

Spider (Arachnida, Araneae) diversity and distribution in the Gandhigram Rural Institute campus, Dindigul district, Tamil Nadu, India

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ABSTRACT: Spiders are key arthropod predators that regulate insect populations and respond sensitively to habitat heterogeneity, making them effective indicators of ecosystem condition. This study assessed spider diversity, distribution, and functional guild structure across six habitat types within The Gandhigram Rural Institute campus, Dindigul district, Tamil Nadu, India. A total of 61 species representing 5,719 individuals, 19 families, and 46 genera were recorded during a three-month survey (January 2025 - March 2025), during the dry season. Salticidae was the most species-rich family, while Oecobiidae, Pholcidae, and Lycosidae were numerically dominant. Alpha diversity varied among sites, with highest richness and Shannon diversity observed in heterogeneous agricultural habitats, whereas built-up areas exhibited greater dominance. Moderate beta diversity (Whittaker = 0.64126; Bray-Curtis similarity) reflected species turnover across contrasting microhabitats. Gamma diversity indices ($H' = 3.053$; $1-D = 0.9341$) indicated a diverse campus-wide assemblage. Diurnal and nocturnal sampling revealed comparable richness, highlighting complementary activity patterns. Guild analysis demonstrated functional diversity dominated by active hunters and web-builders. © 2026 Association for Advancement of Entomology

KEY WORDS: Alpha and beta diversity, campus ecology, habitat heterogeneity, guild analysis

INTRODUCTION

Arachnids (Arthropoda, Chelicerata) comprise a diverse assemblage of terrestrial invertebrates represented by 13 extant orders, including spiders, scorpions, mites, ticks, harvestmen, and solifuges (Ballesteros *et al.*, 2022). Among them, spiders (order Araneae) constitute one of the largest and most ecologically significant predatory groups. With

more than 53,600 described species worldwide (World Spider Catalog, 2026), spiders occupy a wide range of microhabitats and exhibit diverse foraging strategies, including active hunting and web-building (Foelix, 2011). As generalist predators, they regulate insect populations and contribute substantially to trophic dynamics in both natural and managed ecosystems (Nyffeler and Birkhofer, 2017). Their sensitivity to microclimatic conditions,

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vegetation structure, and habitat disturbance also makes them reliable bioindicators of environmental change (Marc *et al.*, 1999).

Despite their ecological importance, spider diversity remains insufficiently documented in many tropical and subtropical regions. Globally, a considerable proportion of arthropod diversity is yet to be described, with tropical landscapes representing major knowledge gaps (Cardoso *et al.*, 2011). In India, arachnological research has predominantly focused on biodiversity hotspots such as the Western Ghats, whereas semi-arid and human-modified habitats are comparatively understudied (Siliwal *et al.*, 2005). Although a recent checklist enumerates 1,984 spider species from India (Caleb and Sankaran, 2026), only about 19.9 per cent have been reported from Tamil Nadu (Sen *et al.*, 2025), highlighting the need for systematic regional surveys.

University campuses represent heterogeneous landscapes comprising gardens, agricultural plots, built structures, and remnant vegetation patches. Such environments function as transitional zones between natural and anthropogenic habitats and can support substantial invertebrate diversity. Documenting spider assemblages in these semi-managed systems provides baseline data for understanding species distribution patterns and the influence of land-use practices. In rural institutions promoting sustainable agriculture and reduced chemical inputs, spiders may play an important role in natural pest regulation, thereby contributing to ecological management strategies.

The Gandhigram Rural Institute (GRI), Tamil Nadu, integrates organic farming and environmentally conscious practices within its campus landscape. However, the diversity and distribution of spiders within this semi-arid, human-modified ecosystem remain undocumented. Assessing species composition and spatial distribution across different habitat types within the campus will generate baseline data essential for biodiversity monitoring and sustainable land-use planning. Therefore, the present study aims to document the spider diversity and distribution within the GRI campus and evaluate patterns in relation to habitat heterogeneity.

