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Original Article

New data on family Araneidae from district Swat with updated checklist of the family from Pakistan

Novos dados sobre a família Araneidae do distrito Swat com lista de verificação atualizada da família no Paquistão

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Abstract

The aims of the present research was to find out the diversity of family Araneidae in district Swat Pakistan and to provide updated checklist of the family Araneidae from Pakistan. Also their occurrence throughout the year was given from District Swat Khyber Pakhtunkhwa, Pakistan. Data was collected from January 2018 to December-2018 from seven different Tehsils of District Swat by using different methods like pitfall trap, ground hand collection, air hand collection and were then preserved in plastic vials and appendorf tubes by using 70% ethanol. Camera mounted on microscope was used for photography. By using literature from World Spider Catalog, 2022, spiders were identified to species level. In a ttal of 1243 specimens of family Araneidae 4 genera and 7 species were identified. Dominant species with great number of specimen collected was *Cyrtophora citricolla* with 229 (18.4%) samples, followed by *Bojaranius mitificus* (15.7%), *Neoscona Scylla* (15.4%), *Argiope lobata* (14.8), *Neoscona theisi* (14.6%) and *Neoscona polyspinippes* (13.8%) respectively. While lowest collection was done of *Argiope versicolor* with 90 (7.3%) samples. High occurrence of spiders was studied during July 187 samples. Fluctuation in temperature can affect the diversity of spiders observed and recorded in present study with lowest collection done in low temperature. Moreover, the humidity also play a great role in spiders' population and occurrence.

Keywords: Aranaedae, Swat, checklist, diversity, spider, Pakistan.

Resumo

Os objetivos da presente pesquisa foram descobrir a diversidade da família Araneidae no distrito Swat, Paquistão, e fornecer uma lista atualizada da família Araneidae nesse país. Sua ocorrência ao longo do ano também foi dada no Distrito Swat, Khyber Pakhtunkhwa, Paquistão. Os dados foram coletados de janeiro de 2018 a dezembro de 2018 de sete diferentes Tehsils, do Distrito Swat, usando métodos diferentes, como armadilha de queda, coleta no solo com a mão e coleta no ar com a mão, e foram então preservados em frascos de plástico e tubos eppendorf usando etanol 70%. Foi usada câmera montada em microscópio para fotografia. Utilizando a literatura do World Spider Catalog (2022), as aranhas foram identificadas em nível de espécie. Em um total de 1.243 exemplares da família Araneidae, foram identificados 4 gêneros e 7 espécies. A espécie dominante com grande número de espécimes coletados foi *Cyrtophora citricola* com 229 (18,4%) amostras, seguida por *Bojaranius mitificus* (15,7%), *Neoscona scylla* (15,4%), *Argiope lobata* (14,8%), *Neoscona theisi* (14,6%) e *Neoscona polyspinippes* (13,8%), respectivamente. Já a menor coleta foi feita de *Argiope versicolor* com 90 (7,3%) amostras. A alta ocorrência de aranhas foi estudada em julho, com 187 amostras. A oscilação na temperatura pode afetar a diversidade de aranhas observadas e registradas no presente estudo com menor coleta feita em baixa temperatura. Além disso, a umidade também desempenha um grande papel na população e ocorrência de aranhas.

Palavras-chave: Araneidae, Swat, checklist, diversidade, aranha, Paquistão.

1. Introduction

Spiders are ancient and successful group of invertebrate animals (Singh and Borkotoki, 2014). Also called poisonous arthropods (Perveen and Jamal, 2012). Some scientists believed that origin of spider take place in sea. Later spider evolved in two groups, one without and second with extensor leg muscles. 400 million years ago spider originated. Recent spiders have unsegmented abdomen but earliest spider was with segmented body and larger in size. Most ancient type of spiders belonged to the suborder Mesothelae. In New York, USA oldest fossil of Devonian period (410 to 360 million years) was found in rock. The fossil spiders with segmented abdomen were recognized

