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Spider diversity across different habitat types in Bannur village, Dakshina Kannada district, Karnataka, India

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Abstract

Spiders are ecologically important indicators of biodiversity, exhibiting diverse distributions influenced by habitat types. This study investigated spider species richness across five habitats in Bannur Village, Dakshina Kannada District, Karnataka, India, amidst rapid urbanization and habitat transformations. Field surveys conducted from April to June 2020 revealed a total of 73 spider species across 18 families. Notably, the highest species richness was found in native forest (59) followed by home gardens (44), *Areca* plantation land (15), buildings (9), and acacia forest (6). Results also emphasize the habitat-specific adaptation and influence of urbanization on spider diversity. The diverse native forest supported most species while low-diversity acacia forest and regularly checked buildings hosted fewer spider species. This highlights impact of habitat changes on spider diversity. Further long-term research considering variables like climate change, vegetation density, and prey availability would yield a comprehensive understanding of the intricate interplay between environmental factors and spider populations.

Key words: *Areca* plantation, Karnataka, native forest, Salticidae, urbanization

Introduction

Spiders–an incredibly widespread and diverse order within the Phylum Arthropoda–stand as one of the most abundant groups of creatures on Earth. Constituting the seventh largest order in terms of known species (Sharma et al., 2020), they boast a staggering 51905 species across 4,375 genera within 138 families (World Spider Catalog, 2024). Their global distribution encompasses nearly every corner of the world, excluding Antarctica (Foelix, 2011).

Efforts have been made to comprehend how spider diversity and abundance varies across habitats receiving different degrees of human disturbance (Chen and Tso, 2004; Rajeevan et al., 2019), distribution patterns in heterogeneous and severely fragmented coastal dune landscapes (Bonte et al., 2004), diversity in different natural habitats (Malhotra et al., 2019), including forests and plantations (Hore and Uniyal, 2008); all these studies indicate that spider diversity and abundance vary across habitats. Hence it is important to understand the relationship between spider availability and habitats and how spider availability is getting affected by urbanization, so as to help in habitat management (Magura et al., 2010). In this context, the current study assessed the relationship between spider species richness and habitat by exploring the species richness in five different habitats, including both natural and altered ecosystems.

Material and Methods

Study site

Five habitats were chosen in Bannur village (12.78º N 75.19º E) of Puttur Taluk, Dakshina Kannada district of Karnataka, India (Fig. 1). Five habitats were considered as five different study sites:

Study site 1: Native Forest: A native forest patch was selected containing mainly the trees *Aporosa cardiosperma*,

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Butea monosperma, *Ficus racemosa*, *Syzygium caryophyllatum*, *Minusops elengi*, *Grewia serrulata*, *Bombax ceiba*, *Tectona grandis*, *Borassus flabellifer*, *Alstonia scholaris*, *Canthium angustifolium*, *Mangifera indica*, *Artocarpus heterophyllus*, *Macaranga peltata*, *Millettia pinnata*, along with bushes, vines, herbs, and grasses. This forest patch was surrounded by Acacia Forest patch and a few houses.

Study site 2: Acacia Forest: A site dominated by an invasive species of tree, *Acacia auriculiformis* (Sandilyan et al., 2018) was selected for the survey. It was adjacent to the selected Native Forest patch and other sides were surrounded by a village road and a few houses. This patch had no significant amount of other vegetation.

Study site 3: *Areca* Plantation: A well-maintained *Areca catechu* plantation was selected which was bordered by a small road on one side with infrequent vehicle movement and native plants on the other side with rare vehicle movement. This plantation was grown by a family as a commercial crop.

Study site 4: Home Gardens: About 30 home gardens were selected. These included mainly native flowering plants and a few *Codiaeum variegatum* (Garden croton) (about 3 houses had Garden croton plants).

Study site 5: Buildings: About 30 houses and 6 shop buildings were selected which were near village roads.

Study site mapping

Map was created using Google Earth Pro and ArcGIS version 10.3 with WGS 84 maps of Country and State boundaries.

Data collection and species identification

All potential microhabitats of spiders such as leaves, flowers and twigs of plants, tree trunks, ground, litter, and building walls were closely examined for the presence of spiders during dawn and dusk. Spiders were photographed and identified with the help of literature (Caleb, 2016; Caleb, 2020; Mondal et al., 2020. Sangavi et al., 2023), and nomenclature is in accordance with World Spider Catalog (2023). No spiders were collected from the field.