MATERIALS AND METHODS

The present study was conducted at GRI campus, located in Dindigul District, Tamil Nadu, India (10°27'96" N; 77°93'45" E), at an elevation of approximately 265 m above mean sea level. The campus lies about 10 km south of Dindigul town and 55 km from Madurai city, positioned in the valley between the Sirumalai and Kodaikanal hill ranges, close to the foothills of Sirumalai. The terrain comprises a mosaic of plains and gentle elevations. The region experiences a tropical savanna climate, characterised by a wet season from June to September and a pronounced dry season from January to May.

Owing to its proximity to the Sirumalai hills, the campus supports varied vegetation and habitat types. Microhabitats include irrigated agricultural fields, deciduous vegetation patches, grasslands, and clusters of academic, administrative, and residential buildings (Fig. 1). For the purpose of this study, the area was divided into six sites (A–F). Sites A, B, and C comprised agricultural landscapes, while Sites D, E, and F represented built-up zones associated with institutional and residential infrastructure (Fig. 2). This heterogeneity provides an opportunity to examine spider assemblages across contrasting land-use types.

The survey was conducted over a three-month period during the dry season (January 2025 - March 2025), with occasional rainfall events. Although the campus landscape is relatively managed, factors such as pesticide application, construction activities, and other anthropogenic disturbances may influence spider distribution and community structure. No previous comprehensive study on spider diversity has been undertaken within the campus, making this survey a baseline assessment for future ecological monitoring and conservation planning.

The study focused on documenting species composition, abundance, guild structure, diurnal and nocturnal occurrence, and spatial distribution across the selected microhabitats.

Spiders were sampled using standardised field techniques including line transects, visual searching,

hand collection, and the inverted umbrella method. Specimens were temporarily collected in Petri dishes, photographed using a Samsung A54 mobile device, and subsequently released at the point of capture to minimise disturbance. Sampling was carried out at all six sites during morning (06:00–09:00 h) and evening (18:00–21:00 h) sessions to record both diurnal and nocturnal species.

Each site was visited 6 times, 3 hours in the morning, per session, totalling 18 hours per site. The same 18 hours effort was carried out in the evening per site/replication. There was 36 hours sampling each day per site replication. Over all there were 216 hours field sampling in all 6 sites. Transect length for this study was not fully structured. But followed zig-zig transect across all sites except buildings where surveyed around the walls.

Specimens were identified based on available taxonomic literature (Tikader, 1970, 1982, 1980; Tikader and Malhotra, 1980; Majumder and Tikader, 1991; Kronestedt, 2010; Huber, 2011; Caleb and Sanap, 2016; Caleb *et al.*, 2018; 2020; Tyagi *et al.*, 2019; Caleb, 2020; Caleb and Wijesinghe, 2022; Jager *et al.*, 2022; Sudhin *et al.*, 2023). Identified species were categorised into nine ecological guilds

following the framework proposed by Cardoso *et al.* (2011).

Species diversity was evaluated using Dominance (D), Simpson's Index ($1-D$), Shannon–Wiener Index (H'), Evenness ($e^{H'/S}$), Whittaker's beta diversity, and the Chao-1 estimator. All diversity analyses were performed using the Paleontological Statistics (PAST) software package.

Geospatial mapping and habitat-based visualisation were carried out using GIS software, with base imagery derived from Google Earth (Version 10.78.02) (Fig. 3). Graphical representations, including bar and pie charts, were prepared using Microsoft Excel (Version 2021).

RESULTS

A total of 61 spider species, comprising 5,719 individuals and representing 19 families and 46 genera, were recorded across the six study sites of the GRI campus (Fig. 4; Tables 1, 4). Salticidae was the most species-rich family (13 species), followed by Araneidae, Lycosidae, Oxyopidae, and Thomisidae. Numerically, Oecobiidae, Pholcidae, and Lycosidae contributed the highest number of individuals.

