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Original Article

Studying biodiversity of spiders species in seven different localities of Charsadda District, Khyber Pakhtunkhwa, Pakistan

Estudando a biodiversidade de espécies de aranhas em sete localidades diferentes do distrito de Charsadda, Khyber Pakhtunkhwa, Paquistão

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Abstract

The current research work aims to provide knowledge about the diversity of spiders' fauna and their occurrence throughout the year from District Charsadda Khyber Pakhtunkhwa, Pakistan. Research data were collected from March-2015 to January-2017 from seven different localities of Charsadda District by using the camera, bottle, plastic bags, paraffin films, field book and 70% of ethylene alcohol and 20% of glycerine were used as chemicals. By using special identification keys, spiders were differentiated into families, genera and species. During the study time, a total of 2734 specimens of spiders were collected belonging from 35 genera, 15 families and 44 species were identified. Salticidae was the dominant family according to genera studied plus spiders samples numbers collected with 10 genera and 616 species specimens count. The high occurrence of spiders was studied during July. The result of the current study also shows a reduction of spider's species in December due to lowering the temperature. The current study shows that Salticidae were the dominant family as capered to other species. The occurrence of spiders species greatly depends on changing the weather condition. The present study also shows great fluctuation in spider's occurrence with changing of hot climate to colder during the study duration. Moreover, the wet season plays a great role in spiders' population increase and growth.

Keywords: spiders, Aranaedae, Salticidae, occurrence, Pakistan.

Resumo

O objetivo do presente trabalho de pesquisa é fornecer conhecimento sobre a diversidade da fauna de aranhas e sua ocorrência ao longo do ano no distrito Charsadda Khyber Pakhtunkhwa, Paquistão. Os dados da pesquisa foram coletados no período de março de 2015 a janeiro de 2017 em sete diferentes localidades do distrito de Charsadda por meio de câmera, garrafa, sacos plásticos, filmes de parafina, livro de campo, e 70% de álcool etílico e 20% de glicerina foram utilizados como produtos químicos. Usando chaves de identificação especiais, as aranhas foram diferenciadas em família, gênero e espécie. Durante o período de estudo foram coletados 2.734 espécimes de aranhas pertencentes a 35 gêneros, 15 famílias e 44 espécies. Salticidae foi a família dominante de acordo com os gêneros estudados mais o número de amostras de aranhas coletadas com 10 gêneros e contagem de 616 espécies. Altas ocorrências de aranhas foram estudadas durante o mês de julho. O resultado do estudo atual também mostra redução das espécies de aranhas no mês de dezembro devido à diminuição da temperatura. O estudo atual mostra que os Salticidae foram a família dominante como alcaparras para outras espécies. A ocorrência de espécies de aranhas depende muito da mudança das condições climáticas. O presente estudo também mostra grande flutuação na ocorrência de aranhas com a mudança do clima quente para mais frio durante a duração do estudo. Além disso, a estação chuvosa desempenha um grande papel no aumento e crescimento da população de aranhas.

Palavras-chave: aranhas, Aranaedae, Salticidae, ocorrência, Paquistão.

1. Introduction

Spiders are among the most common and abundant arthropods (Buchholz, 2009). They have eight legs and chelicerae that inject venom. Spiders are air-breathing. A spider employs pedipalps, which are placed on the tarsi of the appendages, to manipulate prey and transmit chemosensory information (Blumenthal, 1935). Despite acting as a biological control by protecting crops against pesticides, spiders are considered as most venomous and injurious animals (Davey, 1994; Sabelis, 1991; Penney, 2004). Spider venom is less contaminated than pesticides used in

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agriculture (Novak, 2001). Spiders are an important aspect of world biodiversity because they serve several key roles as predators in ecosystems and food chains (Sharma et al., 2010).

According to the latest available literature; 131 spider families, 4247 genera, and 50009 species have been reported worldwide (WSCA, 2022). Taxonomists recorded at least 109 spider families and 43,678 spider species in 2008. Pakistan has a diverse fauna of spiders, but there is no consolidated catalogue of these spiders. Research on spiders in Pakistan is scarce. Researchers from all over the country have identified a variety of spider species. Platnick identified and updated the genus *Oxyopes* Latreille (297 species and subspecies) globally in 2013. In Pakistan, the genus *Oxyopes* has been recorded which includes 17 species. A Cambridge student reported the species *Oxyopes jubilans* from Karakorum and Islamabad, Pakistan (Platnick, 2009). In any ecosystem, spiders are mostly integrated, numerous, and diversely populated among invertebrate's fauna (Coddington and Levi, 1991; Wolff, 1990). There has been some extremely important information provided on the taxonomy, range, and abundance of agroecosystem spiders (Shakila et al., 2000; Abida and Beg, 2000; Ghafoor and Beg, 2002; Butt et al., 2006; Butt and Siraj, 2006; Tahir and Butt, 2008, 2009).