Study design and data analysis

Field surveys were carried out for 3 months from April to June 2020. Five field surveys were done per week making a total of 60 surveys, 12 visits to each study site. Field surveys were carried out during dawn Data collected were analyzed and visualized through graph plotting, performed in RStudio 4.3.0 using the ggplot2 package (Hadley, 2016).

Results

Spider species richness varied across different habitats and gave a total of 73 species belonging to 18 families (Table 1). Diversity among families varied from having only one genus and species to 21 genera and 21 species. However, a total of 7 families—Cheiracanthiidae, Ctenidae, Eresidae, Hersiliidae, Linyphiidae, Liocranidae, and Scytodidae—were each represented by only a single genus and species (Table 1). Spider diversity was maximum in Native Forest (59 species), followed by Home Gardens (44 species), *Areca* Plantation (15 species), Buildings (9 species) and Acacia Forest (6 species). Also, a few species were observed to be habitat (study site) specific during the study period. Habitat (study site) specific species were highest in Native Forest (59), followed by Buildings (7), Home Gardens (3) and *Areca* Plantation (1) (Fig. 2).

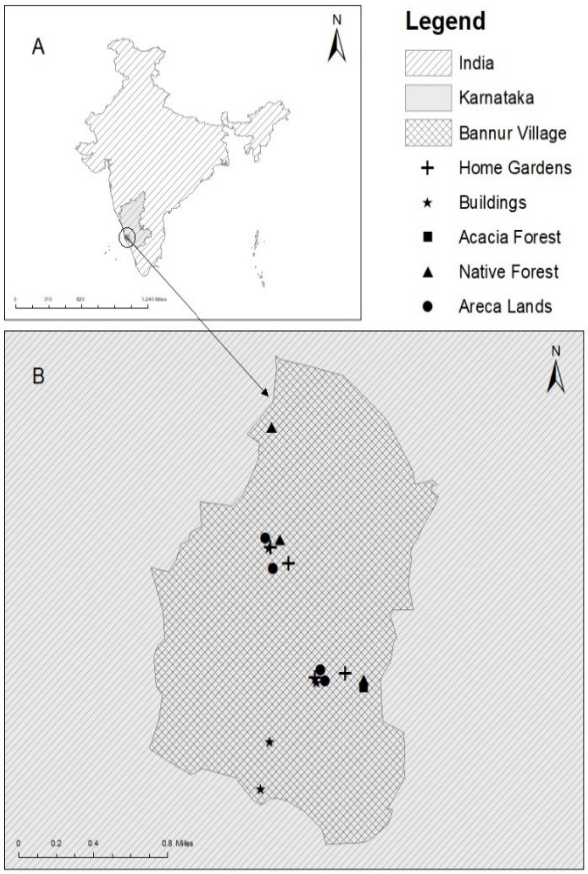

Figure 1: Study site map shows (A) boundary of India and Karnataka state, and (B) Bannur village. Symbols represent different study locations as mentioned in the legend.

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Table 1: Spider species recorded in all study sites during the study period. Note: '1' represents the presence and '0' represents the absence of species in particular site.

