ19	<i>Neoscona</i> sp. 3	-	+
	SUBIOZ20	<i>Neoscona</i> sp. 4	+	+
Sheet-web builders	Family: Filistatidae			
	SUBIOZ21	<i>Pritha dharmakumarsinhji</i> Patel, 1978	+	-
Ground runners	Family: Gnaphosidae			
	SUBIOZ22	<i>Setaphis subtilis</i> (Simon, 1897)	-	+

Table 1. Continued.

Functional guild	Registration No.	Species Name	Sites	
			S1	S2
Foliage hunters	Family: Hersiliidae			
	SUBIOZ23	<i>Hersilia</i> sp.	+	+
Ground runners	Family: Lycosidae			
	SUBIOZ24	<i>Lycosa</i> sp.	+	-
Space-web builders	Family: Oecobidae			
	SUBIOZ25	<i>Oecobius</i> sp.	+	+
Stalkers	Family: Oxyopidae			
	SUBIOZ26	<i>Oxyopes bharratae</i> Gajbe, 1999	+	+
	SUBIOZ27	<i>Oxyopes birmanicus</i> Thorell, 1887	+	+
	SUBIOZ28	<i>Oxyopes chittrae</i> Tikader, 1965	+	-
	SUBIOZ29	<i>Oxyopes javanus</i> Thorell, 1887	+	+
Ambushers	Family: Philodromidae			
	SUBIOZ35	<i>Thanatus</i> sp. 1	+	+
	SUBIOZ36	<i>Thanatus</i> sp. 2	+	-
Ambushers	Family: Pisauridae			
	SUBIOZ37	<i>Paranethis</i> sp.	+	-
Stalkers	Family: Salticidae			
	SUBIOZ38	<i>Hasarius adansoni</i> (Audouin, 1826)	+	+
	SUBIOZ40	<i>Langona aperta</i> (Denis, 1958)	+	+
	SUBIOZ42	<i>Langona</i> sp. 1	-	+
	SUBIOZ44	<i>Langona</i> sp. 2	-	+
	SUBIOZ45	<i>Menemerus bivittatus</i> (Dufour, 1831)	+	+
	SUBIOZ46	<i>Phintelloides</i> sp.	+	-
	SUBIOZ47	<i>Phintella vittata</i> (C. L. Koch, 1846)	+	+
	SUBIOZ48	<i>Plexippus paykulli</i> (Audouin, 1826)	+	+
	SUBIOZ49	<i>Stenaehurillus jagannathae</i> Das, Malik & Vidhel, 2015	+	+
	SUBIOZ50	<i>Telamonia</i> sp.	-	+
Foliage hunters	Family: Scytodidae			
	SUBIOZ52	<i>Scytodes</i> sp.	-	+
Orb-web builders	Family: Tetragnathidae			
	SUBIOZ53	<i>Leucage</i> sp.	+	-
Space-web builders	Family: Therididae			
	SUBIOZ54	<i>Theridion melanostictum</i> O. Pickard-Cambridge, 1876	+	-
Ambushers	Family: Thomisidae			
	SUBIOZ55	<i>Tmarus</i> sp.	+	-
	SUBIOZ56	<i>Thomisus</i> sp.	+	-
Orb-web builders	Family: Uloboridae			
	SUBIOZ57	<i>Uloborus plumipes</i> Lucas, 1846	+	+
	SUBIOZ58	<i>Uloborus</i> sp.	-	+

MATERIALS AND METHODS

Study area

The experiment was conducted from June 2019 to November 2019 (for 06 months) from vegetative stages of the Mango orchards at the Village Morjar (21°22'43.5"N, 71°06'51.9"E) and Village Dudhala (21°09'34.8"N, 71°03'21.1"E). Both sites are located at the North - East of Peninsular Saurashtra region, Tehsil Dhari, District Amreli, Gujarat, India (Fig. 1).

A total area of the Morjar site is spread over 69,618 m² and the Dudhala site is spread over 45,017 m².

Methods of collection

Proposed work was conducted during June to November 2019 (06 months) of vegetative crop stage of spiders in Mango orchards at two villages namely Morjar and Dudhala, Amreli district, Gujarat. For the collection of taxa a quadrat method was employed at random and samplings completed under total 36

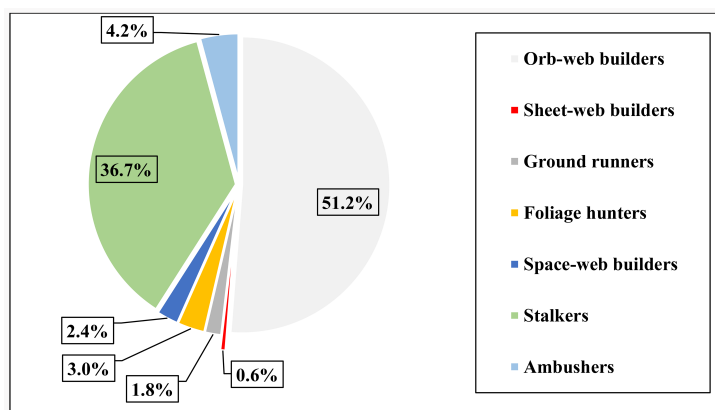


Figure 3. Distribution of spiders according to guild structure from Study sites (Sampling unit N=72).

