Project Report

INVESTIGATION ON THE SPIDER DIVERSITY IN KOLLAM DISTRICT, KERALA

Dissertation submitted to the University of Kerala
in partial fulfillment of the requirements for
the award of the degree of

BACHELOR OF SCIENCE IN ZOOLOGY

(2017-2020)

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DEPARTMENT OF ZOOLOGY
T.K.M. COLLEGE OF ARTS AND SCIENCE, KOLLAM-05

MARCH 2020

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CERTIFICATE

This is to certify that the dissertation entitled '**Investigation on the Spider Diversity in Kollam District, Kerala**' is an authentic record of the work done by a group of ten students of B. Sc Zoology, 2017-20 batch under my supervision as partial fulfillment of the requirements for the award of the Degree of **Bachelor of Science** in **Zoology** and this report has not been submitted earlier for the award of any degree or diploma or any other similar titles anywhere.

Certified bona fide:

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EXAMINERS:

1.

2.

DECLARATION

We do hereby declare that this dissertation '**Investigation on the Spider Diversity in Kollam District, Kerala**' is a bona fide report of the project work carried out by us, under the supervision and guidance of Dr. Jasin Rahman V.K, Asst. Professor, Department of Zoology, TKM College of Arts and Science, Kollam as a partial fulfillment of the requirements for the award of the Degree of **Bachelor of Science** in **Zoology**.

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DEDICATED TO OUR PARENTS AND TEACHERS….

INTRODUCTION

Spiders belong to the order Araneae of Class Arachnida under Phylum Arthropoda. This group features eight legs and chelicerae with fangs able to inject venom. They are the largest order of arachnids and rank seventh in total species diversity among all orders of organisms (Sebastian and Peter, 2009). Spiders are found worldwide on every continent except for Antarctica, and have become established in nearly every habitat with the exceptions of air and sea colonization. As per World Spider Catalog in the Natural History Museum Bern, as of July 2019, at least 48,200 spider species, and 120 families have been recorded by taxonomists. However, there has been dissension within the scientific community as to how all these families should be classified, as evidenced by the over 20 different classifications that have been proposed since 1900 (Foelix and Rainer, 1996).

Spider like arachnids with silk-producing spigots appeared in the Devonian period about 386 million years ago, but these animals apparently lacked spinnerets. True spiders have been found in Carboniferous rocks from 318 to 299 million years ago, and are very similar to the most primitive surviving suborder, the Mesothelae. The main groups of modern spiders, Mygalomorphae and Araneomorphae, first appeared in the Triassic period, before 200 million years ago.

Being arthropods spiders have segmented bodies with jointed limbs, all covered in a cuticle made of chitin and proteins; heads that are composed of several segments that fuse during the development of the embryo. Anatomically, spiders differ from other arthropods in that the usual body segments are fused into two tagmata, the cephalothorax or prosoma and abdomen or opisthosoma, and joined by a small, cylindrical pedicel. Unlike insects, spiders do not have antennae. In fact, chelicerates' 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. Unlike most arthropods, spiders have no extensor muscles in their limbs and instead extend them by hydraulic pressure. Their abdomens bear appendages that have been modified into spinnerets that extrude silk from up to six types of glands. Spider webs vary widely in size, shape and the amount of sticky thread used.

The species *Bagheera kiplingi* was described as herbivorous (Meehan et al., 2009), but all other known species are predators, mostly preying on insects especially agricultural pests and on other spiders, although a few large species also take birds and lizards. Spiders also play an important role by being exclusively predatory (Wise, 1993) and thereby regulate insect populations. It is estimated that the world's 25 million tons of spiders kill 400–800 million tons of prey per year (Nyffeler et al., 2017). Spiders use a wide range of strategies to capture prey: trapping it in sticky webs, lassoing it with sticky bolas, mimicking the prey to avoid detection, or running it down. The best-known method of prey capture of spiders is by means of sticky webs. Varying placement of webs allows different species of spider to trap different insects in the same area, for example flat horizontal webs trap insects that fly up from vegetation underneath while flat vertical webs trap insects in horizontal flight. Web-building spiders have poor vision, but are extremely sensitive to vibrations. Most detect prey mainly by sensing vibrations, but the active hunters have acute vision, and hunters of the genus *Portia* show signs of intelligence in their choice of tactics and ability to develop new ones. Spiders' guts are too narrow to take solids, so they liquefy their food by flooding it with digestive enzymes. They also grind food with the bases of their pedipalps, as arachnids do not have the mandibles that crustaceans and insects have.