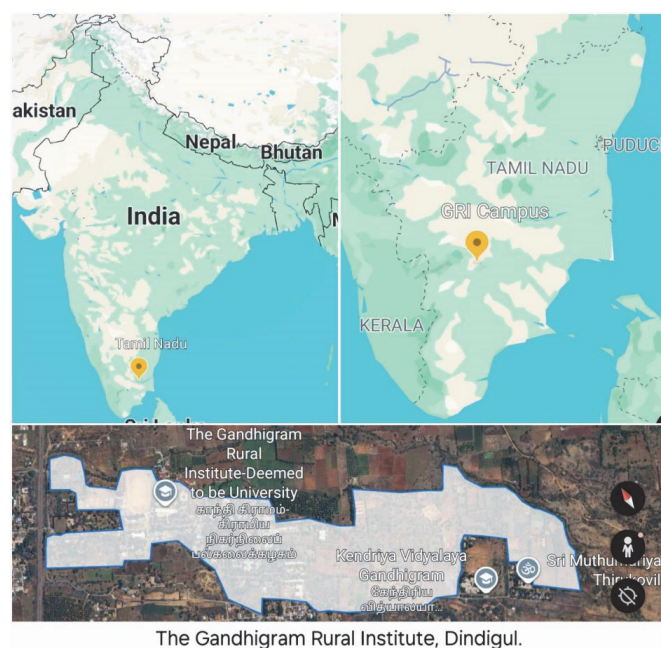


Fig. 1 Study area map of the Gandhigram Rural Institute

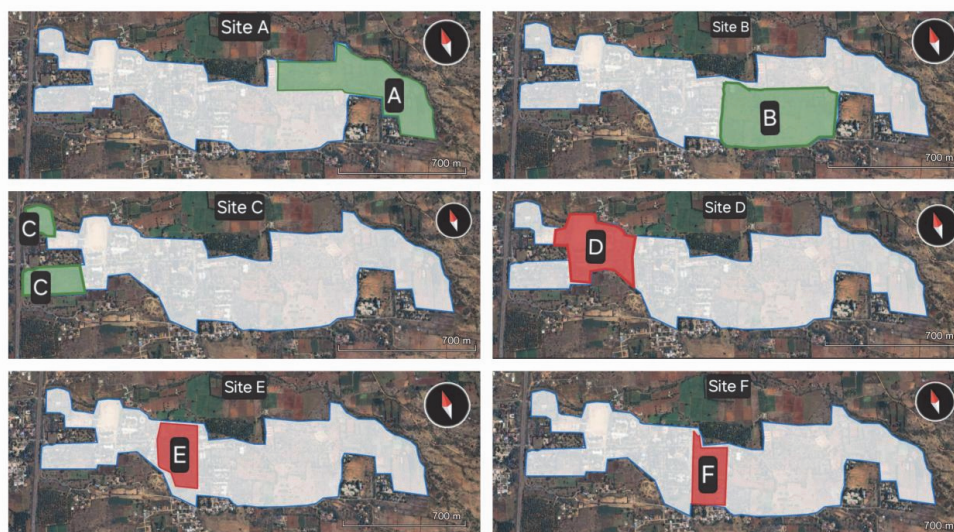


Fig. 2 Site map of GRI campus (Green = Agricultural land, Red = Human habitation)

