



Species abundance and ecology of spiders fauna of district Swat, Khyber Pakhtunkhwa

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Spiders are group of organisms that belongs to phylum Arthropoda and order Araneae. Spiders are diverse group of 120 families belonging to class arachnids. They also have diverse habitats. Some are found throughout the years while some are seasonal. Between March 2018 and January 2020, Researchers in Pakistan's Swat KPK District examined the spider fauna first. There were about 5000 examples of 44 species from 29 families and 15 groups gathered. These families are represented in the study area: Araneidae had four species; Clubionidae had three; Corinnidae had one; Hersiliidae had three; Oxyopidae had four, and Pisaurids had just one. The Trochanteriids had merely one organism in the study area, and the Trochanteriidae family had one specie. Salticidae and Sparassidae were the two most influential families in the region. The research region has never before yielded any information on any species. This study will provide a base for further study as spiders of the area is unexplored very well.

Keywords: Arachnida, Log abundance, sampling protocol, species-area relationship, diversity, species quality index

INTRODUCTION

Class Arachnida (Arachnida) is the largest and most diverse order in the Class Insecta, with over 38,000 known species from all corners of the globe (Buchholz, 2017). As many as 170,000 species may exist, according to some estimates. Others estimate that there are as many as 200,000 distinct species globally. Even though all insect species are toxic, only 40 of them are potentially harmful to humans (Cushing, 2017).

Arachnids, including spiders, are the most diverse group of creatures in terms of overall species diversity (Soomro, 2010). Proposed 400 million-year-old spiders were more extensive and had segmented bodies, whereas all modern spider species have an unbranched abdomen, save for members of the Mesothelae suborder. Spiders have long legs and gesture with teeth for injecting venom, and they breathe via their mouths. Pede palps on the tarsi of the spider's limbs are used to gather olfaction information throughout prey handling (Karren, 2012).

Venomous and voracious predators, spiders guard our crops against harmful insect pests by eating a wide variety of bugs and their larvae. They may be utilized as biocontrol agents because of this ability (Platnick, 2013). Anthropogenic disturbances in ecological systems may be assessed using spiders as bio indicators. In many terrestrial settings, they help control insect populations (Selden, 2009).

Spiders come in a wide range of shapes and sizes

and a variety of colors. Theraphosid (Thorell) is the biggest of the spiders, measuring 75 mm in length and 25 mm in leg length. A female spider's size dwarfs that of a male. The spider's carapace is replaced throughout metamorphosis, leading to an increase in size (Mathe, 2019). Spiders with various life patterns, physical adaptations, and behaviors occupy practically every environment (Kingsley, 2011).

Spiders may be found in multiple places, including trees, rocks, logs, and forest floors. It's not unusual for them to live on the earth or in underground tunnels, although they prefer damp areas. Coastal and freshwater habitats are home to several species of spiders and the water spiders (*Argyroneta aquatic*) (Sebastin, 2013). According to new research, more than 42751 spider species have been identified in 3859 genera across 110 spider families. Over 42,055 species have been documented in Turkey, including 757 Araneidae species from 265 tribes and 48 families. There are 95 types of spiders from 56 tribes and 18 families (Kunt, 2012).

Despite extensive research into the world's spider fauna, little is known about the species distribution in nations like Pakistan. Because of this, there is no comprehensive documentation on Pakistani spider habitats. As a result, the region must be thoroughly investigated and its rich species documented. This research aimed to learn more about the rich spider fauna of Pakistan's Swat District.



Figure 1: Map of the Study Area.

MATERIALS AND METHODS

2.1 Study Area

Swat is located around 71-29' and 71-54' east longitudes, 34-03' and 34-38' degrees north latitude, and 276 m above mean sea level (908 feet). Mardan, Malakand, Tribal Agency of FATA, Nowshera, and Pakhtunkhwa districts are all within the Swat district's borders (Kalita, 2012).

