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Diversity of Spider Fauna in P.S.M.O. College Campus, Tirurangadi Malappuram, Kerala, South India

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Abstract: ***Spiders are most diverse, female-dominated and entirely predatory order in the arthropod world. They are the most permeating predators in both agricultural and natural ecosystem. They serve as indicator of environmental quality and as biological control agents in agricultural ecosystem. Hereby we report the Diversity of spider fauna in P.S.M.O. college campus, Tirurangadi, Malappuram, Kerala. The study was conducted during the period of six month from September 2019 to February 2020. Total 25 species were reported and belonging to 7 families. The reported families are Araneidae, Lycosidae, Oxyopidae, Philodromidae, Pholcidae, Salticidae and Tetragnathidae. Among the seven families, Salticidae is the dominant family comprising 7 species. The second dominant families are Oxyopidae and Tetragnathidae comprising 5 species each, followed by Araneidae with 4 species, Pholcidae with 2 species and Lycosidae and Philodromidae with 1 species. The family Salticidae represents most prominent family (28%) followed by Oxyopidae and Tetragnathidae (20%) each, Araneidae (16%), Pholcidae (8%) and Lycosidae and Philodromidae (4%) each. The relative abundance of the family represented the order Salticidae > Oxyopidae = Tetragnathidae > Araneidae > Pholcidae > Lycosidae = Philodromidae.***

Keywords: Spider fauna, Diversity, Ecosystem, PSMO COLLEGE CAMPUS

1. Introduction

Spiders belong to the order 'Araneae' of class 'Arachnida' of phylum 'Arthropoda'. Spiders are air breathing Arthropods that have eight legs and chelicerae with fangs that inject venom. They are ancient animals with a history going back over 350 million years. They are abundant and widespread in almost all ecosystems and constitute one of the most important components of global biodiversity. Spiders play a significant role in ecology by being exclusively predatory and there by maintaining the ecological equilibrium.

More than 45,000 extant species have been described, organized taxonomically in 3,958 genera and 114 families. Fossil diversity rate make up a larger proportion than extant diversity would suggest with 1,593 Arachnid species described out of 1,952 recognized spider belong to the phylum Arthropoda. It is included in class Arachnida and order Araneae. It has two suborders Mesothelae contain segmented spiders and suborder Opisthothelae include all other spiders (Mithali, 2018).

Spiders are chelicerates and therefore Arthropods. As Arthropods they have segmented body with jointed limbs, body completely covered with cuticle made up of chitin and proteins; heads that are composed of several segments that fuse during the development of embryo. Being chelicerates their bodies consist of two tagmata, sets segments that serve similar function; the foremost one, called the cephalothorax or prosoma, is a complete fusion of the segments that in an insect would form two separate tagmata, the head and thorax; the rear tagma is called the abdomen or opisthosoma. In spiders, the cephalothorax and abdomen are connected by a small cylindrical section, the pedicel. The pattern of segment fusion that form chelicerate's head is unique among Arthropods, and what would normally be the first head segment disappears at an early stage of development, so the chelicerates lack the antennae typical of most arthropods. In fact chelicerate's only appendages ahead of the mouth are a pair of chelicerae, and they lack anything that would function directly as "jaws". The first appendages behind the mouth are called pedipalps, and serve different functions within different groups of chelicerates (Tikader, 1987).

The abundance of the spiders can be summarized in the following sentences of Gertsch, "spiders are among the dominant predators of any terrestrial community. When the fauna of soil its plans cover is analyzed, they come to light in vast numbers, in such convincing abundance that it is evident that they play a significant part in the life of every habitat" (Tikader, 1987).

The most characteristics features of spiders are their ability to produce silken threads. When any insect prey gets entangled in the web, the spider quickly rushes into and injects venom through fangs into the prey to kill it and sucks the prey dry. The different spiders are lives on different habitat based on environmental conditions.

2. Objectives of the Study

- The main aim of this study was to explore the diversity of the spider fauna in P.S.M.O. college campus Tirurangadi, Malappuram, Kerala.
- To identify the collected spiders.
- Morphological analysis of collected spiders.
- Prepare a list of family of spiders in the study area.
- To understand the ecological importance of spider.
- Preservation of collected specimens.