visits continuous 06 days in a month (03 days/site). Total 72 quadrates (single tree as a quadrate with size between 04×04 m to 07×07 m as per diameter of a single tree) were obtained for samplings in morning (08:00 to 10:00hours) for two hours using aerial hand collection, ground hand collection pitfall traps, sweeping net, umbrella, beating vegetation and litter sampling methods on suitability.

Preservation and identification

As spiders invented, the collection was kept into plastic bottles with small holes for aeration. In the laboratory, only voucher specimens were transferred to 70% alcohol for later identification and kept into specimen tubes 6.0×2.5 cm sized glass vials with screw caps with labelling and remaining common spiders were free to nature for the conservation aspects. The detailed examination for identification of species made under stereo-zoom dissecting binocular

microscope (Stemi 305 Zeiss ISH500) up to generic and species level with updates. Accurate identification on the family, genus and species level is only feasible with an adult specimen. A detailed taxonomic study was carried out based on the various references available on (WSC 2020). Microscopic Photographs of spider were taken using Power Shot A2300 HD Digital Camera, Canon along with above mentioned binocular stereomicroscope and habitus photographs taken by Nikon Coolpix P900 camera.

Data analysis

Data analysis attained checklist with systematics, species composition, familial population up to genus and species level, functional guild analysis, site wise diversity indices, Sørensen similarity index and a photographic plate of spiders with their habitus (Tables 1 and 2, Figs. 2-5).

Ecological indices like Simpson diversity (1-D and 1/D); Shannon diversity-H', evenness index (e), Dominance (D) and Margalef's species richness (d) were computed using PAST software of (Hammer et al. 2001). Sørensen similarity index of (Sørensen 1948) was calculated by the given below formula :

$$QS = \frac{2C'}{A+B}$$

Where A and B are the number of species in site 1 and site 2, respectively and C is the number of species shared by the two sites.

Table 2. Diversity Indices of spiders in Mango orchards of Amreli District, Gujarat, India

Diversity Indices	Site1	Site 2	Overall
Taxa—S	39	30	47
Individuals	88	78	166
Dominance—D	0.05	0.08	0.06
Simpson—1/D	19.17	13	17.20
Simpson—1-D	0.95	0.92	0.94
Shannon—H	3.33	2.99	3.35
Evenness-e ^{H/S}	0.71	0.66	0.61
Margalef richness d	8.48	6.65	8.99
Sorensen similarity index	—	—	64%



Figure 4. Showing habitus photographs of the spiders recorded in study sites during study period.

RESULTS

Out of inventoried 166 spiders of infra order: Araneomorpha, Order: Araneae; total 47 morphospecies, 30 genera and 15 families were recorded during the study period (Table 1). Among them 13 families, 88 individuals, 27 genera and 39 species recorded from Morjar site whereas 09 families, 78 individuals, 20 genera and 30 species recorded from the Dudhala site. The overall supreme population found from family Araneidae with 74 individuals, 7 genera and 16

species which is followed by Salticidae representing 39 individuals, 8 genera and 11 species (Fig. 2). Guild structure analysis (Uetz et al. 1999) revealed seven feeding guild (i.e. stalkers, orb-web builders, space web builders, ambushers, foliage hunters, ground runners and sheet-web builders). Most dominant feeding guild were orb-web builders (51.2%) followed by stalkers (36.7%), ambushers (4.2%), foliage hunters (3%), space web builders (2.4%) ground runners (1.8%) and sheet-web builders (0.6%) of the total collected spiders (Fig. 3).

