



SPECIES RICHNESS AND DIVERSITY OF SPIDERS IN THE SEMIARID HABITATS OF NORTH INDIA

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ABSTRACT

A total of 1140 spiders belonging to 31 species, 11 families and 26 genera were recorded from Agra (Uttar Pradesh), Ludhiana and Kapurthala (Punjab) in north India. Araneidae (20%) was the most predominant family followed by Tetragnathidae (17%), Salticidae (14%), Eresidae (11%), Lycosidae (10%), Selenopidae (10%), Hersilidae (7%), Oxyopidae (7%), Sparassidae (2%) and Thomisidae (2%). Standardization of collection techniques and assessment of species richness during the pre and post monsoon period were accomplished. Observations revealed that the best fit method for collection was in the following order: visual searching (44%)>hand collection (33%)> pit fall (7%)>beating (7%)>transect (6%)> sweep net (3%). Species richness was computed using Shannon (H') (3.03), Simpson (λ) (0.0624) and Dominance (0.938) indices, which shows good diversity. This study is in continuity with surveys done from the semiarid habitats, and it revealed that diversity increased to 65 species from north India with the present study.

Key words: Spiders, biodiversity, indices, Agra, Ludhiana, Kapurthala, species richness, families, sampling methods

Spiders (Araneae) are one of the significant and most diverse groups of invertebrates in the terrestrial ecosystem (Coddington and Levi, 1991). Their diversity pattern in various ecosystems is required to be studied. Ground dwelling spiders might be important in transporting energy directly from the below-ground detritus food source to the above- grounds terrestrial food web of the birds, reptiles, amphibians and mammals (Johnston, 2000). Taxonomically, spiders were characterized in India by Stoliczka (1869) and Pocock (1899; 1900). From Indian subcontinent, spider fauna of desert area in Rajasthan (Tikader, 1966), Assam (Tikader, 1969), Maharashtra (Tikader, 1963), Sikkim (Tikader, 1970) and from Andaman Nicobar (Tikader, 1977). An occasional paper on spider fauna of Calcutta was published by Tikader and Biswas (1981) and by Tikader and Malhotra (1980) and Tikader and Bal (1980; 1981).

The fauna was updated by Gajbe (2004) from the Madhya Pradesh. Siliwal et al. (2005) summarized 1442 species belonging to 59 families from India. Recently the checklist was updated by Keshwani et al., (2012) who catalog the 1686 species belonging to 60 families and 438 genera. From the north Indian region especially from Uttar Pradesh and Punjab the data is scanty. Patel and Nigam (1996) from Uttar Pradesh, Sadana (1969;

1995) on Salticidae and Lycosidae from Punjab are few. The present study is on the diversity and richness of spiders from North India- habitats and agricultural fields from Agra, Uttar Pradesh; and Ludhiana and Kapurthala, Punjab, in continuation of updating the data of Anjali and Prakash (2012). Thus, a total of 31 species are added now.

MATERIALS AND METHODS

The study was carried out in the agro-ecosystems in Punjab and Agra- semiarid habitats of north India. The collection was done from corn, rice and cotton fields from Ludhiana and Kapurthala, Punjab and second collection site was from flood plains around the river Yamuna and the green belt around the Taj Mahal, Agra. These sampling sites were selected due to the wide coverage of dense vegetation which supports spiders. The study was carried out during July 2016 to October 2017.

Sampling was done at 14th day intervals, with six collection methods viz., visual searching, hand collection, sweeping net, beating, pit fall and transect. Visual searching of spiders was done in the morning 8-10 hr and in the evening between 4-6 pm. In hand collection method spiders were picked by hand by wearing gloves, using paint brush or a cotton swab.

Beating method was applied on the vegetation of trees and shrubs. An umbrella was placed just beneath the tree or shrub then the plant was tapped 6-8 times with the help of a stick. In case of short and twisted branches of tree the branches were held with one hand and shake it for some time. The spiders fell down in the umbrella and then they were immediately transferred to the collection vials. Pit fall collection was done by designing the pit fall traps by using the waste water bottles. The top of the bottle was cut and jars were prepared of the height of 15 -18 cm. At the bottom, one fourth part of the jar was filled with 70% of alcohol with salty water. The pits were removed after 24 hr and spiders were collected; Transect method was modified from Kapoor (2006), and belt transects of 3.05 x 0.13 m used. 10 transects were applied, there was 1 m distance between each. Beside these, spiders detected on vegetation (up to 1.6 m height), on webs were also recorded. The sampling

time was 30 min for each transect. Deep scanning was done under the leaf litters where small threads of webs were found. Sweep net method was used to collect from grasses and flowers, in the morning (8-10 am) and evening (4-6 pm), the interval between one sweep to the next sweep was 4-5 min.