Swat is a district located in the central plain of Northwest India. The River Kabul, which runs along the district's southern border, enters the area from the southwest. This river flows through the district's southernmost portion. It has a population of roughly 334,453 people living in the space of 2,296 square kilometers (Kalita, 2012). The climate in the Swat region can be pretty extreme. Summer is a brutally hot time of year. From May to June, the temperature rises quickly. Temperatures reach record highs even in the summer months of July, August, and September. Dust storms are common at night in May and June. June is the month with the highest average high temperatures. The area is humid and uncomfortable because of the extensive farming and irrigation. As October progresses, a sharp drop in temperature is seen. January is the coldest month. Thunderstorms and hail are not uncommon in the last stages of cold weather. The wettest months are July and August when the temperature

rises and the humidity increases. The year-round humidity level is relatively high. December is when the humidity reaches its highest point. The Swat receives more rain in the winter than in the summer (Kalita, 2012). Swat's rich land produces a wide variety of vital crops. The vast majority of the land is planted with various crops, which serves as a home for a wide range of invertebrates. Spiders are among the most prominent members of the community. Since most academics consider them insignificant, they have been understudied in the past (Dist. Census Report, 2012).

2.2 Sample Collection

Actively searching for the spiders, we visited seven distinct Swat districts (tangi, Sherpa, umarzaisi, turangzaisi, utmanzais, and the trees of tharao doaba) during March 2015-January 2021 to collect them from urban areas, homes, and chicken farms to agricultural areas and river/stream banks, as well as the tharao doaba forest, which is a protected area (Fig. 2).

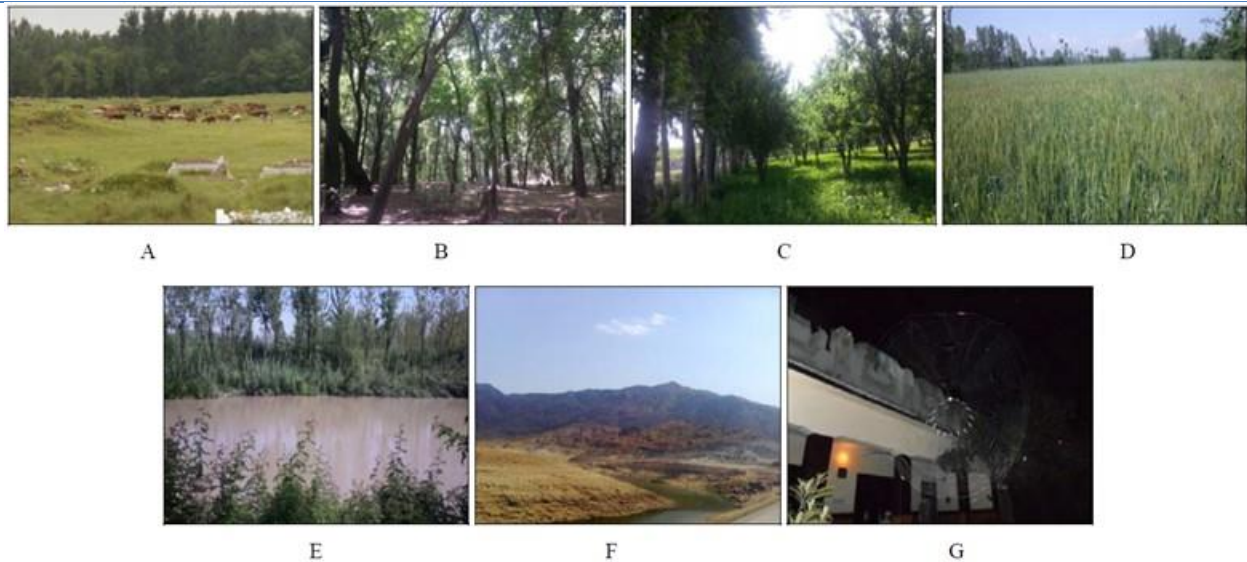


Figure 2: Numerous Habitations examined for spider gathering (a) Pasture, (b) Woodland, (c) Plot of plums (d) Wheat grounds, (e) Torrent bank, (f) Peaks, (g) Domestic

2.3 Sampling methods

We sampled throughout the summer (March-June 2016), the monsoon (July-October 2017), and the winter (November-February 2020), and those exact three times were picked up until February 2021. Searching branches, limbs, tree stumps, and areas in between from knee height to the greatest above arm's reach was part of the aerial sample process for spiders up to 1.5 m.