Sl. No.	Family	Species	Native Forest	Acacia forest	*Areca* Plantation	Home Gardens	Buildings
1	Araneidae	*Anepsion* sp.	1	0	0	1	0
2		*Argiope aemula* (Walckenaer, 1841)	1	0	0	1	0
3		*Argiope* sp.	1	0	0	0	0
4		*Bijoaraneus mitificus* (Simon, 1886)	1	0	0	1	0
5		*Cyclosa bifida* (Doleschall, 1859)	0	0	1	0	0
6		*Cyrtophora cicatrosa* (Stoliczka, 1869)	1	0	1	1	0
7		*Eriovixia* sp.	1	1	0	0	0
8		*Gasteracantha geminata* (Fabricius, 1798)	1	0	0	1	0
9		*Gea* sp.	1	0	0	1	0
10		*Neoscona molemensis* Tikader and Bal, 1981	0	0	0	1	0
11		*Neoscona* sp.	1	0	0	1	0
12		*Neoscona nautica* (L. Koch, 1875)	1	0	0	1	0
13		*Paraplectana* sp.	1	0	0	0	0
14		*Parawixia dehaani* (Doleschall, 1859)	1	0	0	1	0
15		*Pasilobus* sp.	1	0	0	0	0
16		*Thelacantha brevispina* (Doleschall, 1857)	1	0	1	1	0
17	Cheiracanthiidae	*Cheiracanthium* sp.	1	0	1	1	0
18	Corinnidae	*Castianeira zetes* Simon, 1897	1	0	0	0	0
19		*Coenoptychus* sp.	1	0	0	0	0
20	Ctenidae	*Ctenus* sp.	1	0	1	1	0
21	Eresidae	*Stegodyphus sarasinorum* Karsch, 1892	1	0	0	0	0
22	Hersiliidae	*Hersilia savignyi* Lucas, 1836	1	0	1	1	0
23	Linyphiidae	*Neriene sundaica* (Simon, 1905)	1	0	1	1	0
24	Liocranidae	*Oedignatha* sp.	1	0	0	0	0
25	Lycosidae	*Hippasa* sp.	1	1	1	1	0
26		*Hogna* sp.	1	1	0	0	0
27		*Lycosa* sp.	1	0	0	1	0
28		*Pardosa* sp.	1	0	1	1	0
29	Oxyopidae	*Hamadruas* sp. (Thorell, 1887)	1	0	0	1	0
30		*Hamataliwa* sp.	1	0	0	1	0
31		*Oxyopes shweta* Tikader, 1970	1	0	0	1	0
32		*Oxyopes* sp.	1	0	0	0	0
33		*Peucetia viridana* (Stoliczka, 1869)	1	1	0	1	0
34	Pholcidae	*Artema* sp.	0	0	0	0	1
35		*Crossopriza lyoni* (Blackwall, 1867)	0	0	0	0	1
36		*Pholcus* sp.	0	0	0	0	1
37	Salticidae	*Asemonea tenuipes* (O. Pickard-Cambridge, 1869)	1	0	0	0	0
38		*Brettus cingulatus* Thorell, 1895	1	0	0	1	0
39		*Carrhotus viduus* (C. L. Koch,1847)	1	0	1	1	0
40		*Chrysilla volupe* (Karsch, 1879)	1	0	1	1	0

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Table 1: (Continued).

Sl. No.	Family	Species	Native Forest	Acacia forest	*Areca* Plantation	Home Gardens	Buildings
41	Salticidae	*Epeus* cf. *indicus* Proszynski, 1992	1	0	1	1	0
42		*Hasarisus adansoni* (Audouin, 1826)	0	0	0	1	1
43		*Hyllus semicupreus* (Simon, 1885)	1	0	0	1	0
44		*Indopadilla* sp.	1	0	0	0	0
45		*Menemerus bivittatus* (Dufour, 1831)	0	0	0	1	1
46		*Myrmaplata plataleoides* (O. Pickard-Cambridge, 1869)	1	0	0	1	0
47		*Myrmarachne melanocephala* MacLeay, 1839	1	0	0	1	0
48		*Phintella vittata* (C. L. Koch, 1846)	1	0	0	1	0
49		*Phintella platnicki* Sudhin, Sen and Caleb, 2023	0	0	0	1	0
50		*Plexippus paykulli* (Audouin, 1826)	0	0	0	0	1
51		*Plexippus petersi* (Karsch, 1878)	0	0	0	0	1
52		*Portia* sp.	1	0	0	0	0
53		*Rhene flavicomans* Simon, 1902	1	0	0	0	0
54		*Siler semiglaucus* (Simon, 1901)	1	0	0	1	0
55		*Stenaelurillus* sp.	1	0	0	0	0
56		*Telamonia dimidiata* (Simon, 1899)	1	0	0	1	0
57		*Thiania bhamoensis* Thorell, 1887	1	0	0	1	0
58	Scytodidae	*Scytodes* sp.	0	0	0	0	1
59	Sparassidae	*Gnathopolystes* sp.	1	0	0	1	0
60		*Heteropoda venatoria* (Linnaeus, 1767)	0	0	0	0	1
61		*Olios* sp.	1	0	0	0	0
62	Tetragnathidae	*Leucauge decorata* (Blackwall, 1864)	1	0	1	1	0
63		*Leucauge fastigata* (Simon, 1877)	1	0	0	0	0
64		*Tetragnatha* sp.	1	0	1	1	0
65	Theridiidae	*Meotipa* sp.	1	1	0	0	0
66		*Thwaitesia* sp.	1	1	0	1	0
67	Thomisidae	*Amyciaea forticeps* (O. Pickard-Cambridge, 1873)	1	0	0	0	0
68		*Camaricus formosus* Thorell, 1887	1	0	0	1	0
69		*Misumena* sp.	0	0	0	1	0
70		*Indoxysticus* sp.	1	0	0	0	0
71		*Thomisus* sp.	0	0	0	1	0
72	Uloboridae	*Miagrammmopes* sp.	1	0	0	0	0
73		*Zosis geniculata* (Olivier, 1789)	1	0	1	1	0
TOTAL			**59**	**6**	**15**	**44**	**9**