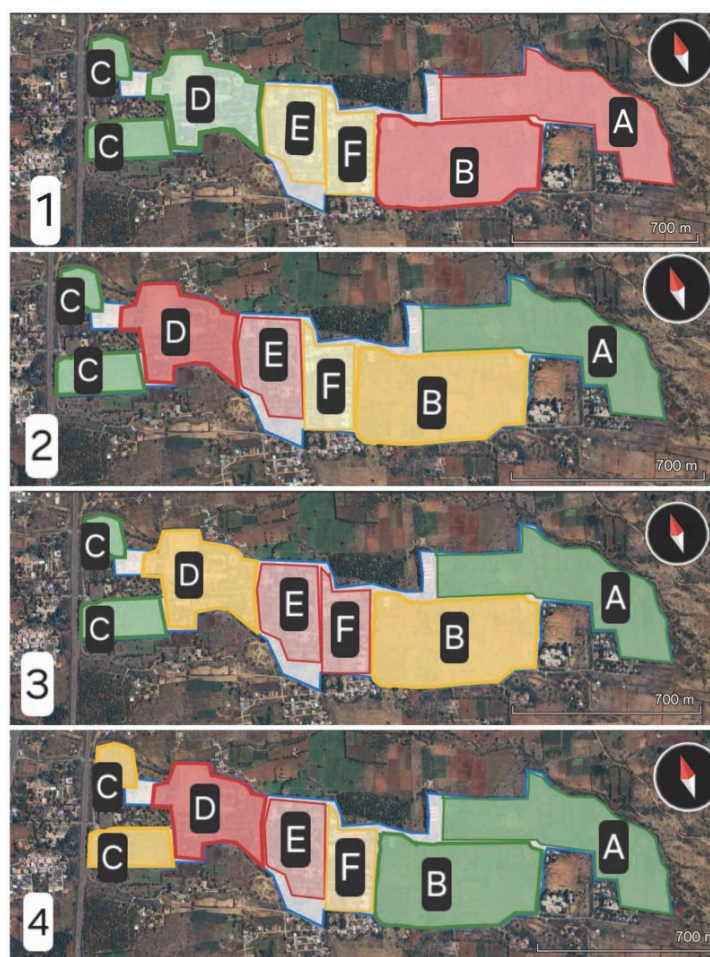


Fig. 3 GIS representation of species richness and 3 diversity indices across 6 sites in GRI. 1. Species richness; 2. Simpson index; 3. Shannon index; 4. Evenness index (Green - High; Yellow - Medium and Red - Low)

Table 1. List of species identified in GRI campus

No.	Family/Guild	Name	No. of individuals
1	Araneidae (Orb web weavers)	<i>Argiope aemula</i> (Walckenaer, 1841) [#]	29
2		<i>Argiope anasuja</i> Thorell, 1887	66
3		<i>Argiope pulchella</i> Thorell, 1881	15
4		<i>Cyrtophora cicatrosa</i> (Stoliczka, 1869)	187
5		<i>Cyrtophora citricola</i> (Forsskål, 1775) [#]	3
6		<i>Eriovixia excelsa</i> (Simon, 1889) [#]	23
7		<i>Eriovixia laglaizei</i> (Simon, 1877) [#]	53
8		<i>Gasteracantha geminata</i> (Fabricius, 1798)	8
9		<i>Neoscona</i> sp.	20
10		<i>Neoscona vigilans</i> (Blackwall, 1865) [#]	21
11	Cheiracanthiidae (Other hunters)	<i>Cheiracanthium melanostomum</i> (Thorell, 1895) [#]	15
12		<i>Cheiracanthium</i> sp.*	7
13		<i>Cheiracanthium trivittatum</i> Simon, 1906 [#]	2
14	Clubionidae (Other hunters)	<i>Clubiona filicata</i> O. Pickard-Cambridge, 1874 [#]	11
15	Corinnidae (Ground hunters)	<i>Castianeira</i> sp.*	5
16		<i>Cambalida flavipes</i> (Gravely, 1931) [#]	5
17	Eresidae (Sheet web weavers)	<i>Stegodyphus sarasinorum</i> Karsch, 1892	451
18	Idiopidae (Ambush hunters)	Genus and species indet.	2
19	Lycosidae (Ground hunters)	<i>Draposa</i> sp. 1	86
20		<i>Draposa</i> sp. 2	189
21		<i>Hippasa pantherina</i> Pocock, 1899 [#]	441
22		<i>Hippasa madraspatana</i> Gravely, 1924	2
23		<i>Lycosa</i> sp.	6
24		<i>Wadicosa</i> sp.	198
25	Oecobiidae (Sensing web weavers)	<i>Oecobius putus</i> O. Pickard-Cambridge, 1876 [#]	474
26		<i>Oecobius</i> sp.*	572
27	Oxyopidae (Other hunters)	<i>Hamataliwa</i> sp.1*	12
28		<i>Hamataliwa</i> sp.2*	9
29		<i>Oxyopes hindostanicus</i> Pocock, 1901 [#]	217
30		<i>Oxyopes shweta</i> Tikader, 1970	24