According to a study, many factors such as ecosystem disturbances, variations in plant community structure, and abiotic parameters such as soil plus ambient humidity and temperature have a significant impact on spider assemblages (Bonte et al., 2002). The relationship between spiders with wheat crops and the nearby environment was studied in Buenos Aires, Argentina (Armendano and Gonzalez, 2011). Another study by Horvath et al. (2009) found that spiders are less diverse in overgrazed grasslands but not in small isolated meadows in East Hungary. In China, 21 new spider species have been found (Barrion et al., 2012). In the entire tropical rice agro-ecosystems of Asia, spider species have been recorded in the Philippines, and it is considered the greatest record of spider species (Barrion, 1999, 2001).

In the Terai Conservation Area, spider variety was documented in diverse habitats (Uniyal and Hore, 2008c). Another study compared the community structure of spider assemblages occurring in various vegetation types of the Terai Conservation Area to see how the fire affected spider assemblages in Terai grasslands (Hore and Uniyal, 2008b). Furthermore, the effect of habitat conditions on species occurrence was described (Hore and Uniyal, 2008a). Spider species were studied as indicators of specific habitat types, and it was determined that species are mostly influenced by the habitat's moisture and canopy cover. However, there is a scarcity of studies on the biodiversity of spiders in the Himalayan and sub-Himalayan foothills of North India (Hore and Uniyal, 2008a).

2. Materials and Method

2.1. Study sites and sampling

The current research study was carried out from March-2015 to January-2017 in seven different localities of Charsadda District namely Palai dam hills near Tangi, Sherpao, Umarzai, Turangzai, Utmanzai, Rajjar, and Prang. The spiders were searched visually and collected from the surveyed areas generally at the time of morning and night. Spiders were collected at random from urban areas, villages, residences, Farms, and private property, as well as agricultural and unmanaged terrain. The spider webs were examined, as well as the egg sacs and spiderlings were identified. Ground spiders from graveyards, meadows, mounts, roadsides, and gardens, tree trunk dwelling spiders (poplar, eucalyptus, mulberry), building walls dwelling or domestic spiders, jumping spiders, wandering grounds spiders, web weaving spiders, foliage dwelling spiders, grass dwelling, streams bank side spiders, and garden spiders were among the spiders include in the study.

2.2. Habitat types

A study of spiders was conducted in seven main habitats, including meadows, forests, gardens, crops fields, stream banks, hills (tangi area), and domestic environments.

2.3. Materials and chemicals

Spiders were collected from the different areas by using a camera, bottle, plastic bags, paraffin films, field book and 70% of ethylene alcohol and 20% glycerine were used as chemicals.

2.4. Methods

Sample collection of Spiders from 2015 to 2017 were carried out in three seasons of the year; Summer, monsoon and winter. Aerial sampling which is up to 1.5 m from the ground level involved searching for leaves, branches, and trunks of the trees. Ground collecting (for ground layer spiders) included searching on hands and knees beneath low knee level for leaf litter, logs, stones, and plants. Beating (for middle layer spiders up to 1 m) involved hitting foliage with a 1 m long rod and trapping the spiders on a tray held horizontally under the vegetation. In the litter collection tray, spiders from leaf litter were collected with help of a hand. In the same way, ground layer spider webs like funnel webs were surveyed and photographed on tree logs, rocks, and the ground.

2.5. Samples preservation

Spider samples were labelled after collection using jarring when spiders were collected from foliage and by manual handpicking by jars and plastic bags. Finally, spiders were preserved in vials with 70% ethanol and 20% glycerine, which will be used for ecological research.

2.6. Identification and photography

After preservation, materials were brought to the laboratory and identified by using the relevant literature. Collected spiders were identified with the help of keys and all adult spiders were identified to family, genera and species using existing identification keys wherever possible. To study different organ for identification purpose, a stereomicroscope (XTD-2A) were used in the Laboratory

of Zoology Department, Islamia College Peshawar, KPK, Pakistan.

2.7. Statistical analysis

Spider relative abundance was estimated by regressing cumulative capture data on total captures across areas. All the data were analysed through simple percentage formula using Microsoft Excel Worksheet 2016.