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from Carboniferous period (360 to 290 million years). In Mesozoic era (240 to 65 million years) little information about spider is available. Newer spider for catching flying insects developed aerial web in flora and early built web near the ground. Spider evolution correlated to the insect's evolution (Perveen et al., 2012). Spiders belong to class Arachnida, order Araneae and Phylum Arthropoda. They vary in size, shape and behavior. Body divided into cephalothorax, abdomen, have pedipalps, eight legs, no antenna, produce silk. They use the silk to wrap the prey, to hang from and to make egg sacs and nests (Turnbull, 1973; Nyffeler and Benz, 1987). A single spider may produce more than a half dozen difference kinds of silk (Sharma et al., 2010).

They exploit a wide variety of niches in virtually all the earth's biomes and highly species rich Arthropoda. Some species of spiders build webs and trap prey in webs whereas some are web less. Spiders are taxonomically diverse, indicators of environmental change and community level diversity. They show variety of ecological niches (Blackledge et al., 2011). Spiders are venomous, 40 species of spiders are potentially deadly to humans. Spiders are voracious predators and carnivorous. The worldwide status of the taxonomy of the spiders has depicted by Platnick (2004). Spiders are the group of arachnids comprises more than thirty thousand species, 60 families distributed over worldwide (Sharma et al., 2010). Biological control is the most effective control measures against insect pests. Insect pests have successfully been controlled by using natural predators like spiders and beetles (Nyffeler et al., 1994). Spiders are natural predators in agro ecosystems (Nyffeler et al., 1994; Nyffeler and Sunderland, 2003; Tahir et al., 2011). A spider not only preys on adult insects but also egg, larval etc. stages (Harwood and Obrycki, 2007). Spiders are carnivorous feeding on small arachnids, insects that bothers human like mosquitoes and cockroaches etc. During the lifetime of spiders, they may eat hundreds of mosquitoes and reduce their numbers (Sharma et al., 2010).

According to Boyer et al. (2007), a good ecological indicator should be sensitive to slight ecosystem changes in a predictive manner, thereby allowing the detection and measurement of the effect of various disturbances to the ecosystem. Invertebrates are critical components of ecosystems and can make excellent bio-indicators (Kremen et al., 1993) of ecosystem health and change as they are sensitive to change, and can be used to index changes in the environment at small, spatial and very short, temporal scales (Ginsberg, 1993; Schroeter et al., 1993). The large numbers of invertebrates makes them more amenable to statistical analyses than vertebrate data (Kremen et al., 1993).

Present study on different species of the family Araneidae indicate that a great diversity was observed among the species of the family in different habitats of the study area. Present study aims to find out the diversity of the family Araneidae in district Swat, Khyber Pakhtunkhwa (KP) Pakistan.

2. Materials and Method

2.1. Introduction to study area

The current study was conducted from March 2018 to December 2019 in District Swat. The valley of Swat is situated in the north of Khyber Pakhtunkhwa, 35° North latitude and 72° and 30° East longitude, enclosed by the sky-high mountains (Rasool et al., 2018). Chitral and Gilgitare situated in the north, Dir in the west, and Mardan in the south, while Indus separates it from Hazara in the east. On the basis of Physical Features, Swat is divided into two physical regions: Mountainous Ranges and Plains. Swat is divided into seven tehsils: Babuzai, Barikot, Kabal, Matta, Charbagh, Khwazakhela and Bahrain. Each tehsil is further divided into certain number of union council (Rasool et al., 2018).

2.2. Geography

Area is 5,337 km^2, Swat valley lies between 72′ to 74°-6′ E longitude and 34°-40′ to 35° N latitude. It is located in between the hills of Hindukush mountain range. Swat is bounded by Gilgit-Baltistan in North Shangla, Buner and Kohistan, Chitral, Upper Dir and Lower Dir in the West, in the South East and East. The southern tehsil of Buner was established the status of an isolated district in 1991. Swat Valley is situated in northern Khyber Pakhtunkhwa and surrounded by excessive mountains.