3. Significance of the Study

- Spiders belong to largest order of arachnids and seventh rank in total species diversity among all other groups of organisms.
- Spiders are found on every continent except Antarctica (Coclidington, 1991).

- Spiders are exclusively predators and thereby maintaining Ecological equilibrium.
- It acts as good biological control agent.
- Spiders exhibit protective coloration and mimicry.
- Spiders are important in the natural suppression of many insect pests.
- Spiders are good bioindicators and act as a pollution indicator.
- Spiders have a capacity to monitor the early warning signs in environmental conditions.
- Spiders are important food source for a variety of birds, lizards, wasps and mammals.
- Chemicals harvested from spider venom help control and treat several diseases and used as a non- polluting pesticides.
- Spider silk has proven to be one of the strongest natural materials, currently inspiring mechanical engineering to new heights.

4. Review of Literature

Spiders are the most diverse group of animals, which constitute the seventh largest order. There are around 40000 different species of spiders. Spiders are found worldwide on every continent except for Antarctica. The distribution diversity of spiders has drawn attention of naturalist in different parts of world since the eighteenth century.

A general description of spiders from all over the world has been provided by Rod and Ken Preston-Mafham (1984). Latreille(1804), Leach(1815), Koch(1836), Cambridge(1885,1892 and 1897), and Simon(1887) prepared the early taxonomic records on spiders. Nyffeler *et al.* (1987b). Randall (1982) asserted that the green lynx is "counterproductive" as a biological control agent, but the sure way to determine this would be to study the agroecosystem in its presence and absence.

Platnick (1989) added new taxa and taxonomic references and provided synonyms of various taxa. He also provided a bibliography of work relating to Araneae published from 1981-1987. Platnick (2005) launched on internet, "The world spider catalogue", which included all description of new species, all post-Rower transformation or synonymies of previously described taxa. According to his catalogue, up till now 44,032 spider species have been described world-wide belonging to 3905 genera and 112 families.

Saeed et al., (2015) described a study from October 2011 to August 2012 based on some aspects of spider fauna of the distinct Buner. Here spiders were collected by hand picking method and pit fall trap. Total thirteen species of spiders were identified in different families such as tetragnathidae, sparrasidae, pholcidae. According to The world spider Catalog, Version 12.0 by Planthick (2011), the updated lists documented 42473 species of spider worldwide belonging to 3849 genera and 110 families.

Spiders are extremely abundant throughout our country, but our knowledge of Indian spiders is extremely fragmentary. Studies on Indian spiders were earlier done by several European workers and later by Indian Arachnologists. Gravely (1915) added considerably to our knowledge of Indian spiders through his work on mimicry of spiders. Jambunathan (1905) described the habit and life history of the social spider Stegodyphus sorasinorum. The studies on Lycosidae, Argiopidae and Hersitidae by Sinha (1951) may also be mentioned as important contribution to our knowledge of Arachnology of India.

Beginning in the 1960 for about four decades, Tikader's work occupied a prominent portion of Arachnology in India. These works gave the firm foundation of Arachnology in India and inspired several other works into this field. He described 1,066 species belonging to more than families distributed throughout the country. These works are good field manuals for both professionals and amateur workers.

5. Materials and Methods

Data Collection

Spiders are collected from different habitat of college campus include grassy area, arid area, canopy area. Various methods are used for the collection of spiders. Spiders were sampled at regular intervals. Samplings were done once in each month from September 2019 to February 2020, between 9-10 AM. Photography and specimen collection are the major mode of the data collection.

1) Hand Picking Method

One of the best methods to collect is by hand. A soft paint brush can be used to gently knock the specimen in to collecting vial. Specimens can also be carefully picked by hand. Turning over stones logs exposes many spiders and hand collection is the method of choice. (Plate.2) (Fig.1).

2) Sweep Net Method

This is one of the simplest way to collect spiders, which are on vegetation. The ideal habitat for using a sweep net is one with grasses and flowers. A sweep net is made with cotton fabric. The net can be purchased from a biological lab, but they can be made easily and much more cheaply at home. To use the sweep net, drag the net back and forth as many times as necessary to get good sample. Spiders that fall into the net can be collected to killing bottle before they escape. (Plate.2) (Fig.2).

3) Beating Method

This method is also called "Inverted umbrella method". It is very useful to collect spiders from the sturdier vegetation, such as trees and shrubs. A big umbrella is kept under the tree in inverted position. Then a fine stick is used to tap the branches of the plant. After tapping number of times, some spiders fell down into the umbrella.

