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Homestead spider diversity (Arachnida: Araneae) of six selected panchayath with mixed agro-ecosystems of Palakkad district, central Kerala, India

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Abstract
Study of diversity and distribution of spiders from 6 homestead agro ecosystems (Kavasseri, Puthucode, Vandazhi, Kizhakkenchery, Tarur and Thathamangalam) of Palakkad, District, Kerala, India. The study was conducted for 6 months from September 2023 to February 2024. A total 104 species of spiders belonging to 72 genera and 18 families were recorded during the study period. The family Araneidae (26.31%) with 28 species was the most dominant followed by Salticidae (24.21%), Tetragnathidae (12.63 %), Oxyopidae (7.14%). Highest generic diversity was found in the family Salticidae with 19 genera (26.4%) followed by Araneidae with 16 genera (22.22%). The dominant guild was Orb web builders with 43 species (38.77%) followed by Stalkers with 28 species (30.61%). Agro ecosystem of Puthucode (Site B) showed maximum diversity, followed by Site D – Kizhakkenchery. The structure of the agro- ecosystem was found to influence the diversity of spiders. Spiders are abundant and wide spread in almost all ecosystems and they are the best bio-indicators of the overall species richness and health of terrestrial communities.

Keywords: Agro-ecosystem, diversity, guild, Araneae, spiders, Palakkad

Introduction

Spiders are cosmopolitan terrestrial predators. Mixed agricultural lands are imitations of different types of land use, with areas of mixed semi-natural habitats scattered among cultivated areas. Uneven arrangement of such areas influences the composition and diversity of animal communities strongly (Murcia, 1995 [4] and Bennett and Saunders, 2010) [1]. Such diverse environment thus becomes important areas for the entry of animals from nearby natural habitats. The behavior of predators in both agricultural fields and surrounding habitats is therefore a major research field in the ecology of agricultural landscapes. The landscape, habitat and plant growth also play vital role in the diversity of the spiders (Suana et. al., 2004) [8], they also acts as predators and biocontrol agent in insect pest control (Symondson et. al., 2002 [9] and Öberg, 2007) [5]. Alex et.al., (2018) observed Araneidae as the most dominant family followed by Salticidae from agro ecosystems of Kavvayi river basin. Only few studies on spider diversity of mixed agroecosystems of Palakkad district is conducted, Ranjini (2016) [6] conducted preliminary studies on the spider fauna in different agro-ecosystems of Kozhinjampara, Palakkad.

Spiders are cosmopolitan in distributioncontinent except for Antarctica. According to World catalog (2023) 51,673 species of spiders from 136 families have been recorded by taxonomists worldwide. Current attempt was to identify the home-stead spider diversity of six panchayths of Palakkad district with various vegetation and agro-ecosystems.

Materials and methods

Palakkad district is located between 10^0 20" to $11^0$14" N latitude and $76^0$02" to $76^0$54" E longitude. Physiographic nature of this district includes midland and highland. Total 49% of the district occupies cultivated areas. The study was conducted in 6 home - stead ecosystems having an area around 10 cents belonging to six panchayath of Palakkad district from September 2023 to February 2024.