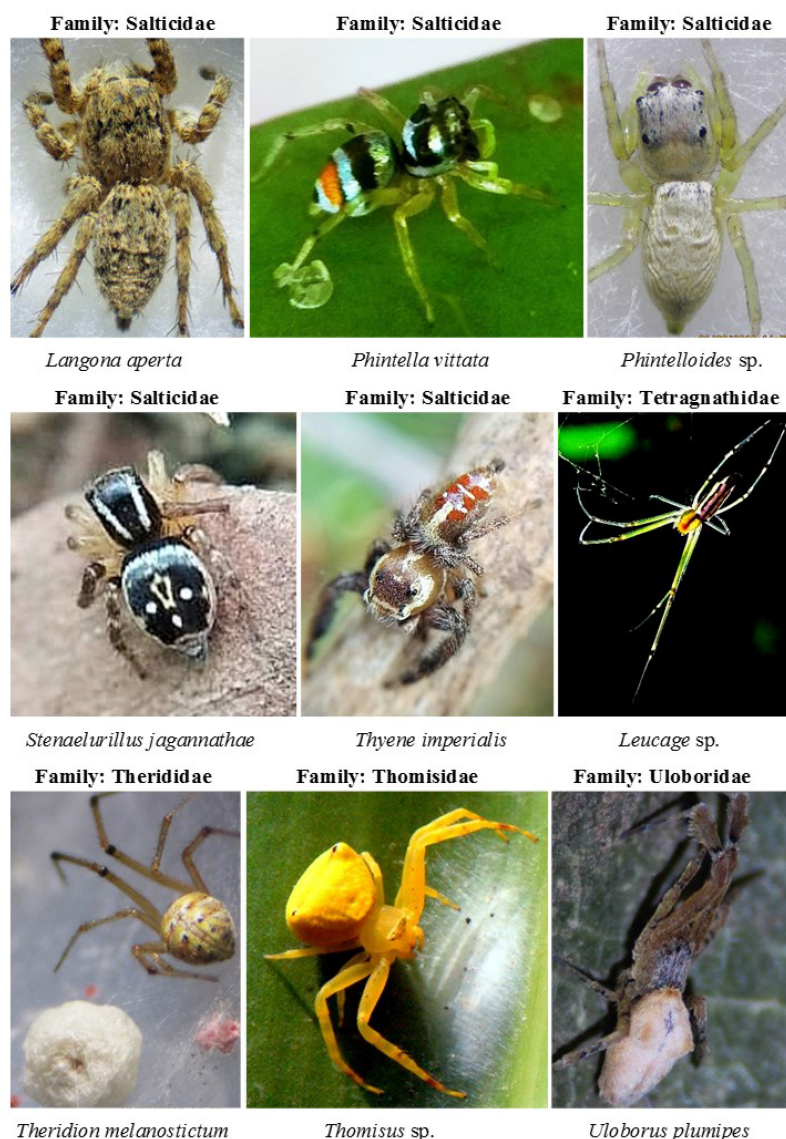


Figure 5. Showing habitus photographs of the spiders recorded in study sites during study period..

Diversity assessment

This study indicated that total diversity indices from both study site records dominance (D): 0.06, Simpson index (1/D): 17.20, Simpson index (1-D): 0.94, Shannon Weiner Index (H): 3.35, Evenness index (e): 0.61 and Margalef species richness (d): 8.9. Diversity indices of Morjar site records dominance (D): 0.05, Simpson index (1/D): 19.17, Simpson index (1-D):

0.95, Shannon Weiner Index (H): 3.33, Evenness index (e): 0.71 and species richness d: 8.48. Diversity indices from Dudhala site records dominance (D): 0.08, Simpson index (1/D): 13, Simpson index (1-D): 0.92, Shannon Weiner Index (H): 2.99, evenness index (e): 0.66 and species richness (d): 6.65. The result indicate that diversity indices significant in Morjar site as compare to Dudhala site. According to the Sorensen similarity index, the result at the

level of species were 64% similar in both study sites during the study period. It may be due to the habitat structure of Mango orchards farms and micro climatic characteristics of the study sites (Table 2).

DISCUSSION

A total of 15 spider families distributed among 30 genera and 47 species were reordered during the study A total of 15 spider families distributed among 30 genera and 47 species were reordered during the study 791 791 period. It represents 37.5 % of the total 40 families reported from Gujarat (Yadav et al. 2017); 25 % of the total 60 families reported from India (Keswani et al. 2012); 12.5% of the total 120 families reported from the world (World Spider Catalog 2020). There are many environmental factors that affect species diversity. Some of these factors include seasonality, spatial heterogeneity, competition, predation, habitat type, environmental stability and productivity (Rosenzweig 1995).

Diversity values varied considerably among both study sites and similar habitat types did not necessarily have similar diversities. There was significant difference between the diversity, evenness and richness among the study sites. The result shows diversity indices significant in Morjar site as compare to Dudhala site. It may be due to food availability, environmental stability and less disturbance. It revealed that no one habitat structure of mango orchard site was less important than another (Downie et al. 1999 and New 1999) have revealed that spiders are extremely sensitive to small changes in the habitat structure, including habitat complexity, litter depth and microclimate characteristics. Thus the physical structure of environments has an important influence on the habitat preferences of spider species, especially web-building species (Uetz 1991, Hurd and Fagon 1992).

CONCLUSION

It concludes that the possible such high level of occurrence of spider species within six months reveal that habitat structures of selected study areas may be suitable for a diverse group of spiders and environmental factors like climate, habitat structure,

food availability, habitat stability and anthropogenic activities having a huge impact on species richness and population of spiders.

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