31		<i>Oxyopes javanus</i> Thorell, 1887 [#]	18
32		<i>Peucetia viridana</i> (Stoliczka, 1869) [#]	141
33	Philodromidae (Other hunters)	<i>Thanatus</i> sp.*	2
34	Pholcidae (Space web weaver)	<i>Artema atlanta</i> Walckenaer, 1837 [#]	753
35		<i>Pholcus phalangioides</i> (Fuesslin, 1775)	160
36	Pisauridae (Other hunters)	<i>Hygropoda</i> sp.*	1
37	Salticidae (Other hunters)	<i>Afraflacillia</i> sp.*	2
38		<i>Brettus</i> sp.*	1
39		<i>Carrhotus viduus</i> (C. L. Koch, 1846)	1
40		<i>Carrhotus sannio</i> (Thorell, 1877) [#]	2
41		<i>Chrysilla volupe</i> (Karsch, 1879) [#]	5
42		<i>Hasarius adansoni</i> (Audouin, 1826) [#]	10
43		<i>Hyllus semicupreus</i> (Simon, 1885)	146
44		<i>Menemerus bivittatus</i> (Dufour, 1831) [#]	18
45		<i>Myrmarachne</i> sp.*	10
46		<i>Plexippus paykulli</i> (Audouin, 1826)	124
47		<i>Stenaehurillus megamalai</i> Sudhin, Sen & Caleb, 2023 [#]	264
48		<i>Stenaehurillus lesserti</i> Reimoser, 1934 [#]	217
49		<i>Telamonia dimidiata</i> (Simon, 1899)	53
50	Scytodidae (Other hunters)	<i>Scytodes fusca</i> Walckenaer, 1837 [#]	5
51	Sparassidae (Other hunters)	<i>Gnathopalystes flavidus</i> (Simon, 1897) [#]	13
52		<i>Heteropoda venatoria</i> (Linnaeus, 1767) [#]	42
53		<i>Olios</i> sp.	12
54	Tetragnathidae (Orb web weavers)	<i>Leucauge decorata</i> (Blackwall, 1864)	33
55	Theridiidae (Space web weavers)	<i>Rhomphaea projiciens</i> O. Pickard-Cambridge, 1896 [#]	4
56	Thomisidae (Ambush hunters)	<i>Henriksenia hilaris</i> (Thorell, 1877) [#]	11
57		<i>Indoxysticus minutus</i> (Tikader, 1960) [#]	507
58		<i>Thomisus</i> sp.	3
59		<i>Tmarus</i> sp.*	1
60		<i>Xysticus</i> sp.*	2
61	Uloboridae (Orb web weavers)	<i>Uloborus</i> sp.	5
Total	19	61	5,719