Physically Swat can be divided into two regions.

I) Mountainous Series
II) Plains

2.3. Habitats and environmental condition

2.3.1. Climate

Swat is lying in the temperate region in the Northern hilly ranges of the Indo-Pak Sub-continent, therefore at this point weather is affected by all the climatic influences "altitude, Latitude and rain bearing winds. In summer season, the monsoon starts in Swat, while in winter, it is pretentious by cyclonic current from the Mediterranean Sea.

2.3.2. Temperature

Thus the temperature is concerned, the elevation of Swat differs from 2500 ft to 7500 ft, and therefore, this is cooler zone. Due to the lack of meteorological section, we cannot figure the actual documented data; January is the coolest month of the year in District Swat. The temperature, mostly, remains between 2°C to -2°C. Season for the water-freezing is starts from the very last week of Month December to the end of Month February. In hilly zones it takes more than 3 months. July and August are the hottest months, in which the temperature increases to more than 39°C in the plains, but in hilly areas, it is lesser.

Thus the area consists of high ranges of mountains, hills, plains, river sides, forests, marshes, fields and grassy land which are spot for boundless biodiversity. There are versatile diversity in territories in the Swat area. Due to highly diverse environment the region is species fully rich. (Wikipedia)

2.4. Materials

The following different materials were used for studying and measuring of size of different parts of spiders. Camera (D71 Olympus) connected to microscope used for taking snaps of different parts of spider specimen. Compound microscope (CX 41, Olympus). Stereomicroscope (TC 5400, Mejji), various kinds of vials, for small spider specimens Eppendorf tubes were used, ethanol 70-80% and 100%, for studying spiders under microscope glycerin, glass petri dish with ethanol, in ethanol specimens immersed, for clearing and formation of slides Xylene were used, slides, forceps, genetilia are removed with the help of needles, cover slips were used for slide fixation, for coordinates of the exact locality were taken, for large spiders to measure scale were used, labeled-vials, beating-sheets and pitfall traps.

2.5. Methods

This was the first detailed study of the spiders from District Swat. A total of specimens 1643 were collected from different regions like plain zones, streams, mountains, hills, leaf letters, some were collected from trees stem and bushes, on ground, houses, crop fields, underground grasses, stones, near water, webs, marshy places and rocks, the collected specimens belonging to various families.

2.6. Spider collection

The following different methods were used for the spiders collection in different habitats. Ground Hand Collection (Sorensen et al., 2002), Pitfall trap, Aerial Hand Collection, Vegetation Beating, Cryptic Searching (Sajid et al., 2021; Sorensen et al., 2002).

2.7. Preservation

From various regions and habitats spiders were collected. Proper tagging of the spiders specimens was done, which comprises date of collection, locality, temperature and other necessary notes. The tagged samples were then stowed in seventy (70%) percent athanol. Some samples were also well-preserved in 100% (percent) for DNA extraction. The existing literature are used for the collected spiders samples upto species level (WSCA, 2022; Tikader, 1987; Platnick and Ubick, 2007; Metzner library for salticidae, Nentwig et al., 2010).

2.8. Morphological studies

2.8.1. Spider identification

Stereomicroscope are used for identification of spiders and their various organs in Zoology Department laboratory at Islamia College Peshawar, Zoology Department University of the Punjab Lahore and Histopathology Laboratory at Academic Block of Veterinary Sciences, University of Agriculture Peshawar. The collected specimes of spiders were identified with the assistance of existing works and Keys. A particulars were achieved of specimens by measuring body length, a alliance of eye piece, measuring glass with 0.2mm gap of measuring units, glass and measuring index made were at 2X, 4X and 10X zoom. Carapace weidth, height and length were measured, Eyes width and length were measured, abdomen width and length were measured, ocular area were measured, legs measurement were also done (Leg I, Leg II, Leg III, Leg IV), for compulsory parts studied in existing work, structures of females Epigyne and male palps were studied with existing work and drawing were sketched for the preeminent matching.