Study area

Site A: Kavassery II Panchayath (10.631019N, 76.498547E). Home stead garden comprised of different types of roses, variety of flowering plants, papaya, coconut and rubber. Study site was surrounded by Rubber and plantations like banana and pine apple. Site B: Puthucode Panchayath (10.627608N, 76.422581E). Study site contains Mahagani, Arecanut, Coconut, Rubber, Betel, Sapodilla, Guava, Jack tree, Tamarind, Mango, Pappaya, Cinnamon, Moringa and garden plants like Rose, Ixora, Nerium, Coin wheel, Tulasi, Aloevera, Chrysanthimum, Hibiscus, Cassava, Chilli, Adathoda and Brinjal. Area was surrounded by paddy fields and rubber plantations. Site C: Vandazhi Panchayath (10.520657N, 76.546161E). Site includes trees like Rubber, Arecanut, Tapioca, Mango, Banana, Jack trees, Rambutan and Coconut trees. Site D: Kizhakenchery Panchayath (10.541060N, 76.491512E). Study site comprised of tress like Coconut, Mango, Papaya, Mahagani, Rambutan etc. Home stead garden comprises of different varieties of roses. Acres of paddy fields surrounded this site. Site E: Tarur Panchayath (10.66954 N, 76.485878E). Study site consisted of trees like Mango, Jack, Papaya, Ponderosa lemon and Papaya. Garden contains few rose plants and Brinjal. It also contains turmeric plants. Site F: Thathamangalam – Chittur panchayath (10.684307N, 76.698331E). Site includes Coconut tree, Tamarind and Banana. Home stead garden consists of Rose, marigold and Hibiscus.

Sampling

Sampling was carried out from September 2023 to February 2024. Weekly surveys were conducted in the morning hours from 7 am to 11 am and evening 4 pm to 6 pm. Visual searching method was followed for sampling. All habitats that hoard the spiders such as grounds, litter, brushwood, bushes, tree trunks, foliage, and water bodies were examined. Data on web patterns and microhabitat type were recorded with every encounter. Encountered spiders was photographed at different angles, collected and preserved in 70% alcohol with proper labeling. Spiders were identified using field guide and identified with the help of World spider catalogue. Confirmation of identified spiders was done with the help of eminent taxonomists at the CATE, Department of Zoology, Christ College, Irinjalakuda, Trichur.

Results

A total of 104 species (5 spiders identified only up to genus level) of spiders belonging to 72 genera under 18 families were identified from six study sites of mixed agro-ecosystem of Palakkad (Table: 2; Fig. 2). Salticidae (Jumping spiders) was found to be the most dominant family with 19 genera (26.4%) followed by Araneidae (Orb weaver) with 16 genera (22.22%), Thomisidae (Crab spiders) with 6 genus (8.3%), Theridae (Cob web spiders) with 5 genus (6.9%), Tetragnathidae (Long jawed orb weaver) with 4 genus (5.55%), Sprassidae (Huntsman spider) and Oxypodidae with 3 genus (4.26%) each. Family Lycosidae, Theraphosidae, Pisauridae and Philodromidae with 2 species each and Family Pholidae, Scytodidae, Chiracanthidae, Corrinidae, Gnaphosidae, Nephilidae and Desidae represented by one family each. Although Salticidae was with 19 genera, Araenidae was found to be most dominated with 28 species followed by Salticidae with 22 species and Tetragnathidae with 13 species. Both Thomisidae and Oxypodidae consisted of 7 species. While only single species was recorded from five Families Cheracanthidae, Corrinidae, Graphsidae, Nephilidae and Desidae. Seven families was recorded from site A – Kavassery II, with (Araneidae (50%), Salticidae (15%), Tetragnathidae (14%) and remaining families represented 7% each (Fig. 3). Distribution of spider families from site B- Puthucode (Fig.4) showed that dominant family was Araneidae (37%), followed by Tetragnathidae (27%) and Pholcidae (18%). Philodromidae and Salticidae (9%) each. Site C – Vandazhi represented 6 families (Fig. 5) with dominance of Salticidae (59%). Site D – Kizhakkenchery (Fig. 6) represented 7 families. Here Araneidae dominated with (25%) and Pholcidae, Salticidae and Oxyopidae 17% each Tetragnathidae, Sparassidae and Pisuaridae 8% each (Fig.8). Site E – Tarur (Fig. 7) represented only 4 families, with least diversity. Both Araneidae and Tetragnathidae represented 33% and Philodromidae and Pholcideae with 17%. Site F- Thathamangalam (Fig. 8) represented 7 families- that is Theridiidae and Araneidae in equal proportion (25%) followed by Oxypodidae (17%). Out of the total 104 (Table: 4) species identified Site B showedmaximum diversity (53%) followed by Site D with 51%. Site E showed comparatively less diversity. The spiders identified from the study sites belonged to six functional guilds on the basis of their foraging behavior (Table: 1 and Fig.1). The dominant guild was (i) Orb web builders/weavers represented by 43 species (Araenidae, Tetragnathidae, Nephilidae and Desidae), they are found to construct circular nets with the numerous radial and spiral threads which are placed in open spaces between trees and shrubs. Trailed by (ii) Stalkers (Salticidae and Oxypodidae) with 28 species, they are long- legged and running spiders mostly observed during evening. Ambushers represented 13 species (Thomisidae, Pisauridae and Philodromidae), this group was found to simply waiting at places where insects feed and pounce on them (Thomsidiae, Theraphosidae, Pisauridae and Philodromidae). While Theraphosidae was found to lie out sticky snare lines and reel the catch in when it becomes stuck. Ground runners (Lycosidae, Sprassidae, Gnaphosidae, Corriniidae and Scytodidae) represented 12 species, cob web builders (Theridiidae and Pholidae) with 7 species and Foliage runners with single species (Table: 1). Functional guild analysis revealed six feeding guilds. The dominant feeding guild being Orb-web builders representing 41.35% of the total sample collected. Followed by stalkers (27.88%) followed by ground runners (11.54%) and least percentage were represented Foliage runners by 0.96%.