Females of the water spider *Argyroneta aquatica* build underwater 'diving bell' webs that they fill with air and use for digesting prey, molting, mating and raising offspring. They live almost entirely within the bells, darting out to catch prey animals that touch the bell or the threads that anchor it (Schütz and Taborsky, 2003). A few

spiders use the surfaces of lakes and ponds as 'webs', detecting trapped insects by the vibrations that these cause while struggling.

Net-casting spiders weave only small webs, but then manipulate them to trap prey. Those of the genus *Hyptiotes* and the family Theridiosomatidae stretch their webs and then release them when prey strike them, but do not actively move their webs. Those of the family Deinopidae weave even smaller webs, hold them outstretched between their first two pairs of legs, and lunge and push the webs as much as twice their own body length to trap prey, and this move may increase the webs' area by a factor of up to ten. Experiments have shown that *Deinopis spinosus* has two different techniques for trapping prey: backwards strikes to catch flying insects, whose vibrations it detects; and forward strikes to catch ground-walking prey that it sees. These two techniques have also been observed in other deinopids. Walking insects form most of the prey of most deinopids, but one population of *Deinopis subrufa* appears to live mainly on tipulid flies that they catch with the backwards strike (Coddington and Sobrevila, 1987). Studies into the design and strength of spider's webs have led to producing super- strong artificial silk that scientists reckon can be used in parachutes and bullet proof vests.

Mature female bolas spiders of the genus *Mastophora* build 'webs' that consist of only a single 'trapeze line', which they patrol. They also construct a bolas made of a single thread, tipped with a large ball of very wet sticky silk. They emit chemicals that resemble the pheromones of moths, and then swing the bolas at the moths. Although they miss on about 50% of strikes, they catch about the same weight of insects per night as web-weaving spiders of similar size. The spiders eat the bolas if they have not made a kill in about 30 minutes, rest for a while, and then make new bolas (Eberhard, 1977 and 1980). Juveniles and adult males are much smaller and do not make bolas. Instead they release different pheromones that attract moth flies, and catch them with their front pairs of legs (Yeargan and Quate, 1997). To avoid being eaten by the females, which are typically much larger, male spiders identify themselves to potential mates by a variety of complex courtship rituals. Males of most species survive a few matings, limited mainly

by their short life spans. Females weave silk egg-cases, each of which may contain hundreds of eggs. Females of many species care for their young, for example by carrying them around or by sharing food with them. A minority of species are social, building communal webs that may house anywhere from a few to 50,000 individuals. Social behavior ranges from precarious toleration, as in the widow spiders, to co-operative hunting and food-sharing. Although most spiders live for at most two years, tarantulas and other mygalomorph spiders can live up to 25 years in captivity.

While the venom of a few species is dangerous to humans, scientists are now researching the use of spider venom in medicine and as non-polluting pesticides. Spider silk provides a combination of lightness, strength and elasticity that is superior to that of synthetic materials, and spider silk genes have been inserted into mammals and plants to see if these can be used as silk factories. There is strong evidence that spiders' coloration is camouflage that helps them to evade their major predators, birds and parasitic wasps, both of which have good color vision. Many spider species are colored so as to merge with their most common backgrounds, and some have disruptive coloration, stripes and blotches that break up their outlines. In a few species, such as the Hawaiian happy-face spider, *Theridion grallator*, several coloration schemes are present in a ratio that appears to remain constant, and this may make it more difficult for predators to recognize the species. Most spiders are insufficiently dangerous or unpleasant-tasting for warning coloration to offer much benefit. However, a few species with powerful venom, large jaws or irritant hairs have patches of warning colors, and some actively display these colors when threatened (Oxford and Gillespie, 1998).