4) Pitfall Trap Method

This is the ideal method for catching ground-dwelling spiders. Pitfall trap usually consist of suitable pots or jars dug into the ground. At the bottom jar contains a small quantity of preserving fluid with water to which trace amount of detergent were added. Plastic cups make suitable pitfall trap. Plastic cup of 9 cm wide and 10 cm deep were used for this work. The traps need to be cleared frequently. Some sedentary spiders resting on walls, leaf, tree trunk or in the webs caught in jar by holding it open beneath them and

by trapping the spiders into it with a lid. (Plate.2) (Fig.3).

5) Kerchief Method

In some case, Kerchief method was also employed. Kerchief will be thrown over the running spiders, which is then carefully caught in the fold of Kerchief. (Plate.2) (Fig.4).

Some precautions have been taken during collection of specimen as such as possible. Care was taken to collect only one specimen from each species.

Preservation

Spiders cannot be preserved as dry specimen. So the specimens were kept in a preservative fluid for long term preservation. 70% formalin is used for preservation. Specimens collected on different dates preserved separately. (Plate.2) (Fig.5).

Identification

The collected and photographed specimens were identified with the help of standard key systematic references and also the systematic includes spiders of India (P.A Sebastian and K.V Peter).The possibilities of internet as well as pictures guides to identification. Identified specimens are confirmed with the help of expert in this field **Dr. Sunil Jose K.** Department of Zoology, Deva Matha College, Kuravilangad, Kerala.

6. Results and Observations

The list of the spiders collected during the study period from the P.S.M.O. COLLEGE campus Tirurangadi is shown in (Table 1)

A total of 25 species of spiders belonging to 7 families were recorded from the study. Families include Araneidae, Lycosidae, Oxyopidae, Philodromidae, Pholcidae, Salticidae and Tetragnathidae. In which Salticidae is the dominant family comprising 7 species. The second dominant families are Oxyopidae and Tetragnathidae comprising 5 species each, followed by Araneidae with 4 species. Pholcidae with 2 species and Lycosidae and Philodromidae with 1 species each were identified during the study.

The study was carried out in P.S.M.O. COLLEGE campus Tirurangadi, Number of spiders were observed in different habitats of college campus. Different types of spiders like jumping spiders, orb-weaver spiders, lynx spiders, wolf spiders, oblong running crab spider etc. are noticed.

Family Salticidae occupied first position in terms of generic diversity as it contains the genus *Plexippus, Telamonia, Phintella, Hyllus* and *Menemerus.* Oxyopidae family contains the genus *Oxyopes* and Tetragnathidae has the genus *Tylorida* and *Tetragnatha* belongs to second position. The Third family Araneidae includes genus *Cyrtophora, Araneus, Argiope and Neoscona.* Fourth family Pholcidae includes genus *Crossopriza* and *Artema.* The last families Lycosidae and Philodromidae include genus *Hippasa and Tibellus* respectively.

Maximum species diversity was exhibited by members of the family Salticidae. This was followed by Oxyopidae and Tetragnathidae comprising five species, followed by Araneidae with 4 species Pholcidae comprises two species and both Lycosidae and Philodromidae comprising one species each. The relative abundance of various families are recorded from this study can be represented as **Salticidae > Oxyopidae = Tetragnathidae > Araneidae > Pholcidae > Lycosidae = Philodromidae** (Fig. 2)

List of spider fauna collected from study site

S. No	*Family*	*Species*
1	Araneidae	(a) *Araneus aemula* (b) *Argiope anasuja* (c) *Cyrtophora cicatrosa* (d) *Neoscona* sp.
2	Lycosidae	(a) *Hippasa* sp.
3	Oxyopidae	(a) *Oxyopes birmanicus* (b) *Oxyopes javanus* (c) *Oxyopes shweta* (d) *Oxyopes quadrifasciatus* (e) *Oxyopes* sp.
4	Philodromidae	(a) *Tibellus oblongus*
5	Pholcidae	(a) *Artema atlanta* (b) *Crossopriza lyoni*
6	Salticidae	(a) *Hyllus semicupreus* (b) *Menemerus bivittatus* (c) *Phintella vittata* (d) *Plexippus paykulli* (e) *Plexippus petersi* (f) *Telamonia dimidiata* (g) *Telamonia elegans*
7	Tetragnathidae	(a) *Tetragnatha javana* (b) *Tetragnatha montana* (c) *Tetragnatha* sp. (d) *Tetragnatha* sp. (e) *Tylorida ventralis*

