



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 3, March 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

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www.ijirset.com

Study on Diversity of Spider Fauna in Sreekrishnapuram Gramapanchayat of Palakkad District, Kerala and Their Phylogenetic Analysis

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ABSTRACT: Spiders are diverse and ubiquitous invertebrate predators in terrestrial ecosystems. Spiders are considered the major agent for controlling insect communities in agricultural ecosystems because of their high abundance and insectivorous foraging habit. A Pioneer study was conducted to reveal the spider diversity in Sreekrishnapuram agroecosystems of Palakkad district, Kerala and their phylogenetic analysis. The major objective of this study was to evaluate the current status of spider diversity in this study area. A total of 30 species of spiders belonging to 27 genera of 11 families were identified and studied during the study period. Salticidae is the dominant family from which 8 species are recorded. Phylogenetic analysis was based on DNA sequences of mitochondrial Cytochrome C Oxidase subunit 1 (CO1). This analysis reveals Salticidae family has the least root distance, 0.070030 which shows much resemblance to the ancestor. Lycocidae is the most diverged Family with root distance 0.208430. The average root distance is 0.122313 and the variation is 0.013395. The vast majority of similarities and differences among species are due to phylogeny. Jumping spiders (Salticidae) all have huge anterior median eyes because they are relatively closely related, and wolf spider (Lycosidae) eyes exhibit their characteristic eye pattern for the same reason. Phylogeny explains more biological pattern than any other scientific theory and therefore classifications based on phylogeny will be maximally predictive. The diversity of Salticidae with 8 species and *Pholcus phalangioides* abundance shows its adaptation in the present agroecosystem.

KEYWORDS: Spider, diversity, guild, spider fauna, phylogenetic analysis.

I. INTRODUCTION

Spiders are most ubiquitous and diverse group of organisms [1]. They are found across the world, except for Antarctica, and have adapted to all known biological settings other than the open sea and the air. Spiders are abundant predators of other forest arthropods, so their ecological importance is undeniable despite their small size [2]. Spiders are one of the most diverse and functionally significant predators regulating the terrestrial arthropod population, thereby, making them effective biological control agents in ecosystems [3]. As a result of their abundance and diversity in almost all microhabitats, and foraging strategies, combined with the advantage of easy collection, they can be effectively monitored in the environment. Spiders are becoming more popular due to their extreme importance as ecological indicators sensitivity to environmental changes and disturbances. Despite their critical roles in most natural ecosystems, they have received little attention in conservation efforts. Numerous spiders are crucial biological control agents for a variety of agricultural pests, particularly in paddy fields [4]. While most spiders are terrestrial, some also dwell in water. The preferred habitats, hunting tactics, and active time of spiders vary widely. The presence of spiders is influenced by a number of biotic and abiotic factors, including prey availability, seasonal changes in temperature, and their own guild-specific reaction. India is having 1,686 species of spiders belonging to 60 families and 438 genera, which constitutes 3.6% of world's spider population [5]. The aim of this study was to investigate the diversity of spiders in Sreekrishnapuram and their phylogenetic analysis. The study if spiders from this area is still far from complete, the present study forms a basis for further investigations.



II.MATERIALS AND METHODS

Area selected for the present study is Sreekrishnapuram gramapanchat located in Palakkad District, with a latitude of 10.906673 and longitude is 76.415810. The vegetation comprises mostly of rubber plantations and vegetable crops.

2.1. Sampling

The study was carried out during the month of September to December in 2022 in Sreekrishnapuram. Spiders were collected during the morning (7.00am to 11.00am) and evening (16.00pm to 18.00pm) time to maximize the species richness. Spider collection was mainly done by handpicking and beating methods. Identification of the collected spiders were done with the help of Dr. Sudhikumar A.V, Assistant professor in Zoology, Christ college Irinjalakuda and also by referring handbook of Indian spiders [6], Keralathile chilanthikal [7], taxonomic keys for Indian spiders [8].