2.3.1 Ground collection

Sifting through leaf litter, pebbles, and plants below knee height was necessary for ground-layer spider species. A 1-meter long stick was used to strike plants and capture the spiders that fell to the ground, then placed on a tray positioned horizontally underneath the vegetation. A litter collecting pan was used to capture spiders from the leaf litter, then hand-sorted for sampling

2.3.2 Foliage dwelling spiders

Rout netting will be used to reach foliage-dwelling spiders (up to a height of one meter).

2.4 Preservation of spiders

Visual searches and collection from the assessed locations took place more often in the early and evening hours.

For example, the labeling of spiders collected in plastic packaging and jars was upsetting because of the sample procedures utilized. Finally, spiders were maintained in 70 percent ethylene alcohol and 20 percent glycerin vials for ecological research.

2.5 Identification of the specimens and photography

The specimens were taken to the lab for morphological and taxonomic character analysis and examined under high magnification (XTD-2A China). They were consulted

with relevant literature (Dyal S., Tikader BK., Pocock RI., 1987). Nikon Camera captured the images (7.0 megapixel; Nikon, Tokyo, Japan).

RESULTS

The spider fauna of District Swat, Pakistan, was studied from March 2015 to February 2021. There were about 5000 specimens of 44 species from 29 families and 15 groups gathered. The most dominating and diverse wealthy family identified throughout the investigation was Salticidae. Araneidae had four species, Clubionidae had three, Corinnidae had one, Gnaphosidae had three, Hersiliidae had one, Lycosids had three, Oxyopids had four, Pisaurids had one, Salticids had ten species, Scytodidae had one, Sparassidae had two, Tetragnathidae had three, Theridi (Table 1). Details on the families and the species reported are included below.

3.1 Family Araneidae (Simon, 1895)

Eriophora transmarina (Keyserlinga, 1865), frequently referred to as the Garden orb traditional spider, *Argiope keyserlingi* (Karschan, 1878), frequently referred to as the St Andrew's cross spider, *Neoscona crucifera* (Lucasi, 1839), frequently referred to as the Hentz orb weaver, and *Backobourkia heroine* (L. Roth, 1871), frequently referred to as the Wheel traditional spider were all found to be members.

Table 1: Proportion of spider relations collected from diverse Habitations

S No.	Families	Usual history	Proportion
1	xAraneidae	Orb net spider	7.589%
2	xClubionidae	Bark bag spider	0.68%
3	xCorinidae	Ant mimic/crushed bag spider	0.28%
4	xGnaphosidae	Minced spider	0.35%
5	xHersilidae	Two tracked/bark spider	1.05%
6	xLycosidae	Casanova spider	1.25%
7	xOxiopidae	Lynx spider	1.88%
8	xPisauridae	Trawling spider	1.98%
9	xSalticidae	Hurdling spider	23.75%
10	xScytodidae	Hawking spider	0.18%
11	xSparasidae	Seeker spider	9.93%
12	xTetregnathidae	Strained/long chatted Spider	5.49%
13	xTherididae	Community spider	2.38%
14	xThomisidae	Crab spider	1.28%
15	xTrochantaridae	Flat stun spider	0.08%

Mueller, 1876).

3.2 Family Clubionidae (Wagner, 1887)

Throughout the research, three members of this family, all belonging to the same genus, were found in the study region. I. Pad spider (Walckenaer, 1802), II. Clubiona comta (C. L. Roth, 1839), and III. Clubiona pallidula (Walckenaer, 1802).