Discussion

Spider diversity of 6 mixed home-stead sites of Palakkad district was studied over a period of 6 months and recorded 104 species under 72 genera under 18 families. Site B and Site D among the study sites have rich stretch of paddy fields together with other agro-ecosystems. Shabnam et. al. (2021) [7] reported a total of 93 species of spiders from different agro-ecosystem of Western Ghats, Kerala. The highest species richness during present study was found in the site B with 53 species belonging to 9 families. Site D recorded 51 species belonging to 9 families. While Site E showed the lowest species richness with only 27 species belonging to 7 families. It was observed that the vegetative structure of the habitats supports the web building in spiders. Contradictory to the previous results family Salticidae was altogether absent in site E. Additionally, the exclusive presence of Family Theraphosidae species at this site may be related to the existence of a favorable microclimate (nocturnal hunting) for these species. Thus vegetative structure is found to influence the diversity of spiders found in the study sites. During present study vegetal wanderers and web builders were sampled more than ground dwellers. This again indicates that structural diversity of the vegetation may, in some way, influence the spider diversity. Which is correlated with the observation of Mathew et. al., (2014) [3], they observed that structurally complex plants significantly influences the spider species especially web- building species. Even though all the six study sites belong to rural areas under constant anthropogenic stresses, presently it supports rich diversity of spiders (104 species). This indicates that the areas still have a healthy population of spiders. Present study provides baseline for the future surveys and to discuss the various threats to the Arachnoid fauna of the Palakkad district.

Table 1: Guilds structure of spiders collected

No.	FAMILY	GENERA	SPECIES	GUILD STRUCTURE	PERCENTAGE
1	Theraphosidae	2	2	Ambusher	10.58
2	Thomisidae	6	7		
3	Philodromidae	2	2		
4	Pisauridae	2	2		
5	Pholcidae	2	2	Cob web builder	6.7
6	Theridiidae	5	5		
7	Cheiracanthiidae	1	1	Foliage runners	0.96
8	Lycosidae	2	3	Ground runner	9.62
9	Scytodiidae	2	2		
10	Sparassidae	2	3		
11	Corinnidae	1	1		
12	Gnaphosidae	1	1		
13	Araneidae	16	28	Orb -web builder	41.35
14	Tetragnathidae	4	13		
15	Desidae	1	1		
16	Nephilidae	1	1		
17	Oxyopidae	3	8	Stalkers	28.85
18	Salticidae	19	22		
	Total	72	104		