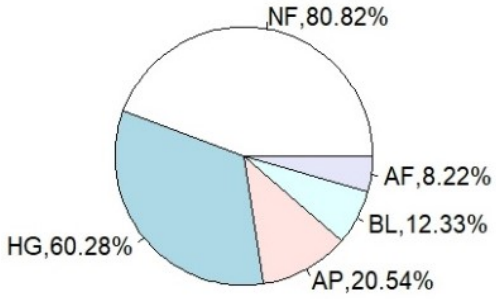

Figure 2: Spider species richness in study sites: The chart shows percentage composition of species diversity found in each study site (habitat). NF = Native Forest; HG = Home Gardens; AP = *Areca* Plantation; BL = Buildings; AF = Acacia Forest.

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In the Native Forest a total of 59 species were documented from 16 families in Native Forest patches. Family Salticidae dominated with 16 species, followed by Araneidae with 15 species, and the fewest were from Cheiracanthiidae, Eresidae, Hersiliidae, Linyphiidae, Liocranidae, and Theridiidae (represented by single species in each). Nearly 25% (18 species) of the species found here were habitat (study site) specific. In the Acacia Forest only 6 species belonging to 4 families were documented. Two species each from Lycosidae and Theridiidae, and the remaining two from Araneidae and Oxyopidae were documented. There was no habitat (study site) specific species. In the *Areca* Plantation, 15 species from 9 families were recorded in *Areca* Plantation. Araneidae and Salticidae had the highest members (3 species in each) followed by Lycosidae and Tetragnathidae (2 species each); the remaining families Cheiracanthiidae, Ctenidae, Hersiliidae, Linyphiidae, and Uloboridae had only a single species in each. Only one species was found to be habitat (study site) specific. In Home Gardens, a total of 44 species were recorded. This is the habitat with the second-highest species richness. Salticidae had the highest number of species (14) followed by Araneidae (11). There were 4 habitat (study site) specific species. In Buildings, a total of 9 species were documented from buildings and, interestingly, 7 were found to be habitat (study site) specific (Appendix 1 and Table 1).

Discussion

This study showed the presence of 73 spider species in the study area (Appendix 2), which is more diverse compared to other diversity studies from elsewhere in Karnataka (Prashanthakumara et al., 2015; Deshpande and Paul, 2016; Prashanthakumara and Venkateshwarlu, 2017a, b; Mubeen and Basavarajappa, 2018; Rao et al., 2018; Tabasum et al., 2018; Suraj and Parimala, 2020; Shraddha and Chaturved, 2019, 2020; Padma and Sundararaj, 2021). Unlike prior studies, which focused solely on overall species numbers, the current study provides a comparative analysis of spider diversity across different habitats.

The findings emphasize the significant role of habitat on spider diversity, particularly in response to urbanization. From the study, it is evident that the Native Forest supports more species, including around 81% of total species diversity (59 out of 73 species). On the other hand, the Acacia Forest is least supportive, containing only 8% (6 out of 73 species). It suggests that the natural resource of the Native Forest supports spider life and though Acacia Forest has trees and green cover, it minimally supports the spider life, which might be attributed to the lack of diversity in vegetation (Foelix, 2011; Saini et al., 2012; Malhotra et al., 2019) and prey availability (Harwood et al., 2001). Also, no habitat (study site) specific species were found in Acacia Forest, indicating that only highly adaptable species prefer this habitat. *Areca* Plantation had only 21% of total species, suggesting that it moderately supports spider diversity, aligning with Sangavi et al. (2023). Buildings had less species richness (9 species), Home Gardens had the second-highest species richness (44 species), suggesting that the vegetation of home gardens also favors spider existence. This might be due to the availability of prey organisms, mainly insects attracted to flowering plants in home gardens. On the other hand, building habitats, which are dominated by humans and regularly checked for pests, was least supportive for spider survival.