3.3 Family Corinnidae (Karsch 1880)

This species is known as the "ground dweller" for a simple reason: It was only found in one location (Keyserlinga, 1891).

3.4 Family Gnaphosidae (Pocock, 1898)

Three species with the same genera were found in the region. (i). Chamberlin 1922 Zelotes duplexi, (ii). Keyserlinga 1887 Zelotes funestus (iii). L.Roch, 1866 Zelotes longipes.

3.5 Family Hersilidae (Thorell, 1870)

Hersilia savignyi (Lucas, 1836), a kind of Bark spider, was gathered to represent the genus.

3.6 Family Lycosidae (Sundevall, 1833)

Schizocosa mccoocki (Montgomery, 1904), Hogna carolinensis (Walckenaer, 1805), and Tigrosa helluo (Walckenaer, 1805) were the three varieties from three separate genera in the family that were discovered.

3.7 Family Oxyopidae (Thorell, 1870)

This genus has four species collected. The spiders in this family are sometimes referred to as Lynx spiders. Oxyopes variabilis, Oxyopes Celtics (Hentz, 1845), Oxyopes macilentus L. Roth, 1878, and Oxyopes javanus (Henra, 1887) are the four species.

3.8 Family Pisauridae (Simon, 1890)

There is just one variety of this family known as the Nursery net of angling spider, Dolomedes instabilis (L.

3.9 Family Salticidae (Blackwell, 1841)

Jumping spiders are another common name for members of this family. This was the most common family in the study region, with ten species observed. To name only a few, there is the Trite Eurycoma Murray, 1886, Menemerus bivittatus (Robust, 1831), Hentzia mitrata (Hentz, 1846), Hentzia vittata (Audouin, 1826), Epocilla aurantiaca (Simon, 1885), Epocilla calcarata (Porsche, 1880), Epocilla Blaire Zabi (C L Koch 1846).

3.10 Family Scytodidae (Blackwall, 1864)

In all, there was just one specimen of Scytodes thoracica, the Spewing Spider (Latreille, 1804), in this genus.

3.11 Family Sparassidae (Bertkau, 1872)

We found two species, each belonging to a different genus. Heteropoda venatoria and Holconia immanis are the two species (Birtaku 1999).

3.12 Family Tetragnathidae (Menge, 1866)

Protracted spiders and four-jawed spiders are both popular names for this family. Two species of the same genus were discovered. There are two species of the genus i) Tetragnathus extensa and ii) Tetragnathus (Simol, 1874).

3.13 Family Theridiidae (Sundevall, 1833)

Two classes of this usually identified Home Spider clan were discovered from the study region. i) Steatoda Triangulosam (C.A., Walkenaer, 1802), ii) Statoda pakulliana (Walkenaer, 1805).

3.14 Family Thomisidae (Sundevall, 1833)

Three families of the Crab web family had five distinct species. Thorell, 1887, Thomisus Wieliczka (Walckenaer, 1805), Synalus angustus (Koch, 1876), Thomisus spectabilis (Walkenaer, 1805), Tmarus angulatus

(Walkenaer, 1837), and Tmarus marmoreus (L. Kay, 1876) are a few of the many species of the genus Thomisus that have been identified.

3.15 Family Trochanteriidae (Karsch, 1879)

There was just one species of Big Rock Spider discovered, Morebilus plagusium (Walkenaer, 1837).