2.2. Phylogenetic Analysis

The COI gene sequences of the identified spider species collected from Sreekrishnapuram which is available at NCBI were downloaded and used for phylogenetic analysis. Multiple sequence alignment was done using Clustal X. The phylogenetic tree was constructed using PHYLODRAW.

2.3. Data analysis: To analyze the distribution and diversity of spiders in study locality Shannon diversity index was used.

Shannon diversity index:

$$H = -\sum_{j=1}^S p_i \ln p_i$$

Where, pi = the observed relative abundance of a particular species in Shannon-Wiener index. Higher the value of H, higher the diversity of species in a particular community. Lower the value of H, lower the diversity. A value of H = 0 indicates a community that only has one species.

III.RESULT AND DISCUSSION

In total 228 spiders were observed of 11 families, 27 genera and 30 species (Table 1). Of the total number of each species observed *Pholcus phalangioides* and *Plexippus paykulli* were found to be abundant, followed by *Heteropoda venatoria*. Whereas *Chrysilla volupe*, *Lycos asp.*, *Oxyopes salticus* and *Indoxysticus minutes*. Photographs of spiders observed have been presented in Fig 3.

Table.1. Spider diversity of Sreekrishnapuram Gramapanchat

SI NO.	Family	Species	Number of Individuals Observed	Guild
1	Araneidae	<i>Neoscona Mukerji</i>	5	Orb-web
		<i>Argiope pulchella</i>	4	
		<i>Argiope anasuja</i>	5	
		<i>Gastracanta geminata</i>	8	
		<i>Argiope brought</i>	15	
		<i>Araneus mitificus</i>	4	
2	Lycosidae	<i>Pardosa sumatrana</i>	7	Ground runner
		<i>Pardosa pseudoannulata</i>	3	
		<i>Lycos asp.</i>	2	
3	Oxyopidae	<i>Oxyopes salticus</i>	3	Foliage runner
4	Pholcidae	<i>Pholcus phalangioides</i>	35	Scattered line weaver
5	Scytodiidae	<i>Scytodes thoracica</i>	5	Ground runner
6	Salticidae	<i>Indopadilla insularis</i>	6	

		<i>Stenaellurillus albus</i>	5	Stalkers
		<i>Hyllus semicupreus</i>	3	
		<i>Rhene rubigera</i>	1	
		<i>Plexippus paykulli</i>	28	
		<i>Telamonia dimidiata</i>	8	
		<i>Phintella vittata</i>	2	
		<i>Chrysilla volupe</i>	1	
7	Sparassidae	<i>Heteropoda venatoria</i>	25	Ground runner
8	Tetragnathidae	<i>Tetragnatha virudorufa</i>	3	Orb web builder
		<i>Tylorida ventralis</i>	2	
		<i>Leucauge fastigata</i>	10	
9	Theraphosidae	<i>Plesiophrictus sp.</i>	5	Ambush predators
		<i>Chilobrachys sp.</i>	13	
10	Theridiidae	<i>Theridion sp.</i>	4	Scattered line weaver
		<i>Nihonhimea mundula</i>	4	
11	Thomisidae	<i>Epidius Parvati</i>	9	Ambusher
		<i>Indoxysticus minutus</i>	3	