Conclusion

Though this short-time study provides a snapshot of the impact of habitat differences on spider species richness, a long-term investigation spanning all seasons would significantly contribute to understanding seasonal variation in spider diversity. Also, future studies extending this analysis with additional parameters, especially climate-change aspects, vegetation density, prey availability, prey density, spider species abundance and density across seasons will furnish insights on the impact of multiple environmental variables to the species richness and abundance of spiders.

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Author contributions

All work in this article was done by the author.

Conflicts of interest

The author declares that there are no conflicting issues related to this research article.

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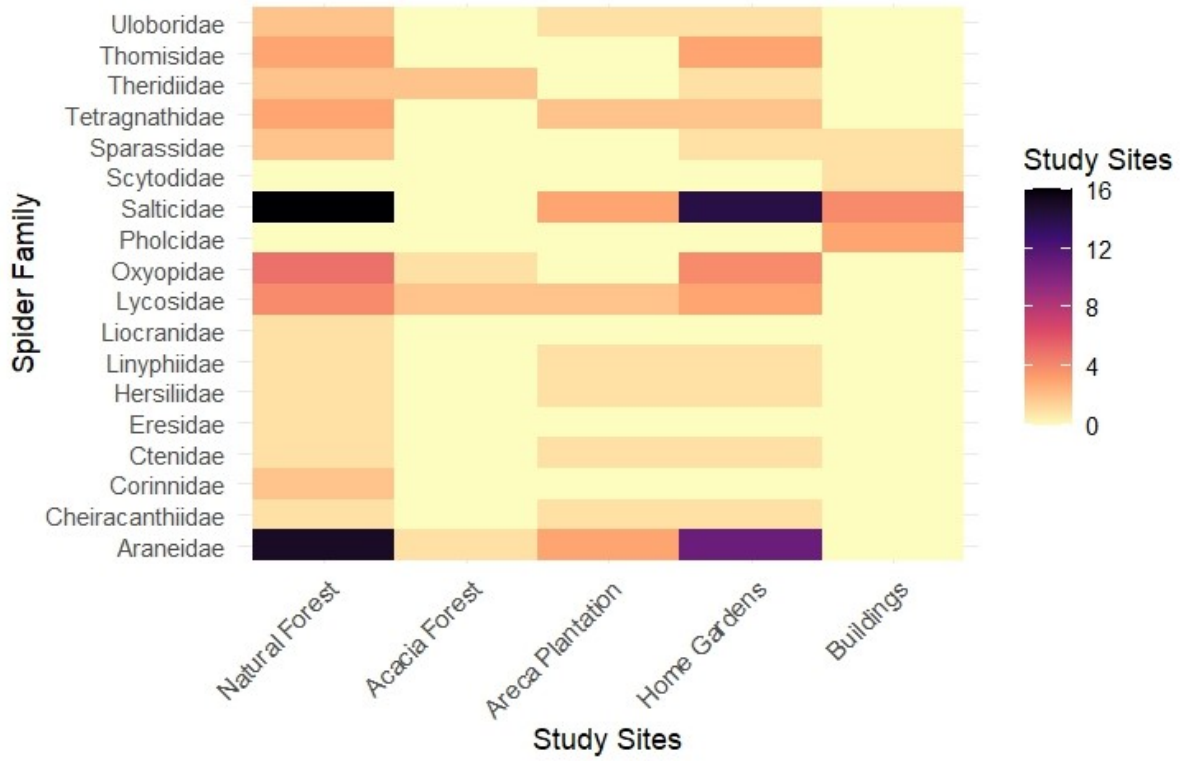
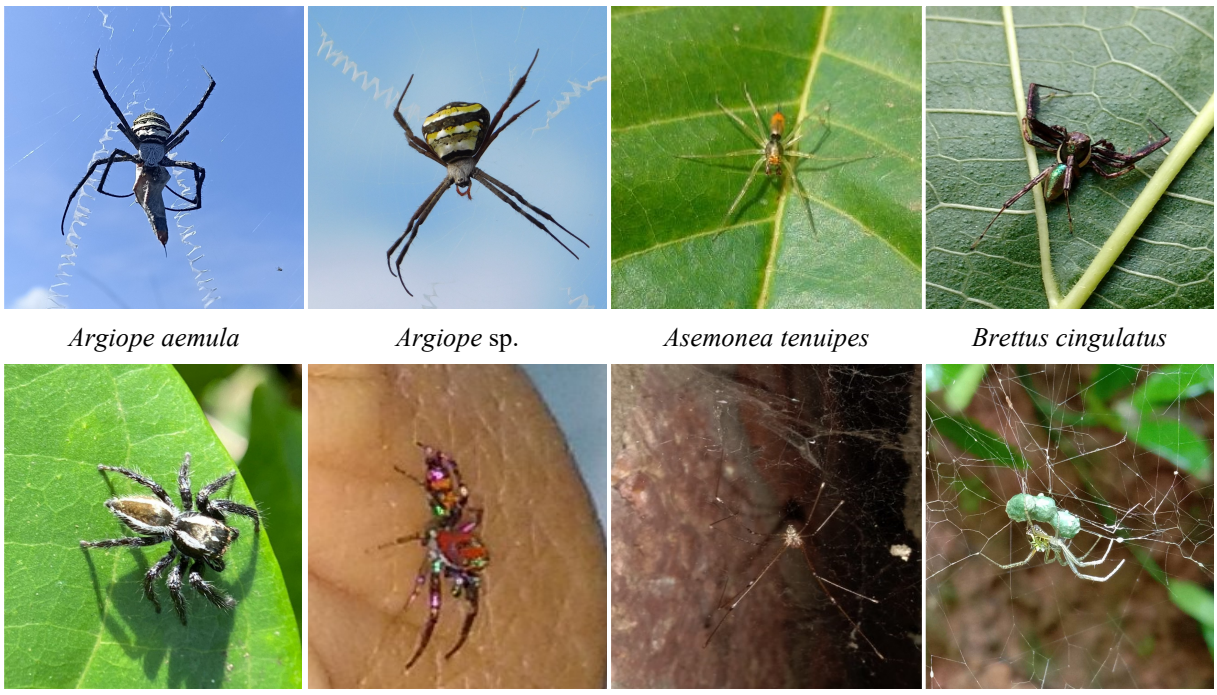
Appendix