3. Results

In the present study, a total of 1243 spider specimens were collected from different habitats of seven Tehsils of District Swat, Pakistan. Out of that huge total, 07 species of family Araneidae were identified belonging to 04 genera. All the species were reported for the 1st time from study area. A checklist of all the species of the family Araneidae from Pakistan is also provided. Family Araneidae gave result of 1243 specimens of which the most dominant species was *Cyrtophora citricolla* with 229 collected specimens from seven different Tehsils of District Swat. The least dominant species of the family was *Argiope vesicolor* which was count 90 (7.3%) of the total collection. Other species that were collected and identified are *Argiope lobata, Bojaraneus mitificus* (previously *Araneus mitificus*), *Neoscona theisi, Neoscona polyspinippes* and *Neoscona Scylla* with their relative abundance and sample collection size 185(14.8%), 195(15.7%), 181(14.6%), 172(13.8%) and 191(15.4%) respectively (Table 1).

Occurrence of the Spider species that were collected in different months of the year were also studied. A high number of spiders were collected during July with 187 specimens and August with 167 specimens after July. Similarly, January showed 66 specimens of spiders, In February 78 species, march with 87 specimens, April with114, May with 135, June with 161, September with 85, October 68, November with 52 specimens respectively. The lowest data was collected in the Month of December with just 43 samples from all the Tehsil of District Swat that include Tehsil Barikot, Kabal, Charbagh, Matta, Khwaza Khaila, Babozai and Bahrain. (July (187 specimens) > August (167 specimens) > June (161 specimens) > May (135 specimens) > April (114 specimens) > March (87 species) > September (85 specimens) > February (78 specimens), October (68 specimens) > January (66 specimens) > November (52 specimens) and December (43 specimens) (Table 2).

Collection done at different Tehsils of district Swat include Tehsil Barikot, Tehsil Kabal, Tehsil Chrbagh, Tehsil Matta, Tehsil Khwazakhaila, Tehsil Babozai and Tehsil Bahrain. Highest number of the samples were collected from Tehsil Matta with 309 (24.85%) samples of seven different species of family Araneidae, in which most abundant was *C. citricolla* (61 samples) and least one was *Argiope versicolor* (17 samples). The least samples were collected from Tehsil Babozai with 112 samples in which highest number was that of *Neoscona Scylla* with 22 samples and least was *N. polyspinippes* and *N. theisi* each with 12 samples. Tehsil kabal, Charbagh, Barikot, Khwazakhaila and Bahrain stand on 2nd, 3rd, 4h, 5th, and

Table 1. Number of spiders collected at different Tehsils of Swat district.

	Specie							
SWAT TEHSILS	***A. lobata* (%)**	***A.versicolo* (%)**	***B. mitificus* (%)**	***N. theisi* (%)**	***N. polyspinippes* (%)**	***N. scylla* (%)**	***C. citricolla* (%)**	**Total**
Barikot	23	13	24	21	18	31	45	175
Kabal	31	07	32	29	37	25	42	203
Charbagh	33	12	36	35	27	27	22	192
Matta	41	17	45	43	45	57	61	309
Khawazakhela	19	14	18	15	19	25	27	137
Babuzai	18	13	18	12	12	22	17	112
Bahrain	20	14	22	26	14	04	15	115
Total	185(14.8)	90(7.3)	195(15.7)	181(14.6)	172(13.8)	191(15.4)	229(18.4)	**1243**

Table 2. Month wise collection of different species of family Araneidae.

	Specie							
Month	***A. lobata***	***A. versicolor***	***B. mitificus***	***N.theisi***	***N.polyspinippes***	***N.sylla***	***C.citricolla***	**Total**
January	10	2	11	11	08	11	13	66
February	12	04	12	11	12	12	15	78
March	14	06	14	14	11	10	18	87
April	21	07	18	14	15	17	22	114
May	22	10	19	19	16	20	29	135
June	22	14	21	28	25	20	31	161
July	30	17	25	28	29	27	31	187
August	26	13	25	19	24	27	33	167
September	10	07	15	12	12	17	12	85
October	09	05	14	10	09	11	10	68
November	05	03	12	08	06	10	08	52
December	04	02	09	07	05	09	07	43
Total	185	90	195	181	172	191	229	**1243**

6th with specimens collected 203, 192, 175, 137 and 115 respectively from each (Table 1).