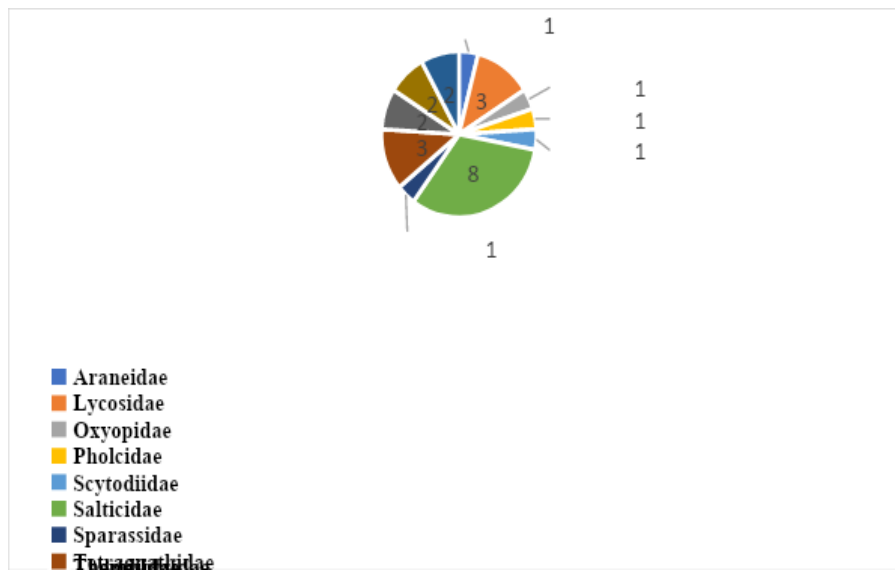


Fig:1 Distribution of spider families in the study area, Sreekrishnapuram

3.1. Functional groups: The collected spiders can be divided into six functional groups (guilds) based on their foraging behaviour in the field (Fig.2). The dominant guild was of the orb web builders and it comprised of 9 species of spiders. Spiders of the families Araneidae, Tetragnathidae fall under this category. Spiders of the category stalkers formed the next dominant guild in this ecosystem comprising of 8 species of spiders. Ground runners (5) foliage runners (1), scattered line weavers (3), ambushers (4) are the other groups.

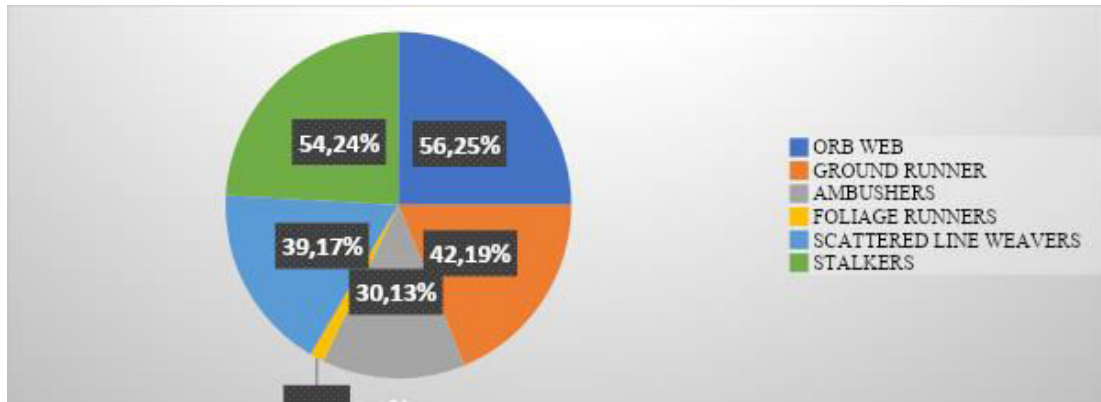


Fig:2 Guild structure of spiders in the study area, Sreekrishnapuram



Pardosa sumatrana



Scytodes thoracica



Indopadilla insularis



Tetragnatha viridorufa



Stenaellurius albus



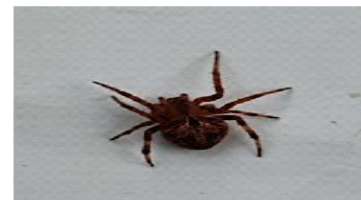
Plesiophrictus sp.



Chilobrachys sp.



Theridion sp.



Neoscona Mukerji



Argiope pulchella



Nihonhimea mundula



Pardosa pseudoannulata



Hyllus semicupreus



Plesiophrictus sp.