Appendix 1: Distribution of spider families across all the study sites, where darker color indicates higher number of species as mentioned in legend.



Argiope aemula | *Argiope* sp. | *Asemonea tenuipes* | *Brettus cingulatus*

Carrhotus viduus | *Chrysilla volupe* | *Crossopriza* sp. | *Cyrtophora cicatrosa*

Appendix 2: Photographic documentation of spider species from the study sites.

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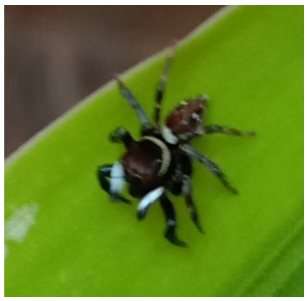
Cyrtophora cicatrosa


Epeus cf. *indicus*


Eriovixia sp.


Hamadruas sp.


Hasarisus adansoni


Hersilia savignyi


Heteropoda venatoria


Hippasa sp.


Hyllus semicupreus


Indopadilla sp.


Menemerus bivittatus


Myrmaplata plataleoides


Neoscona molemensis


Neoscona sp.


Neoscona nautica


Oedignatha spp.


Olios sp.


Oxyopes shweta


Oxyopes sp.


Pasilobus sp.

[DOI: 10.22034/JAD.2024.6.2.3]

Peucetia viridana

Phintella vittata

Phintella platnicki

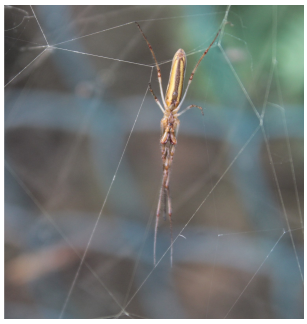
Portia sp.

Rhene flavicomans

Siler semiglaucus

Stegodyphus sarasinorum

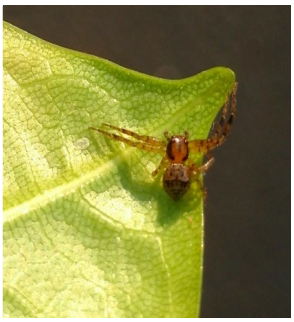
Telamonia dimidiata



Tetragnatha sp.

Thomisus sp.

Thwaitesia sp.



Indoysticus sp.

Thiania bhamoensis

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