Note: [#]New species record; * new genus record to Dindigul district

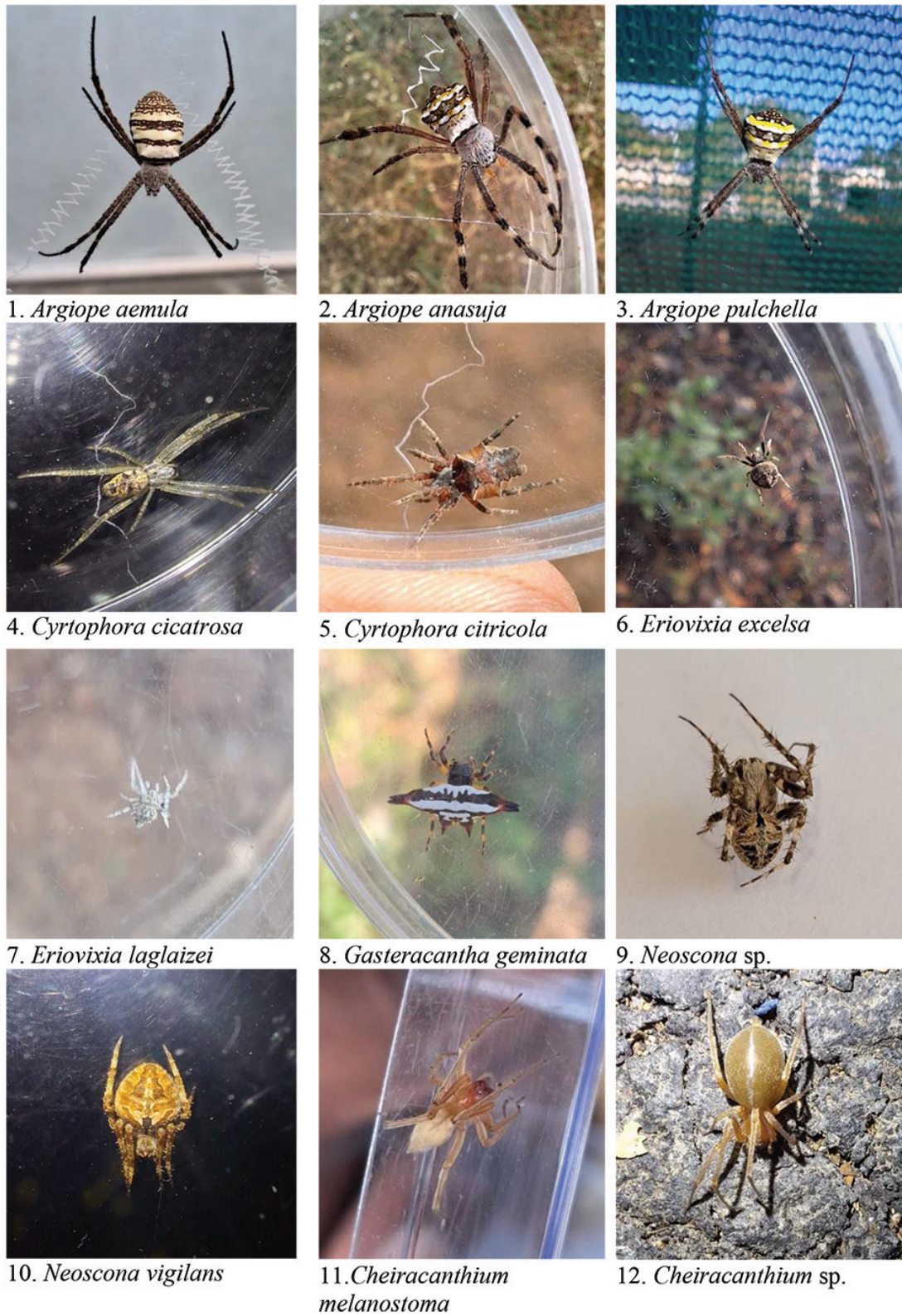


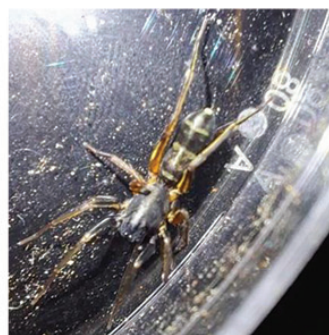
Fig. 4 Spider species recorded in the GRI campus