The spiders collected were identified following keys available (Pocock, 1899; Sebastian and Peter, 2009; Biswas and Majumdar, 1995; Gajbe, 2008; Tikader, 1963; 1977; 1987; Tikader and Malhotra, 1980). The taxonomy and nomenclature followed is as per the World spider catalogue (2019). The diversity indices viz., Shannon-Wiener index (H1)- Shannon (1948), Simpson index (λ)- Simpson (1949) (Solow, 1993); and dominance index were computed in MS Excel and using software Biodiversity calculator

Table 1. Spiders collected from the semiarid habitats of north India

Family	Genus and species	Functional group	No. of specimens
Araneidae	<i>Neoscona theisi</i> (Walckenaer, 1841)	WB	74
	<i>Neoscona mokerjei</i> (Tikader, 1980)		30
	<i>Argiope pulchela</i> (Thorell, 1881)		50
	<i>Cyclosa</i> sp. (Menge, 1866)		22
	<i>Poltya</i> sp. (C. L. Koch, 1843)		10
	<i>Zygiella indica</i> (Tikader & Bal, 1980)		40
Eresidae	<i>Stegodyphus</i> sp. (Simon, 1873)	WS	42
	<i>Stegodyphus sarasinorum</i> (Karsch, 1891)		80
Hersiliidae	<i>Hersilia savignyi</i> (Lucas, 1836)	WS	77
Lycosidae	<i>Pardosa birmanica</i> (Simon, 1884)	WS	12
	<i>Hippasa agelenoids</i> (Simon, 1884)		58
	<i>Hippasa holmera</i> (Thorell, 1895)		21
	<i>Wadicosa</i> sp. (Zyuzin, 1985)		30
Oxyopidae	<i>Oxyopes</i> sp. (Latreille, 1804)	WS	37
	<i>Oxyopes javanus</i> (Thorell, 1887)		42
Selenopidae	<i>Selenops</i> sp. (Latreille, 1819)	WS	112
Sparassidae	<i>Heteropoda</i> sp. (Latreille, 1804)		14
	<i>Olios milleti</i> (Pocock, 1901)		11
Salticidae	<i>Menemerus semilimbatus</i> (Hahn, 1829)	WS	94
	<i>Plexippus petersi</i> (Karsch, 1878)		27
	<i>Myrmarachne orientales</i> (Tikader, 1973)		2
	<i>Phidippus</i> sp. (C.L. Koch, 1846)		7
	<i>Hyllus</i> sp. (C.L. Koch, 1846)		10
	<i>Epocilla aurantiaca</i> (Simon, 1885)		12
Tetragnathidae	<i>Telamonia dimidiata</i> (Simon, 1899)	WB	4
	<i>Leucauge decorate</i> (Blackwall, 1864)		154
	<i>Tetragnatha</i> sp. (Latreille, 1804)		37
Thomisidae	<i>Misumena</i> sp. (Latreille, 1804)	WS	8
	<i>Thomisus</i> sp. (Walckenaer, 1805)		12
	<i>Thomisus lobosus</i> (Tikader, 1965)		8
Philodromidae	<i>Philodromus</i> sp. (Walckenaer, 1826)	WS	3

WFunctional groups: WS- Wandering spiders; WB- Web builders

RESULTS AND DISCUSSION

A total number of described species of spiders from all over the world is 48,173 species belonging to 4139 genera and 117 families (World spider catalog, 2019). In India there are 1686 species belonging to 438 genera and 60 families (Keswani et al., 2012). In this study, 1140 individuals belonging to 11 families, 26 genera and 31 species were obtained from semiarid habitats of north India (Table 1). The maximum number of species belong to the family Salticidae (7 sp.) and Araneidae (6 sp.). Among the abundant families Araneidae, Salticidae and Lycosidae showed that soil and temperature play an important role in the growth of spiderlings (Dobel et al., 1990) as the saline soil has influence on the larger turnover of species from Araneidae, Salticidae and Lycosidae. Spiders generally have humidity and

temperature preference that limits them to certain areas (Riechert and Gillespie, 1986).

The predominant species recorded include: *Leucauge decorata*, followed by *Selenops* sp., *Menemerus semilimbatus*, *Hersilia savignyi*, *Stegodyphus sarasinorum* (Figs.1-8). Of the sampling methods maximum collection was obtained with visual searching (44%) and hand collection (33%) (Table 2). Guild structure provided the knowledge of different habitat and behaviour of spiders (Anjali and Prakash, 2017; 2019); two major functional guilds viz., wandering and web builders were observed. Shannon, Simpson and Dominance indices were 3.03, 0.0624 and 0.938, respectively, revealing that the semiarid habitats hold good diversity. Yadav et al. (2017) stated that there is lack of data on such diversity indices from north India.



Figs. 1-8: 1. *Neoscona theisi*; 2. *Stegodyphus* sp.; 3. *Oxyopes* sp.;
4. *Selenops* sp.; 5. *Olios millet*; 6. *Heteropoda* sp. 7. *Leucauge decorata*;
8. *Telamonia dimidiata*

Table 2. Distribution of spider families in sampling methods

S.No.	Families	Collection Techniques						Total	Total %
		VS	HC	SP	PF	TS	B		
1.	Araneidae	110	88	16	3	3	6	226	20%
2.	Eresidae	60	44	1	-	8	9	122	11%
3.	Hersiliidae	36	39	-	-	1	1	77	7%
4.	Lycosidae	45	10	7	53	6	-	121	10%
5.	Oxyopidae	25	38	2	-	4	10	79	7%
6.	Selenopidae	55	49	1	5	2	-	112	10%
7.	Sparassidae	11	7	2	3	2	-	25	2%
8.	Salticidae	43	50	3	20	30	10	156	14%
9.	Tetragnathidae	102	49	-	-	10	30	191	17%
10.	Thomisidae	13	6	-	-	2	7	28	2%
11.	Philodromidae	3	-	-	-	-	-	3	0.2%
Total		503	380	32	84	68	73	1140	
Total		44%	33%	3%	7%	6%	7%		100%

VS-visual searching; HC-Hand collection; SP-Sweep net; PF-pit fall; TS- transect; B-beating

The present study revealed 31 species under 26 genera and 11 families, as additions to the available list (Anjali and Prakash, 2012).

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