Table 2: Taxonomy of the identified Spiders families detailed in the study

S.no	Family	Genus/body length	Species (Scientific name)	Common name	Natural history
1	Araneidae (Simon,1895)	Eriophora ♀20 – 25 mm ♂ 15 – 17 mm	<i>Eriophora transmarina</i> (Keyserling, 1865)	Garden orb weaver spider	Orb web spider
2		<i>Argiope</i>	<i>Argiope keyserlingi</i> Karsch, 1878	St Andrew’s Cross spider	Orb web spider
3		<i>Neoscona</i> ♀8.5–19.7 mm ♂ 4.4-15mm	<i>Neoscona crucifera</i> (Lucas, 1839)	Hentz orbweaver	Orb-web weaving spiders
4		<i>Backbouburkia</i> ♀15mm, ♂7mm	<i>Backbouburkia heroine</i> (L. Koch, 1871)	Wheel weaver	Orb-web weaving spiders
<i>Total Araneidae: 4</i>					
5	Clubionidae (Wagner, 1887)	<i>Clubiona</i> ♀ are 7–10 mm, ♂ 6–10 mm	<i>Clubiona corticalis</i> (Walckenaer, 1802)	Bark sac spider	Bark of dead trees, sometimes in houses
6		<i>Clubiona</i> ♀ 3-6 mm, ♂ 3-5 mm.	<i>Clubiona comta</i> (C. L. Koch, 1839)	Sac spider	Under bark and sometimes in houses
7		<i>Clubiona</i> ♀7 to 13 mm, ♂ 6 to 9 mm	<i>Clubiona pallidula</i> (Clerck, 1757)	Sac spider	Tree tops and tree barks
<i>Total Clubionidae: 3</i>					
8	Corinnidae (Karsch 1880)	<i>Falconina</i> ♀ 5.9—8.9mm, ♂ 4.6—6.4mm	<i>Falconina gracilis</i> (Keyserling, 1891)	Antmimics and Ground Sac Spiders	Ground dweller
<i>Total Corionidae: 1</i>					
9	Gnaphosidae Pocock, 1898	<i>Zelotes</i> ♀9-19mm, ♂8-15mm	<i>Zelotes duplex</i> Chamberlin 1922	Ground Spiders	Ground dweller
10		<i>Zelotes</i> ♀4-7mm, ♂4-5mm	<i>Zelotes funestus</i> (Keyserling, 1887)	Ground Spiders	Ground dweller
11		<i>Zelotes</i> ♂4-6mm, ♀ 4-8mm	<i>Zelotes longipes</i> (L.Koch, 1866)	Ground spider	Outdoor hunts
<i>Total Gnaphosidae : 3</i>					
12	Hersilidae (Thorell, 1870)	<i>Hersilia</i> , ♀8-10mm ♂ 5-8mm	<i>Hersilia savignyi</i> (Lucas, 1836)	Two-tailed spider	Bark spider
<i>Total Hersilidae: 1</i>					
13	Lycosidae (Sundevall, 1833)	<i>Schizocosa</i> ♀9.6-22.7mm ♂9.1-15mm	<i>Schizocosa mcCooki</i> (Montgomery, 1904)	Wolf Spider	Ground Dweller
14		<i>Hogna</i> ♀ 4-25mm ♂ 19mm	<i>Hogna carolinensis</i> (Walckenaer, 1805)	Carolina wolf spider	Ground Dweller
15		<i>Tigrosa</i> ♀21 mm, ♂ 12 mm	<i>Tigrosa helluo</i> (Walckenaer, 1837)	Wolf spider	Ground Dweller and under rocks
<i>Total Lycosidae: 3</i>					
16	Oxyopidae (Thorell, 1870)	<i>Oxyopes</i> ♀ 7mm ♂ 5mm	<i>Oxyopes variabilis</i> (L. Koch 1878)	Lynx spider	Vegetation, favouring grasses
17		<i>Oxyopes</i> ♀5-6mm, and ♂ 4-5mm	<i>Oxyopes salticus</i> (Hentz, 1845)	Striped Lynx Spider	Grasses and leafy vegetation: grassy, weedy fields, and row crops
18		<i>Oxyopes</i> ♀10 mm ♂ 9 mm	<i>Oxyopes macilentus</i> (L. Koch, 1878)	lean lynx spider	Grassy areas and rice fields
19		<i>Oxyopes</i> ♀ 6-8 mm, ♂ 5-7 mm	<i>Oxyopes javanus</i> (Thorell, 1887)	Striped lynx spider	Forage on the upper surfaces of green leaves and bushes.