It is a major objective for humanbeings to conserve the richness and diversity of spiders for maintaining the ecological balance. This study focusses on the diversity of these fascinating organisms in the Kollam district of Kerala.

OBJECTIVES

- To observe and scientifically identify the spider fauna in Kollam district
- To list out the spiders in the study areas
- To create an awareness on conserving these important natural enemies of agricultural pests

REVIEW OF LITERATURE

Many surveys have been conducted in Kerala and all over the India for exploring the diversity of Spiders. Siliwal et al. (2005) has published an updated checklist of Indian spiders. It referred 1442 species belonging to 361 genera of 59 families from the India. Of the 1442 species, 1002 were endemic to the Indian mainland. Recently, 1520 species belonging to 361 genera and 61 families were reported by Sebastian and Peter (2009) in the book 'Spiders of India'. Earlier the knowledge on the spiders of Western Ghats remained confined to the works of Pocock (1895, 1899, 1900), Hirst (1909), Gravely (1915, 1935), Sherriff (1919, 1927a,b,c), Sinha (1951), Subramanian (1955) and Charpentier (1996). Recently Rajashekhar and Raghavendra (2001), Jose and Sebastian (2001), Smith (2004), Sugumaran et al. (2005), and Jose et al. (2006) tried to document the diversity of spider fauna in and around the Western Ghats. The Western Ghats harbours a total of 275 species of spiders belonging to 139 genera of 39 families (Sebastian et al., 2012).

Sathiamma et al. (1998) studied the predatory spiders associated with coconut plantations of central Kerala. Patel (2003) and Sunil et al. (2008) studied the spiders of Parambikulam wildlife sanctuary, Kerala. Then 2005 witnessed some important studies on the diversity of spider in Kerala (Sebastian et al., 2005, Sudhikumar et al., 2005a and Jose, 2005). Mathew et al. (2005) studied the diversity of spiders in cardamom plantation of highranges of Kerala. A total of 72 species of spiders belonging to 57 genera of 20 families were collected from Mannavan shola, Kerala the largest Shola patch in Asia, existing in the Western Ghats, one of the biodiversity hot spots of the world (Sudhikumar et al., 2005b). Sebastian et al. (2005) documented the spider diversity in the high ranges associated with the Western Ghats of central Kerala. District wise local studies portraying the diversity of spiders deserve more importance in the current scenario of ecological destruction and other anthropogenic interventions.

MATERIALS AND METHODS

STUDY AREA

The study areas included habitats in and around various buildings, gardens and forest patches in Kollam District (Plate 1). This district is located on the southwest part of Kerala State and extends from Lakshadweep Sea to the Western Ghats. It is bordered by Trivandrum district on the South, Alapuzha and Pathanamthitta districts in the North, Thirunelveli district of Tamilnadu State in the East and Lakshadweep sea in the west. It lies between North latitudes 8° 45′ and 9° 07′ and East longitudes 76° 29′ and 77° 17′. It has a geographical area of 2491 sq. km which is about 6.48% of the total geographical area of the State. This district has been gifted with sea, lakes, plains, mountains, rivers, streams, backwaters, forest, vast green fields and tropical crop of every variety, both food and cash crop, hence called God's own Capital. The district is drained by three west flowing rivers, Achenkovil, Kallada and Ithikara, originating in the eastern hilly region. These rivers together with their tributaries exhibit dendritic pattern of drainage. The whole district of the study area has a tropical humid climate, with an oppressive summer, plentiful seasonal rainfall and cool winters. Temperature is almost steady throughout the year. The average temperature is around 25° C to 32° C. Summers usually begin from March and extend till May. The rest of the year is generally dry. The monsoons begin by June and end by September. The district receives an average rainfall of about 2555 mm annually. The major source of rainfall is South West monsoon from June to September which contributes nearly 55% of the total rainfall of the year. The North East monsoon season from October to December contributes about 24% and the balance 21% is received during the month of January to May as pre-monsoon showers. Winter is from November to February during which temperature is moderately cool hovering from 18° C to 25° C. The Relative humidity is higher during the monsoon period and it is higher all through the year during the morning hours. Ecologically Kollam district belongs to Agasthyamalai Biosphere Reserve. The vegetation consists of typical southern subtropical