Occurrence of the specimens were also recorded at different fluctuations of temperature at different month throughout year. An increase was observed with increase in temperature and humidity at different months. From October to March due to low temperature and humidity least amount was collected, also orb weaver spiders form webs in the tree and bushes which are more abundant at warms and humid months, while in winter they hide in leaf letters, bark f trees and crevices. A high rate of occurrence was observed in July (15%) followed by August (13.4%), June (12.95%), May (10.9%), April (9.2%), September (6.83%), March (6.7%), February (6.27%), October (9.5%), January (5.3%), November (4.2%) and December the least occurrence were recorded with (3.45%) (Figure 1).

4. Discussion

The present research work was planned to find out the occurrence of spiders in a different region of Swat District, KPK, Pakistan. An attempt was made to study spider occurrence in various months and times throughout the year between January 2019 and January-2020. A total of 1243 spiders were collected from the study area, representing 07 species from Family Araneidae. The aim of the present study was to investigate spider diversity in District Swat in various environments. The present work examines the distribution and occurrence of family Araneidae in a variety of habitats in District Swat, KPK, Pakistan. Present study provide information that has been reported for the 1st time from Swat district. Spiders were most active at evening time and were recorded hidden in

foliage at day time. Ursani and Soomro (2010) reprted that the occurrence and abundance of spider's species depend upon geography, weather and temperature. Mukhtar (2004) while doing work on spiders 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 family has great diversity in District Swat with the abundant species was *Cyrtophora citricola* with 229 species from different tehsil of Swat. Research work done by Chetia and Kalita (2012), food changes occurring in surrounding environmental changes are also affecting spider's fauna and their abundance and occurrence in different localities. Similarly, present work also indicate the abundance of spiders changed not only according to the change of temperature but also with different habitats. Family members were mostly observed near waters, at night and at summer, while at day time they were recorded at foliage. Mostly they hide in leaves to protect himself from predators as well as from high temperature. All the members form orb weavers. Environment factors like different seasons also have a great effect on spider occurrence. Our data show similarities with data of Riechert and Bishop (1990), occurrence and abundance of spiders is directly affected by climate. Same is observed in present study an increase in abundance was observed with increase in temperature and humidity. Rainfall has great effect on spider's distribution and occurrence with increase in rain an increase in occurrence occur in present study that is obvious from the month of July and August and Figure 1. The same was observed by Kato et al. (1995) and Russell-Smith (2002) who showed the significance of rainfall in spider's richness that caused variability of spider's collection at different timings throughout the year.

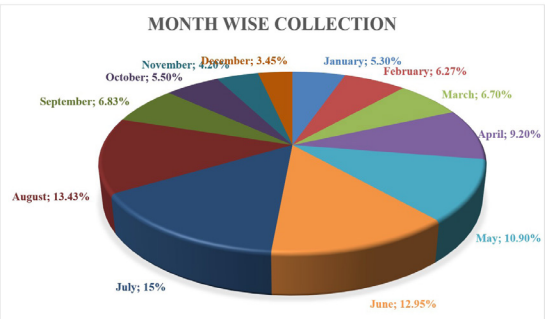

Figure 1. Percentage number of spider species samples collected month wise from district Swat.

Spiders in Pakistan is not explored well, an attempt was made to add some new data to spiders fauna of Pakistan and to update the checklist that was previously published by Sajid et al. (2021). A total of 38 species of the family were confirmed from Pakistan which is now reached to 45 from published literature. Further extensive study and exploration efforts are necessary for documentation of the entire araneid fauna of Pakistan. There are great chances for the presence of many new species. Moreover, species described from neighboring countries like China and India whose fauna are relatively well explored are likely to be present in Pakistan as well. An updated checklist is attached in Table 3.