Total Oxiopidae: 4					
20	Pisauridae (Simon, 1890)	<i>Dolomedes</i> ♀25 mm ♂ 12 mm	<i>Dolomedes instabilis</i> (L. Koch, 1876)	fishing spiders, raft spiders, dock spiders or wharf spiders	Nursery web of fishing spider
Total Pisauridae : 1					
21	Salticidae (Blackwell, 1841)	<i>Trite</i> ♀ 7-9 mm, ♂ 5-7 mm	<i>Trite auricoma</i> (Urquhart, 1886)	Golden brown jumping spider	foliage and on the forest floor
22		<i>Plexippus</i> 9 to 11 mm	<i>Plexippus paykulli</i> ♂ (Audouin, 1826)	Jumping spider	Associated with buildings
		<i>Plexippus</i> 9 to 12 mm	<i>Plexippus paykulli</i> ♀ (Audouin, 1826)	Jumping spider	Associated with buildings
23		<i>Phintella</i> ♂ 3-5mm	<i>Phintella vittate</i> ♂ (C L Koch 1846)	Jumping spider	Flowers and leaves dwelling
		<i>Phintella</i> ♀ 4-5mm	<i>Phintella vittate</i> ♀ (C L Koch 1846)	Jumping spider	Flowers and leaves dwelling
24		<i>Menemerus</i> ♀9mm, ♂slightly smaller than female	<i>Menemerus bivittatus</i> (Dufour, 1831) Jumping spider	Grey wall jumper	Walls dwelling
25		<i>Menemerus</i> ♀7.25 mm ♂6.35mm	<i>Menemerus semilimbatus</i> (Carl Wilhelm Hahn 1827)	Jumping spider	Building walls, gardens and houses
26		<i>Epocilla</i> ♀ 8-9mm ♂ 6-8mm,	<i>Epocilla aurantiaca</i> (Simon, 1885)	Jolly epocilla, Jumping spider	Trees and leaves dwelling
27		<i>Epocilla</i> ♀8mm ♂6.7mm	<i>Epocilla calcarata</i> (Karsch, 1880)	Jumping spider	Vegetation

DISCUSSION

According to this research, ground-dwelling spiders, such as Salticidae, Sparassidae, and Araneidae, predominate in Swat, Pakistan. The summers are pretty hot in the area, with a severe climate. Swat district is home to a wide variety of crops, all of which offer unique homes for various invertebrates. Diverse plants and shrubs foster a more diversified population of spiders (Ghafoor, 2002). According to a recent study, spiders are the most influential members of society. Furthermore, earlier, they have been understudied since most academics consider them insignificant (Tikader, 1987). From March 2015 to February 2021, the research region was home to 44 species, including 29 families and 15 groups. *P. paykoli* and *Argiope keyserlinga* were the two most common species in the domestic habitat. *Leucage drumadaria* and *Macaroesis nidicolous* were the most common species in woodland habitats. *Oxyopes javanus* and *Tetragnatha straminia* dominated the stream bank environment. Contrarily, species such as *Phintella vitatan* and *Oxyopis variabilis* and *Plexippus paykoli*, and *Holconia Omanis* predominate in mountainous habitats and cultivated fields. As with the other species mentioned here, the two most common kinds in the garden were *Uloborus diversus* and *Palystus castanus*.

Citrus fields in Pakistan's Lahore city have resulted in a total of 1098 araneid types that include 38 varieties, 22 families, and nine families. Lycosidae was the most common spider family, whereas Gnaphosidae had the most specimens. One hundred seventy-eight spiders belonging to seven families, ten genera, and 22 species were captured from guava plantations in Gujranwala, Pakistan (Tahir et al. 2011). *Eriophora*, *Argiope*,

Neoscona, and *Backobourkia* are members of the family Araneidae. There was only one genus in the Clubionidae, Zelotes, and Hersilidae families each: Clubiona. In the Gnaphosidae, Zelotes. In the Hersilidae, Hersila.