3. Results

In the present study, a total of 2734 spider specimens were collected. Out of the total, 44 species of spiders were identified belonging to 35 genera and 15 different families were recorded from the research area, while 48 species remained unidentified. The occurrence of different spiders species in different Family were also studied. Family Salticidae showed 616 specimens collected with the most abundant species *Plexippus paykulli* with a total of 281 samples of the same species collected. Similarly, the family Araneidae gave result of 461 specimens of spiders of which the most dominant species was *Argiope lobata* with 105 specimens. Family Sparassidae showed a total number of 258 spiders samples with dominant species as *Olios rossettii* collected 206 spiders. A total of 135 spiders sample were collected from the family Oxyopidae with the most dominantly occurring species as *Oxyopes javanus* found as 106 in number. A total of 119 spiders samples were collected in family Hersilidae with the dominant species found as *Hersilia savignyi* with 75 spiders. Family Pholicidae was represented by spiders specimens number 100 having *Crossopriza lyoni* 100 in number and dominant of all species of the same family. Family Lycosidae consisted of 84 samples during our research and 16 spiders of the dominant *Draposa oakleyi* species were caught. Total spiders recorded from research from the family Gnaphosidae were 36 in which dominant species was *Drassus lutescens* with 18 samples obtained. Family Agelenidae provided data of 14 specimens of species, *Draconarius latellai* obtained as dominant species were 10 in number. Family Scytodidae consist of 12 sample in which 5 spiders specimens of *Olios rossettii* were obtained and it were the dominant species of its family. Family Eutichuridae (This family is now called Cheiracanthiidae) with 10 spider species was searched out, and the dominant species was *Cheiracanthium inclusum* with only 1 sample recorded. Family Sicaridae showed a record of 10 spiders and the dominant species was *Loxosceles rufescens* which were 10 in number. Family Clubionidae showed 10 spiders collected with mostly occurring spider species as *Clubiona filicata* that showed a record of 6 spiders obtained. On the other side family Dysderidae with 9 spiders specimens were studied in which *Dysdera cylindrical* with 9 samples was found to be the dominant species. During the study, 9 species were collected of Family Castaneira in which *Castaneira zetes* were the most dominant species of the family having 9 species (Table 1).

The occurrence of Spider species were also studied in different months. A high number of spiders were collected during July with 90 species and August with 78 species lies next to July. Similarly, April showed 76 species of spiders. In September 62 species, march with 51 species and October with 28 species studies were done. While 17 species were recorded in January, 11 spiders in each February and November and only 2 species of spiders were caught in December (*July (90 species) > August (78 species) > April (76 species) > September (62 species) > March (51 species) > October (28 species) > January (17 species) > February, November (11 species each) > December (2 species)* (Table 2).

Based on temperature fluctuation, the occurrence of spiders was also studied in different months throughout the year. Spiders occurrence showed increased and decreased occurrence during sampling periods. A high rate of occurrence were observed in July (18%) followed by August (15%) and April (14%). A decrease in the occurrence rate of spiders were found in December (1%) followed by November (2%), February (2%) and January (3%) which shows a reduction in the occurrence rate of spiders when the temperature gets colder (Figure 1).

4. Discussion

The current research work was intended to the occurrence of spiders in a different region of Charsadda District, KPK, Pakistan. An attempt was made to study spider occurrence in various months and times throughout the year between March-2015 and February-2017. A total of 2734 spider specimens were collected from the study region, representing 44 species from 35 genera and 15 families. The goal of the research aimed to investigate spider biodiversity in District Charsadda in various environments to provide scientific information on the biology of spiders in the area. The current study examines the distribution and occurrence of spiders in a variety of habitats in District Charsadda, KPK, Pakistan, including ground-dwelling, foliage dwelling, grass dwelling, spiders living in buildings, spiders in crops fields, spiders on tree trunks, in mountainous regions, spiders living on stream banks and forests, as well as spiders found in meadows. As a result, for the first time, an attempt was made on spider fauna to provide scientific research data. Spiders were most active early in the morning before the sun rose, in the evening, and at night, according to the findings. According to Ursani and Soomro (2010), theoccurrence

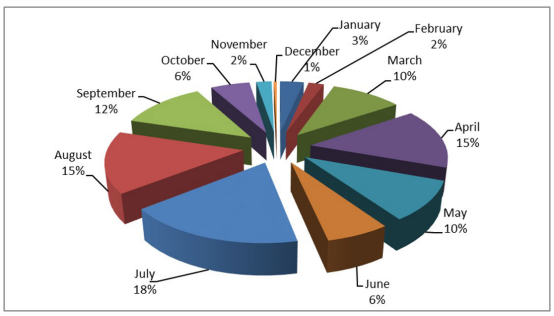

Figure 1. Percentage number of spiders species samples collected month wise during two years research in District Charsadda KPK.