Table 3. Checklist of family Araneidae from Pakistan.

S. No	Species name	Discovery
1	*Araneus alboquadratus*	Dyal, 1935
2	*Araneus altitudinum*	Caporiacco, 1934a
3	*Araneus camilla*	Dyal, 1935
4	*Araneus ellipticu*	Tikader and Bai, 1981
5	*Araneus formosus*	Dyal, 1935
6	*Araneus fulvus*	Dyal, 1935
7	*Araneus obscurissimus*	Caporiacco, 1934
8	*Araneus pontii*	Caporiacco, 1934
9	*Argiope lobata*	Pallas, 1772
10	*Argiope pulchella*	Thorell, 1881
11	*Argiope versicolor*	Doleschall, 1859
12	*Argiope trifasciata*	Forskal, 1775
13	*Argiope aemula*	Walckenaer, 1841
14	*Chorizopes rajanpurensis*	Mukhtar and Tahir, 2013
15	*Cyclosa chichawatniensis*	Mukhtar and Mushtaq, 2005
16	*Cyclosa bifida*	Dolescsall, 1859
17	*Cyclosa conica*	Pallas, 1772

Table 3. Continued...

S. No	Species name	Discovery
18	*Cyclosa kashmirica*	Caporiacco, 1934
19	*Cyclosa insulana*	Costa, 1834
20	*Cyclosa krusa*	Barrion and Litsinger, 1995
21	*Cyclosa mohini*	Dyal, 1935
22	*Cyclosa punjabiensis*	Ghafoor& Beg, 2002
23	*Cyclosa saismarka*	Barrion and Litsinger 1995
24	*Cyclosa spirifera*	Simon, 1889
25	*Cyrtarachne nagasakiensis*	Strand, 1918
26	*Cyrtophora cicatrosa*	Stoliczka, 1869
27	*Cyrtophora citricola*	Forsskål, 1775
28	*Eriovixia excelsa*	Simon, 1889
29	*Gasteracantha dalyi*	Pocock, 1900
30	*Gea spinipes*	C. L. Koch, 1843
31	*Gibbaranea ullrichi*	Hahn, 1835
32	*Neoscona huzaifi*	Mukhtar, 2012
33	*Neoscona pavida*	Simon, 1906
34	*Neoscona theisi*	Walckenaer, 1841
35	*Neoscona adianta*	Walckenaer, 1802
36	*Neoscona crucifera*	Lucas, 1839
37	*Neoscona polyspinipes*	Yin, Wang, Xie and Peng, 1990
38	*Neoscona arabesca*	Walckenaer, 1841
39	*Neoscona Scylla*	Karsch, 1879
40	*Neoscona oaxacensis*	Keyserling, 1863
41	*Nephila pakistaniensis*	Ghafoor and Beg, 2002
42	*Araneus nympha*	Simon, 1889
43	*Argiope anasuja*	Thorell, 1887
44	*Cyclosa hexatuberculata*	Tikader, 1982
45	*Neoscona bengalensis*	Tikader and Bal, 1981

5. Conclusion and Recommendation

Spiders are not explored well from Pakistan and especially from District Swat. There is no available data for spiders in the area. Present study act as a baseline for further studies on spider's diversity and ecology in the area. They are important for various habitats and play vital role in environment. Present study conclude that study area is rich of spider's fauna. Further studies can help in exploring the fauna over here and there is great possibilities of new species to science and Pakistan. The present research work recommend upcoming students to work on fauna of spiders for purpose to find out diversity, species richness, to find out taxonomy and to describe new species from study area. Present study will work as a baseline in helping to obtain the mentioned objectives. It will act as a solid framework for layman and scientists studying spiders. Because they play a role in controlling pests and insects and help the farmers in agriculture. They can be used in stabilizing natural ecosystem and help in integrated pest management techniques. So further work on spider fauna of District Swat is strongly recommended.

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