flora. Though the rural areas are gifted with many undisturbed habitats, most areas are on the threat of unscientific construction activities and destruction of wetlands and rain groves.

Methodology

Regular visits were made in various ecosystems in the study area from the first week of August 2019 to the first week of March 2020. Areas including buildings, gardens, agroecosystems, shrubs and herbs, grasslands and ponds were visited. Typical and unique features of the spider and pattern of web making were noted down. The pattern of color patches was recorded. Spiders were photographed from different angles as often as possible to obtain sufficient photographs to enable positive identification of species. Descriptions and photographs were compared with literature and the species were identified based on the collected data and available reference, both printed and electronic. Species identity was confirmed with the help of 'Spiders of India' by Sebastian and Peter (2009) and papers of Sudhikumar et al. (2005a and 2005b). Taxonomy and nomenclature have been updated. Vegetation of each site and sub site were keenly observed and relevant data were recorded. Special attention was given to the pattern of prey capture and the types of preys preferred out of an interest but they haven't been included in the present study.

RESULTS AND DISCUSSION

A total of 24 spider species belonging to 11 different families were observed (Table 1). Family Salticidae showed the maximum species, comprising of 10 species including *Bianor* sp., *Epeus* sp., *Hyllus semicupreus*, *Hyllus* sp., *Phaeacius* sp., *Plexippus paykulii*, *Plexippus petersi*, *Plexippus* sp., *Rhene flavigera* and *Telamonia dimidiata*. Family Araneidae recorded *Argiope anasuja*, *Argiope pulchella*, *Eriowixia laglaizei*, and *Gasteracantha geminata* and Family Oxyopidae recorded *Oxyopes javanus* and *Peucetia viridana*. Other eight families recorded one species each viz., *Pardosa* sp. in Lycosidae, *Nephila pilipes* in Nephilidae, *Crossopriza lyoni* in Pholcidae, *Psechrus* sp. in Psechridae, *Heteropoda venatoria* in Sparassidae, *Leucauge pondae* in Tetragnathidae, *Plesiophryctus* sp. in Theraphosidae and *Theridion tikaderi* in Theridiidae.

Holloway et al. (1992) observed that conversion of forest to plantation and other man-induced disturbances lead to reduction in the diversity of invertebrates, both in species richness and in the taxonomic and biogoeographic quality. Being an area with varied habitat and climatic zones, top priority must be given for the conservation of its rich diversity. Studies have demonstrated that a correlation exists between the structural complexity of habitats and species diversity (Hawksworth and Kalin-Arroyo, 1995). Diversity generally increases when a greater variety of habitat types are present (Ried and Miller, 1989). Uetz (1991) suggests that structurally more complex shrubs can support a more diverse spider community. Downie et al. (1999) and New (1999) have demonstrated that spiders are extremely sensitive to small changes in the habitat structure, including habitat complexity, litter depth and microclimate characteristics. Spiders generally have humidity and temperature preferences that limit them to areas within the range of their 'physiological tolerances' which make them ideal candidates for land conservation studies (Riechert and Gillespie, 1986). Therefore, documenting spider diversity patterns in this ecosystem can provide important information to justify the

conservation of this ecosystem. The present study recorded considerably little number of spiders. It might be due to the ecological threats posed by the areas because of the decline in the undisturbed shrubby areas and agricultural ecosystems.