Argiope anasuja



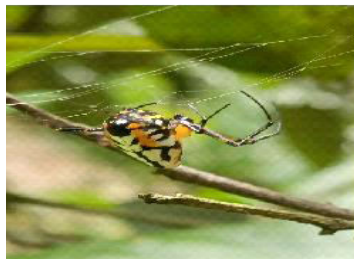
Indoxysticus minutus



Rhene rubigera



Tylorida ventralis



Leucauge fastigata



Plexippus paykulli



Epiarius Parvati



Heteropoda venatoria



Pholcus phalangioides



Araneus mitificus



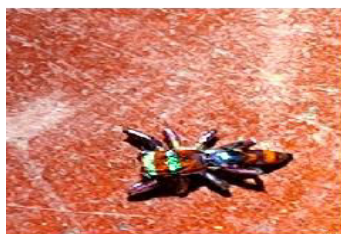
Gasteracantha geminata



Argiope brought



Telamonia dimidiata



Chrysilla volupe



Phintella vittata



Oxyopes salticus

Fig.3. Identified spiders from Sreekrishnapuram

3.2. **Generic diversity:** Out of the 252 genera recorded from the Indian regions [9] 27 genera are discovered in Sreekrishnapuram. Maximum generic diversity was found in Salticidae (8) and in Araneidae (4).

3.3. Species diversity: Total number of species found was 30. Family Salticidae shows species diversity compared to other families observed during the study period. Distribution of species belongs to 11 families described in Fig.4. During the study period 54 spiders reported from the family Salticidae belongs to 8 species followed by Araneidae with 41 spiders belongs to 6 species. Lycosidae (3), Tetragnathidae (3), Theraphosidae (2), Theridiidae (2), Thomisidae (2), Scytodiidae (1), Oxyopidae (1), Sparassidae (1), Phocidae (1) are the other families with different species.

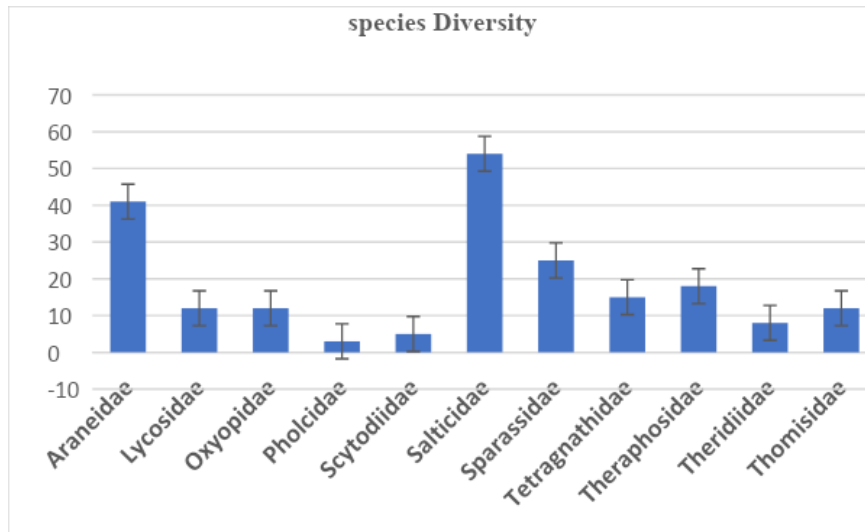


Fig:4 Species diversity of spiders in the study area, Sreekrishnapuram

3.4. Data analysis: Shannon diversity index is the popular matrix used in biodiversity studies(ecology). Shannon diversity index in this area is 2.99. Total number of individuals observed 228 and the species richness is 30.

3.5. Phylogenetic analysis: In phylogenetic analysis (Fig. 5), the tree represents all the spider families are originated from a single common ancestor that is monophyletic origin. During the course of evolution, the node differentiates into two taxa which represents the lineages of the extant taxa. It results in the formation of polyphyletic origin of current families with respect to the internodes.