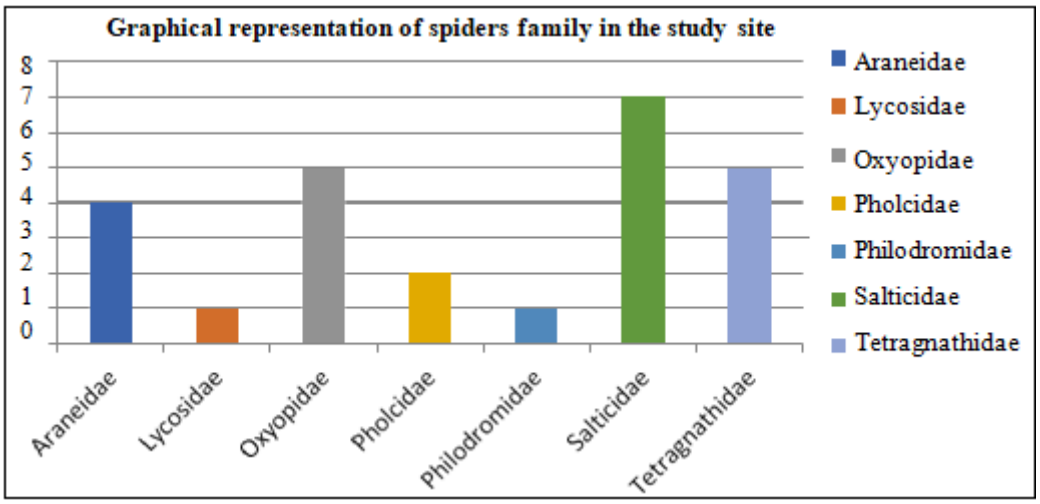

Figure 2

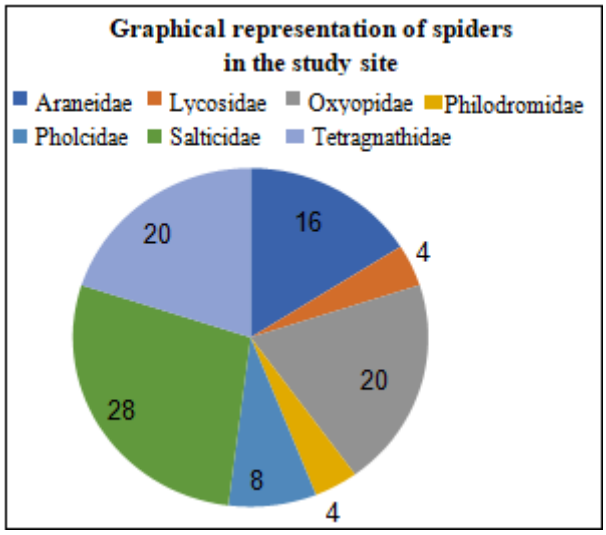

Figure 3

7. Morphological Features of Collected Families

Araenidae
Cosmopolitan family. Commonly known as orb weavers. Small to large in size, three claws, eight eyes in two rows, legs long with spines and hairs, cephalothorax is flat and sternum heart shaped, chelicerae strong and vertical, six simple spinnerets, third diverse family in india.

Lycosidae
Worldwide family of ground dwelling spiders, commonly known as wolf spiders. Small to large on size, eight eyes in three rows, cephalothorax is longer, carapace covered with dense setae, sternum is oval shaped. Dark in color, chelicerae strong and toothed oval in shape, spinnerents are usual in type.

Oxyopidae
The family comprises foliage dwelling spiders, commonly known as lynx spiders. Small to large sized body, there are eight eyes arranged in hexagonal shape, long legs with prominent spines. Cephalothorax is longer than wide and it is concave anteriorly and sloping posteriorly tapering with patches or bands. Body color may vary from bright green to yellowish or dark brown.