Table 1. List of the Spiders recorded from the study area

Sl. No.	Scientific name
Family Salticidae	
1	*Bianor* sp.
2	*Epeus* sp.
3	*Hyllus semicupreus* Simon 1885
4	*Hyllus* sp.
5	*Phaeacius* sp.
6	*Plexippus paykulii* Audouin 1826
7	*Plexippus petersi* Karsch 1878
8	*Plexippus* sp.
9	*Rhene flavigera* C.L. Koch 1846
10	*Telamonia dimidiata* Simon 1899
Family Araneidae	
11	*Argiope anasuja* Thorell 1887
12	*Argiope pulchella* Thorell 1881
13	*Eriowixia laglaizei* Simon 1877
14	*Gasteracantha geminata* Fabricius 1798
Family Oxyopidae	
15	*Oxyopes javanus* Thorell 1887
16	*Peucetia viridana* Stoliczka 1869
Family Lycosidae	
17	*Pardosa* sp.
Family Nephilidae	
18	*Nephila pilipes* Fabricius 1793
Family Pholcidae	
19	*Crossopriza lyoni* Blackwall 1867
Family Psechridae	
20	*Psechrus* sp.
Family Sparassidae	
21	*Heteropoda venatoria* Linnaeus 1767
Family Tetragnathidae	
22	*Leucauge pondae* Tikader 1970
Family Theraphosidae	
23	*Plesiophryctus* sp.
Family Theridiidae	
24	*Theridion tikaderi* Patel 1973


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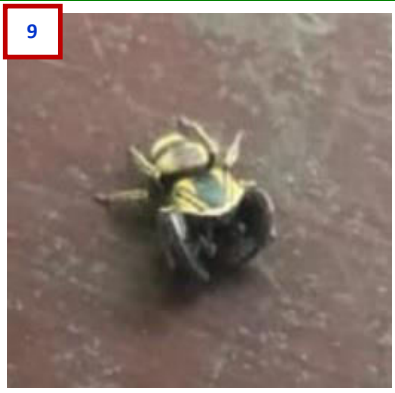
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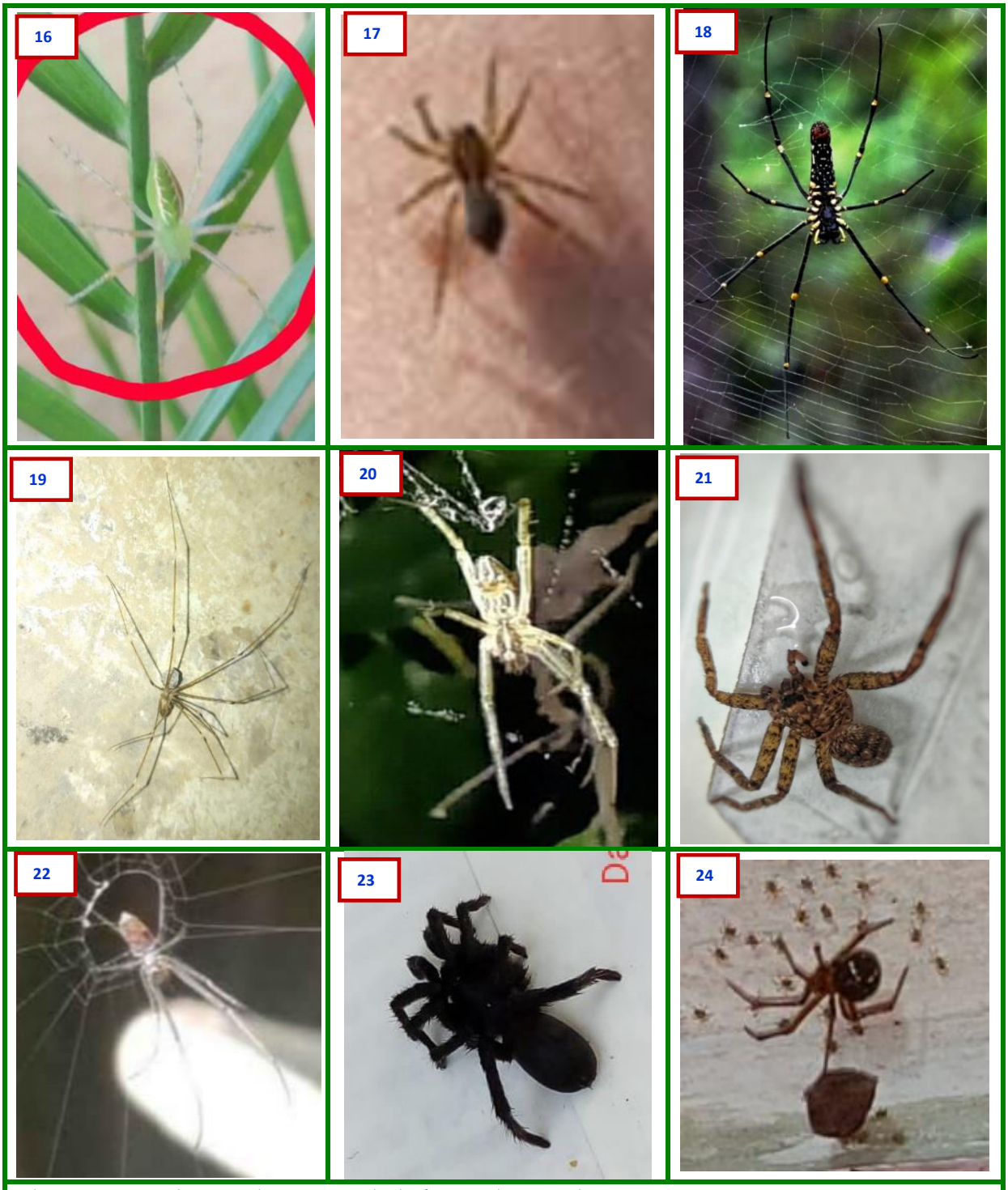