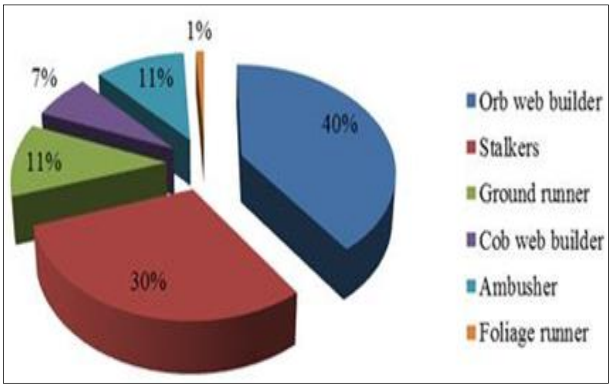

Fig 1: Guild structure analysis of spiders recorded from study sites

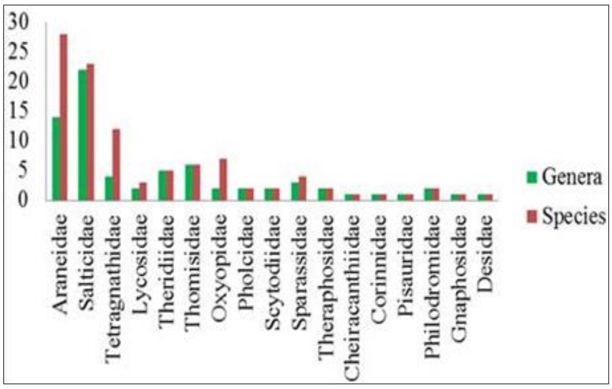

Fig 2: Total Species diversity of spiders

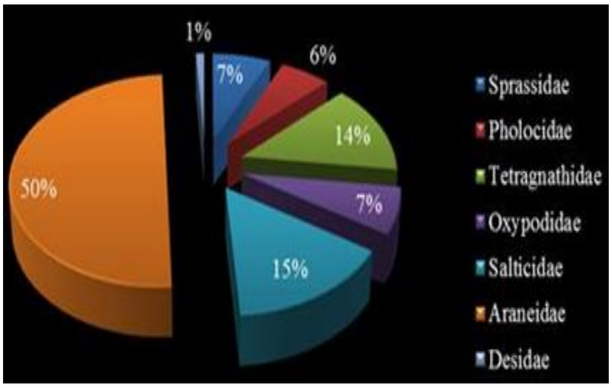

Fig 3: Percentage of spider diversity of Site A

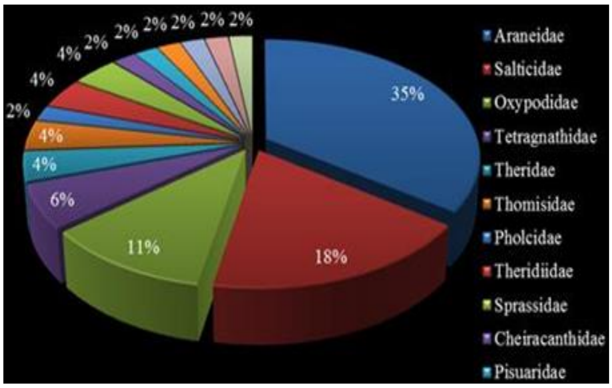

Fig 4: Percentage of spider diversity of site B

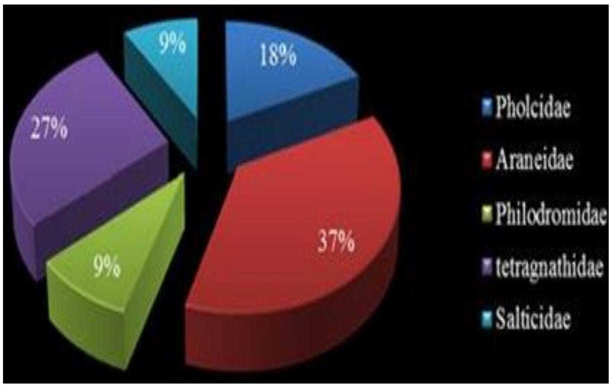

Fig 5: Percentage of spider diversity of Site C

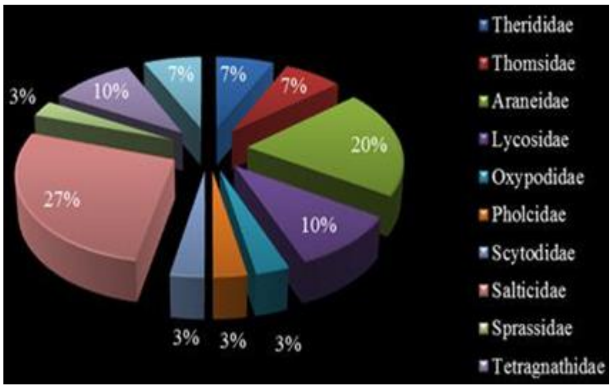

Fig 6: Percentage of spider diversity of Site D

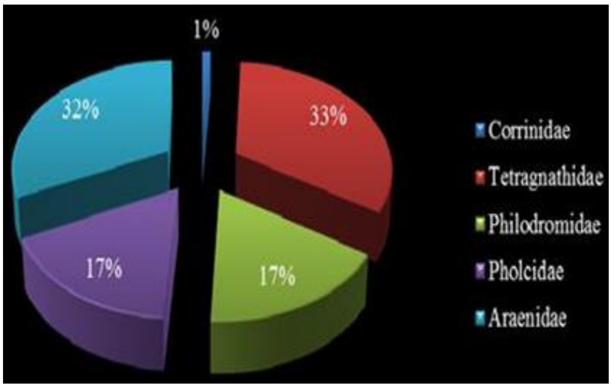

Fig 7: Percentage of spider diversity of Site E

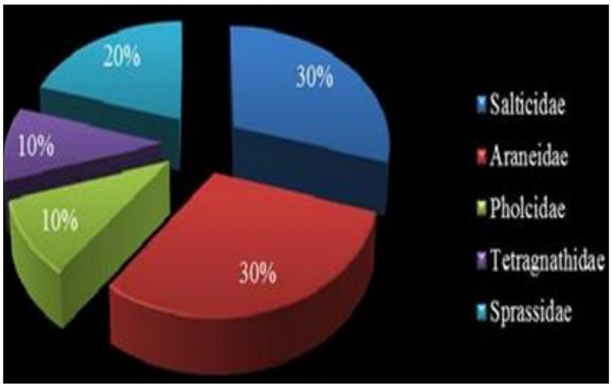

Fig 8: Percentage of spider diversity of Site F

Table 2: Check list of spider species observed from study sites

Sl. No	SPECIES	Sl. No	SPECIES	Sl. No	SPECIES
FAMILY: ARAENIDAE		**FAMILY: SALTICIDAE**		**FAMILY: THOMISIDAE**	
1	*Anepsion maritatum*	1	*Asemonea tenuipes*	1	*Amyciaea forticeps*
2	*Araneus diadematus*	2	*Carrhotus viduus*	2	*Epidius parvati*
3	*Araneus mitificus*	3	*Chrysilla volupe*	3	*Indoxysticus minutus*
4	*Araneus ventricosus*	4	*Cosmophasis umbratica*	4	*Misumessus oblongus*
5	*Argiope aemula*	5	*Epeus indicus*	5	*Oxytate virens*
6	*Argiope anasuja*	6	*Epocilla aurantiaca*	6	*Thomisus projectus*