Philodromidae
Philodromidae, also known as philodromid crab spiders and running crab spiders.. Most are dull colored- brown, gray, yellowish or mottled with a leaf-like cardiac mark on the anterior dorsal abdomen, and seldom reach above 10 millimetres long. None of the species build webs, but they do use silk for draglines and egg sacs.

Pholcidae
The family comprises sedentary spiders, commonly known as Daddy long leg spiders. Body is very small to medium size, with very long, thin and fragile legs. There are six to eight eyes, chelicerae fused with lamina. Cephalothorax is short and round. Abdomen is globose or triangular in shape, sternum is flat. Anterior spinneret is thick and cylindrical, while the posterior one is thin and conical. This family responsible for the 'comb webs' at neglected corners of buildings.

Salticidae
Hunting spider, commonly known as jumping spiders. Very small to medium sized 3-20 mm in length, there are eight eyes arranged in three or four rows. Legs are long and stout with two claws, designed cephalothorax with ocular quadrangle. Sternum variable in size and shape, chelicerae bears fang and teeth. Abdomen is small and rounded. Salticidae is the most dominant diverse family in India.

Tetragnathidae
Long-jawed orb weavers or long jawed spiders. They have elongated bodies, legs, and chelicerae, and build small orb webs with an open hub with few, wide-set radii and spirals with no signal line or retreat. Some species are often found in long vegetation near water.

8. Discussion

Of about 1442 species reported from India (SILIWAL *et al.* 2005), 25 species have been recorded from P.S.M.O. college campus Tirurangadi.

Kerala with its varied geographic climatic and ecological features exhibits a rich assemblage of various types of

spiders. Total 38 families recorded from kerala according to the study of Dr.Sunil jose K. This represents 63% of the total families recorded from India. In this study 25 species from 7 families were recorded from the study area, which represents around 11% of the total families recorded from India. It is relatively fewer in number; it may be due to higher disturbances.

It might be expected that the climatic changes through seasons would influence the diversity of spiders. The diversity was higher in forest edge than agro ecosystem due to less anthropogenic disturbances (Verton *et al*,2009), although spiders are widely distributed, they are affected by human actions and habitat stability. Indiscriminate uses of spiders in biological control of pests have wiped off several species.

Spiders are of different sizes. Some are fuzzy and other in smooth and they belongs to different colors. Spiders live in different kind of places, gardens, houses and the ground. Web builders, ground runners, foliage runners etc. are noticed in this study. They live where it is hot and where it is cold. They live where it is wet and where it is dry. Spiders are found worldwide on every continent except Antarctica.

In this study more number of spiders are collected from least distributed areas of the campus. Only one or more species were found in buildings. High diversity of spider are attributed to high diversity of plants and insects (kalin Arroyo, 1995). Diversity generally increases when a greater variety of habitat types are presented. Spiders are extremely sensitive to small changes in habitat structure, so it acts as an bioindicator, especially pollution indicator. When the pollutants exceed the range of their "physiological tolerance", the number as well as morphological and anatomical changes is taken place (Reichert, Gillespie 1986).

9. Conclusion

The spiders are abundant and widespread in almost all ecosystems and constitute one of the major components of the global diversity. The present study deals with the diversity of spider fauna in P.S.M.O. college campus Tirurangadi. In this study a total 25 species of spiders belonging to 7 families were collected and recorded, in which the family Salticidae represents most prominent family (28%) followed by Oxyopidae and Tetragnathidae (20%) each, Araneidae (16%), Pholcidae (8%) and Lycosidae and Philodromidae (4%) each (Fig.3).

Identified families are Salticidae, Oxyopidae, Araneidae, Pholcidae, Lycosidae and Philodromidae. The relative abundance of the family represented the order Salticidae (7 Species) > Oxyopidae (5 Species) = Tetragnathidae (5 Species) > Araneidae (4 Species) > Pholcidae (2 Species) > Lycosidae (1 Species) = Philodromidae (1 Species).

Spiders are found everywhere in the study area but the numbers are low in disturbed area when compared with undisturbed area. Human interferences and habitat changes are the major reasons to decrease the diversity.

Indiscriminate uses of spiders in biological control of pest have wiped off population of several species. They are also affected by deforestation, urbanization etc. Spiders have very significant role to play in ecology and thereby maintaining ecological equilibrium. The present work is an initiation to explore the more details of local spiders in study areas that include rich spider diversity and merits for further studies.

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