Plates 1-24. The spiders recorded from the study area. 1. *Bianor* sp., 2. *Epeus* sp., 3. *Hyllus semicupreus*, 4. *Hyllus* sp., 5. *Phaeacius* sp., 6. *Plexippus paykulii*, 7. *Plexippus petersi*, 8. *Plexippus* sp., 9. *Rhene flavigera*, 10. *Telamonia dimidiata*, 11. *Argiope anasuja*, 12. *Argiope pulchella*, 13. *Eriowixia laglaizei*, 14. *Gasteracantha geminata*, 15. *Oxyopes javanus*, 16. *Peucetia viridana*, 17. *Pardosa* sp., 18. *Nephila pilipes*, 19. *Crossopriza lyoni*, 20. *Psechrus* sp., 21. *Heteropoda venatoria*, 22. *Leucauge pondae*, 23. *Plesiophryctus* sp., 24. *Theridion tikaderi*

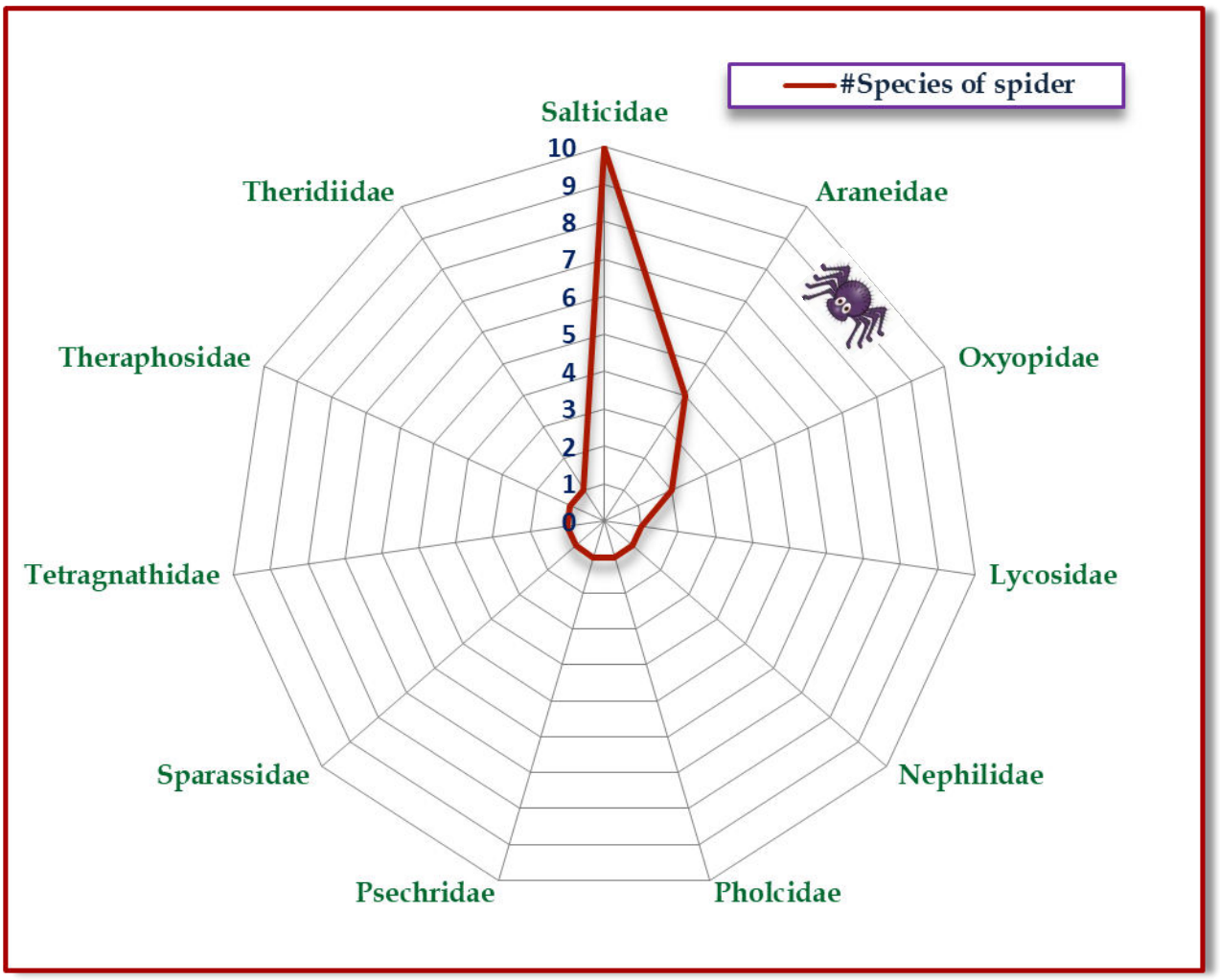

Fig. 1. Number of species observed from each family

SUMMARY AND CONCLUSION

The present study recorded 24 species of spiders from 11 families. Family Salticidae showed maximum number of species (10). Family Araneidae and Family Oxyopidae recorded four and two species respectively. Other families recorded one species each. The present study could record significantly little number of spiders. Since most of the ecosystems face some severe threats by anthropogenic interventions the spider diversity and distribution seem scanty. This study points towards the need for conservation of the rural and suburban ecosystems imposing little threats due to developmental activities thereby conserving entire fauna in these ecosystems. This study serves as a baseline for future study of spiders in these areas using additional collecting methods and/or collecting in different seasons. Future studies can add to this checklist and continue to catalogue the poorly documented spider fauna and perhaps discover new species.

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