Table 1. Number of spider species and sample collected from seven different localities of District Charsadda, KPK.

S. no.	Family	Species name	Tangi	Sherpao	Umarzai	Turangzai	Utmanzai	Rajjar	Prang	Total species of research study	Total specimens per genus
			Number of spider species collected from seven different localities of District Charsadda.							2734	
1	Araneidae	*Argiope anasuja*	✔	✔	✔	✔	✔	✔	✔		461
		Argiope lobate	✔	✔	✔	✔	✔	✔	✔		
		Argiope versicolor	✔	✔	✔	✔	-	✔	✔		
		Cyrtophora cicatrosa	✔	✔	-	✔	✔	-	✔		
		Cyrtophora citricola	-	-	✔	-	✔	✔	✔		
		Neoscona polyspinipes	✔	✔	✔	-	-	✔	✔		
		Neoscona Scylla		✔	-	✔	✔	-	✔		
		Neoscona theisi	✔	✔	✔	-	✔	✔	-		
		Eriovixia excels	✔	✔	-	-	-	✔	✔		
		Nephila pilipes	-	✔	✔	✔	✔	-	-		
		Bijoaraneus mitificus	✔	✔		✔	✔	✔	✔		
		Cyclosa hexatuberculata	-	-	✔		✔		✔		
2	Salticidae	*Phintela vittata*	✔	✔	✔	✔	✔	✔	✔		616
		Menemerus marginatus	✔	✔	✔	✔		✔	✔		
		Menemerus nigli	✔	✔	✔	✔	✔	✔	-		
		Aelurillus logunovi	✔	✔	✔	-	-	✔	✔		
		Bianor albobimaculatus	✔	✔	-	✔	✔	✔	-		
		Hasarius adansoni	-	-	✔	✔	✔	✔	✔		
		Myrmarachne melanocephala	✔	✔	-	-	✔	✔	✔		
		Plexippus Paykulli	✔	✔	✔	✔	✔	✔	-		
		Thyene imperialis	✔	✔	✔	✔	✔	-	✔		
		Epocilla pakhtunkhwa	✔	-	✔	✔	✔	✔	✔		
		Stenaelurillus mardanicus	✔	✔	✔	✔	✔	-	✔		
3	Clubionidae	*Clubiona filicata*	✔	✔	✔	✔	✔	✔	✔		10

Table 1. Continued...

S. no.	Family	Species name	Tangi	Sherpao	Umarzai	Turangzai	Utmanzai	Rajjar	Prang	Total species of research study	Total specimens per genus
4	Agelenidae	*Draconarius latellai*	-	✔	✔	✔	✔	✔	✔		14
		Draconarius pakistanicus	✔	✔	✔	✔	✔	-	✔		
5	Castaneira	*Castaneira zetes*	✔	✔	✔	✔	✔	✔	✔		9
6	Dysderidae	*Dysdera cylindrical*	✔	✔	✔	✔	✔	✔	✔		9
7	Cheiracanthiidae	*Cheiracanthium saccharanalis*	✔	✔	✔	✔	✔	✔	-		10
8	Gnaphosidae	*Drassus lutescens*	✔	-	✔	✔	-	✔	✔		28
		Gnaphosa pakistanica	✔	✔	✔	✔	✔	✔	✔		
		Micaria dives	✔	-	✔	✔	✔	-	✔		
		Zelotus pulchellus	✔	✔	-	-	✔	✔	✔		
9	Hersilidae	*Hersilia savignyi*	✔	✔	✔	✔	✔	✔	✔		119
10	Lycosidae	*Draposa oakleyi*	✔	✔	✔	✔	✔	✔	✔		84
		Hippasa agelenoides	✔	✔	✔	✔	✔	✔	-		
		Pardosa algoides	-	✔	✔	-	✔	✔	✔		
		Pardosa pseudoannulata	✔	✔	✔	✔	-	-	✔		
11	Oxyopidae	*Oxyopes javanus*	✔	✔	✔	-	-	-	-		135
12	Pholicidae	*Crossopriza lyoni*	✔	✔	✔	✔	-	-	-		100
13	Scytodidae	*Scytodes propinqua*	-	-	✔	✔		✔	✔		12
14	Sicariidae	*Loxosceles rufescens*	✔	✔	✔	✔	✔	✔	✔		10
15	Sparassidae	*Olios rossettii*	✔	✔	✔	✔	✔	✔	✔		258
		Olios stimulator	✔	✔	✔	-	✔	✔	✔		

Table 2. Species number, percentages on basis of research visits and species samples number collected during two-year research in District Charsadda KP.