It was found that *Schizocosa*, *Hogna*, and *Tigrosa* covered the genus Lycosidae in the current investigation. *Oxyopes*, in the Oxyopidae family and *Dolomedes*, in the Pisauridae family were two genera researched. There are seven genera in the Salticidae family: *Puerile*, *Phintella*, *Plexippus*; *Menemerus*; *Epocilla*; *Hentzia*; and *Macaroesis*. *Scytodes* is the only genus in the family Scytodidae. In the Sparassidae genus, two families, *Holconia* and *Heteropoda*, were discovered.

The Tetragnathidae family comprised one genus, *Tetragnatha*, and one genus, *Steatoda*, in the tribe Theridiidae in the current investigation. Three genera named *Thomisus*, *Synalus*, and *Tmarus* member of the genus *Thomas dae* and one type, *Morebilus*, was identified in the tribe Trochanteriidae (Table 2).

This study aimed to determine the spider groups, tribes, and species found in diverse environments in the Swat area. According to an analysis of the findings, the Salticidae family was the most prevalent over the whole trapping session. The direction of lavishness of the relations was $x\text{Salticidae} > x\text{Thomisidae} > x\text{Araneidae} > x\text{Oxyopidae} > x\text{Lycosidae} > x\text{Clubionidae} > x\text{Gnaphosidae} > x\text{Tetragnathidae} > x\text{Sparassidae} > x\text{Theridiidae}$

$> x\text{Corinidae} > x\text{Hersilidae} > x\text{Scytodidae} > x\text{Trochanteriidae}$ (Table 1).

There is a need for additional study for finding links among trends for spiders' dispersal and management approaches.

Studying the community compositions of various

management strategies is necessary to identify spider residents. Integrative pest management (IPM) practitioners may find this valuable in altering agricultural settings to sustain and improve spider populations.

Ecology is the scientific study of the interactions between living species, such as people, and their physical surroundings. In ecology, individuals, populations, communities, ecosystems, and the biosphere are all considered. Ecology is a field of study that explores how humans and creatures interact with one another and their surroundings. Analyzing the food supply chain in a marshes environment is one example of ecology. The discipline of biology is concerned with organisms' interactions with their surroundings and one another. The species, colony, population, and environment are the four primary levels of investigation in ecology.

An organism's taxonomic rank and fundamental categorization unit are referred to as "species." If one organism can breed naturally with another and produce viable offspring, it is considered a species. A collection of living creatures capable of interbreeding is often referred to as a species. These include orcas, light-skinned deer, white coniferous forests, sunflowers, and little germs that can't be seen with the human eye. Species among all members of one species are capable of interbreeding and producing children that are likewise fertile. *Vulpes* is both the scientific name for the spiders and Red Fox and the scientific name for the genus as a whole.

CONCLUSION

The spider species studied in this research are included in the baseline data set. We hope that this research will help us better understand the hidden advantages of spiders and their protection. There are several predators in diverse habitats like grasslands, forests, gardens, crops fields, channel banks, hills, tree stumps, and the residential level, such as Araneida, Unionidae, corinnidae, gnaphosidae, Hersilidae, Lycosidae, Oxyopidae, Pisaurid, Salticidae, Scytodidae, Sparassidae and Trochanteriidae. Small insects, including aphids, moths, bugs, dragonflies, and butterflies, are eaten by spiders in these places, which helps control pests and maintain ecological balance. As a result, spiders may be raised and employed as a biocontrol agent in some situations. This research provides light on how various spider species respond to disturbances, food sources, and the surrounding environment in a specific habitat.

The fact that there are 44 varieties in 15 groups in the region indicates a rich and diversified flora. Thus, more study of the flora is needed.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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