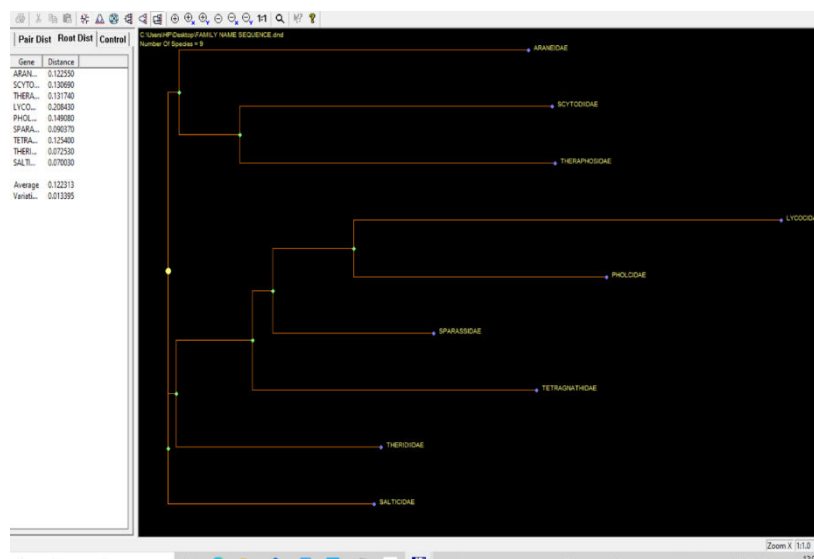


Fig. 5. Phylogenetic relationship of spider families collected from Sreekrishnapuram in PhyloDraw

From the above phylogenetic tree, Salticidae family has the least root distance ,0.070030(it is very much closer to the ancestor). Lycosidae is the most diverged Family with root distance 0. 208430.The average root distance is 0.122313

and the variation is 0.013395. Diverse web builder spiders including orbweavers (Araneidae, Tetragnathidae), irregular web builders (Pholcidae), funnel web builders (Lycosidae) and nonweb builders (Salticidae) were found in the MU Campus similar to our findings [10]. Achal Kumari Pandit [11] identified a total of 18 family, 52 genus and 80 species from Tinsukia district, Assam. In the studies of Achal Kumari Pandit [11] family richest in species were Araneidae, Salticidae, Oxyopidae and Tetragnathidae family was the most rarest to be observed. Interspecific variation in colouration among different spiders differentiating Garden spider to be Colorful in comparison to House and ground spiders to be darker might be linked with different environmental effects and behavioural patterns observed on them [12].

Spiders are taxonomically diverse and exhibit community level diversity; they are useful indicators of environmental change [13]. They are most important as regulators of herbivore populations especially pests. They are also good sources of food for higher trophic levels like birds, small mammals amphibians small reptiles and also for some predatory insects. Spiders can be used in conservation ecology and assessment of environmental changes as their richness correlates with the abundance of other animals like mollusks, orthopterans, carabids and birds Spiders have been also shown to accumulate many trace metals and known to be good indicators of ecotoxicological studies [14].

IV. CONCLUSION

This study is an attempt to identify the various spider families in the Sreekrishnapuram agroecosystem of Palakkad district and their phylogenetic analysis. Spiders are one of the most important arthropod groups in agroecosystems. They colonize almost habitats and have great ability in resisting adverse ecological conditions. It is observed that the atmospheric and ecological conditions of Sreekrishnapuram are suitable for spider fauna. Appropriate conservation strategies should be developed and implemented to conserve the biodiversity in these regions. This study is the first survey of spiders in Sreekrishnapuram agroecosystem. It also emphasizes the need for conservation of this ecosystem by characterizing species diversity and highlighting rare and endemic species in this area. This study serves as a baseline for future study of spiders in Sreekrishnapuram agroecosystem. Such studies can build upon this one by using additional collecting methods in different seasons. Future studies can build upon this checklist and continue to catalogue the poorly documented spider fauna and perhaps discover new species along the way.

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