Months	January	February	March	April	May	June	July	August	September	October	November	December
Number of species collected	17	11	51	76	50	32	90	78	62	28	11	2
Species percentage according to visits	0.62%	0.40%	1.86%	2.77%	1.82%	1.17%	3.29%	2.85%	2.26%	1.02%	0.40%	0.073%

and abundance of spiders species depend upon weather, geography and temperature.

In a study by Mukhtar (2004), in Punjab, a total of 104 spiders were studied with 51 genera and 15 families with Araneidae as maximum in number while the least occurring were spiders of the family Corinnidae.

In our research work, it was found that the most abundant families were Salticidae with 616 spiders collected and the second was Aranidae with 461 spiders specimens collected. Similarly, the family with the lowest number of spiders collected was Castaneira and Dysderidae with a total of 9 spiders sampled. According to the findings of Chetia and Kalita (2012), food changes occurring in surrounding climatic changes are also affecting spider's abundance and occurrence in different localities. Similarly, in our research work, the abundance of spiders changed not only according to the change of temperature from hotter to colder but also the species were found differently in different habitats with different temperatures. In our research, the difference in temperature was observed clearly in different localities like mountainous regions (Palai Dam mountains near Tangi) and Forest areas (Doaba tharnao). The same was observed for the other regions like Meadows (Turangzai), Stream banks (Turangzai), crops fields (Turangzai) and Domestic level (Sherpao, Umarzai, Turangzai, Utmanzai, Rajjar and Prang). Spider diversity was recorded clearly in warmer regions with high temperatures as compared to areas with low temperatures in the same district Charsadda.

Plexippus paykulli (281 spider specimens obtained) and *Crossopriza lyoni* (100 specimens sampled) were the most dominant species of domestic habitat in our current study. The dominant spider species in the woodland habitat were *Plexippus paykulli* (281 spiders recorded). *Draposa oakleyi* (14 samples collected) were the most common spider species in the stream bank environment. In the agricultural fields, however, the species *Phintella vitata* (19 spiders found) are predominated, as did the hilly environment species *Plexippus paykulli* and *Olios rossettii* (206 spiders). Similarly, the species *Olios stimulator* (29 spiders) were the most common spiders in the garden, whereas the other species listed below were less common. When spiders were examined on tree trunks at the domestic level, in forests, and in gardens, *Hersilia savignyi* (75 spiders) were determined to be the most common species, with the remainder of the spiders being discovered in smaller numbers. In research work, a total of 1098 Araneidae species including 38 species, 22 genera and 9 families were recorded from citrus fields in Lahore, Pakistan (Tahir et al., 2011). The most dominant family was Lycosidae while higher numbers of spider specimens were in Gnaphosidae. In Gujranwala Pakistan, 178 spiders were collected belonging to 7 families, 10 genera and 22 species from fields of guava (Ghafoor and Mahmood, 2011). Environment factors like different seasons also have a great effect on spider occurrence.Our results are similar to studies byRiechert and Bishop (1990) that fluctuations in climate affect the occurrence of spiders.

It is concluded from our present research study that wet season or rainfall also greatly affects the spider's occurrence as they increase in number. The same observation was made by Kato et al. (1995) and Russell-Smith (2002) who showed the importance of rainfall in spiders abundance that caused variability of spiders collection at different timings throughout the year. An overview of the result showed that the most abundant among all 23 families during the whole trapping session (2015-2017) was the family Salticidae.

During the two years research study, it was found that a greater number of spiders were collected during July with 90 species and August with 78 species lies next to July. Similarly, April showed 76 species of spiders. In September 62 species, march with 51 species and October with 28 species study was done. While 17 species were recorded in January, 11spiders in each February and November and only 2 species of spiders were Our results showed that spiders occurrence was high in warm temperatures which were similar to the research work of Sudhikumar et al. (2005).

5. Conclusion and Recommendation

The study of spiders is unexplored in Charsadda District, Pakistan. There is no data for spiders in the area. As a result, this research establishes a baseline for the existence, diversity, and ecology of various spider species. Studying their occurrence in different habitats, seasons and climatic conditions will help us to work for specifying the importance of spiders and the conservation of the species. Dynamic habitats were explored in detail to recommend potential scenes for upcoming researchers studying spiders. It will provide researchers with the knowledge that will act as a solid framework for layman and scientists studying spiders. Their presence in the district requires special monitoring because they are effective against a variety of insect pests as well as highly resistant arthropods. They could be used to stabilise natural ecosystems by employing various integrated pest management techniques.

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