7	*Argiope brought*	7	*Hasarius adansoni*	7	*Thomisus spectabilis*
8	*Argiope keyserlingi*	8	*Hentzia mitrata*	**FAMILY: THERIIDAE**	
9	*Argiope pulchella*	9	*Hyllus semicupreus*	1	*Theridion manjithar*
10	*Araniella nympha*	10	*Menemerus bivittatus*	2	*Nihonhimea mundula*
11	*Cyclosa bifida*	11	*Menemerus semilimbatus*	3	*Chrysso spiniventris*
12	*Cyrtarachne gravelyi*	12	*Metaeyrba taeniola*	4	*Meotipa sahyadri*
13	*Cyrtophora cicatrosa*	13	*Myrmarachne plataleoides*	5	*Parasteatoda tepidariorum*
14	*Cyrtophora* sp.	14	*Phidippus clarus*	**FAMILY: SPRASSIDAE**	
15	*Eriovixia excelsa*	15	*Phintella vittate*	1	*Heteropoda maxima*
16	*Eriovixia laglaizei*	16	*Phlegra bresnieri*	2	*Heteropoda venatoria*
17	*Gasteracanta geminata*	17	*Plexippus paykulli*	3	*Olios mileti*
18	*Herennia multipuncta*	18	*Plexippus petersi*	**FAMILY: PHOLCIDAE**	
19	*Hypsosinga pygmaea*	19	*Rhene rubigera*	1	*Holocnemus pluchei*
20	*Hypsosinga rubens*	20	*Stenaellurillus albus*	2	*Pholcus phalangioides*
21	*Neoscona crucifera*	21	*Stenaelurillus lesserti*	**FAMILY: SCYTODIIDAE**	
22	*Neoscona molemensis*	22	*Telamonia dimidiate*	1	*Scytodes thoracica*
23	*Neoscona mukerji*	**FAMILY: OXYPODIDAE**		2	*Scytodes globula*
24	*Neoscona nautica*	1	*Hamadruas hieroglyphica*	**FAMILY: THERAPHOSIDAE**	
25	*Nephila pilipes*	2	*Hamadruas insulana*	1	*Plesiophrictus sp.*
26	*Parawixia dehaani*	3	*Hamadruas sikkimensis.*	2	*Chilobrachys sp.*
27	*Phonognatha graeffei*	4	*Oxyopes birmanicus*	**FAMILY: PISAURRIDAE**	
28	*Trichonephila inaurata*	5	*Oxyopes salticus*	1	*Dolomedes tenebrosus*
TETRAGNATHIDAE		6	*Oxyopes shweta*	2	*Pisaurina dubia*
1	*Leucage argyra*	7	*Oxyopes sunandae*	**FAMILY: CHEIRACANTHIIDAE**	
2	*Leucage decorata*	8	*Peucetia viridiana*	1	*Cheiracanthium sp.*
3	*Leucage dorsotuberculata*	**FAMILY: LYCOSIDAE**		**FAMILY CORINNIDAE**	
4	*Leucage venusta*	1	*Pardosa pseudoannulata*	1	*Castianeira zetes*
5	*Leucauge fastigata*	2	*Pardosa sumatrana*		
6	*Opadometa fastigata*	3	*Lycosa barnesi*		
7	*Tetragnatha elongata*	**FAMILY: GNAPHOSIDAE**			
8	*Tetragnatha laboriosa*	1	*Callilepis nocturna*		
9	*Tetragnatha maxillosa*	**FAMILY: DESIDAE**			
10	*Tetragnatha montana*	1	*Badumna insignis*		
11	*Tetragnatha sp.*	**FAMILY: PHILODROMIDAE**			
12	*Tetragnatha virudorufa*	1	*Tibellus chaturshingi*		
13	*Tylorida ventralis*	2	*Philodromus aureolus*		

Conclusion

The study emphasizes that the spider fauna is qualitatively rich in all the study sites. It can be understood that floral and faunal diversity provide best abode for variety of spiders. Many studies also showed correlation between the habitat complexity and species diversity.

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