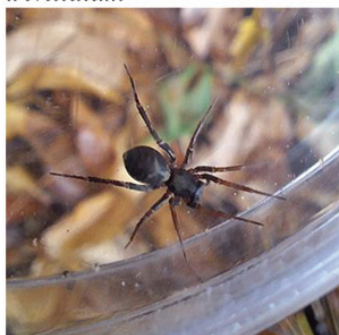
13. *Cheiracanthium trivittatum*



14. *Chubiona filicata*



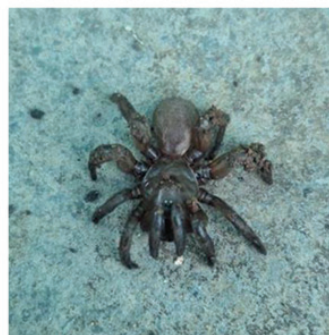
15. *Castianeira* sp.



16. *Cambalida flavipes*



17. *Stegodyphus sarasinorum*



18. *Idiopidae* indet.



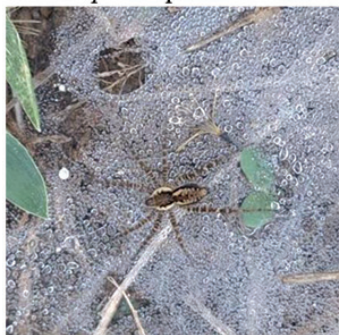
19. *Draposa* sp. 1



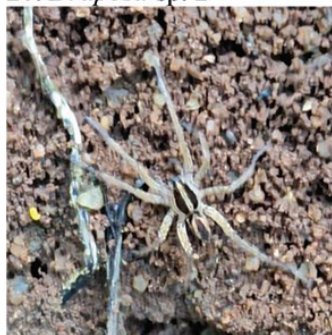
20. *Draposa* sp. 2



21. *Hippasa pantherina*



22. *Hippasa madraspatana*



23. *Lycosa* sp.



24. *Wadicosa* sp.

Fig. 4 Spider species recorded in the GRI campus (Contd.)



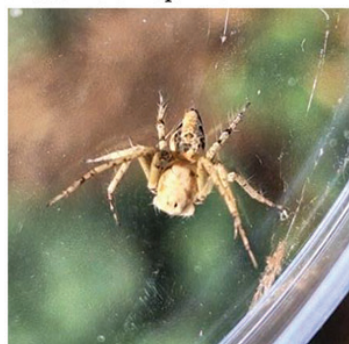
25. *Oecobius putus*



26. *Oecobius* sp.



27. *Hamataliwa* sp.1



28. *Hamataliwa* sp.2



29. *Oxyopes hindostanicus*



30. *Oxyopes shweta*



31. *Oxyopes javanus*



32. *Peucetia viridana*



33. *Thanatus* sp.



34. *Artema atlanta*



35. *Pholcus phalangioides*



36. *Hygropoda* sp.

Fig. 4 Spider species recorded in the GRI campus (Contd.)

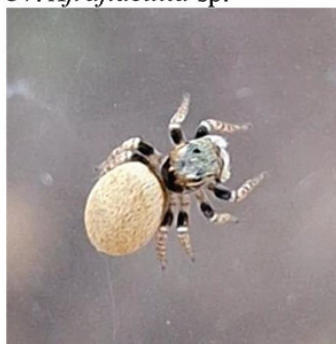
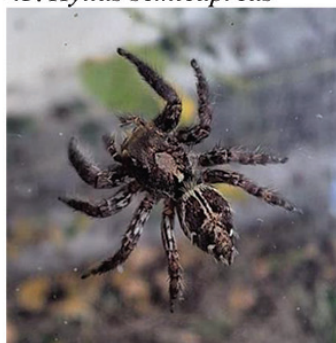
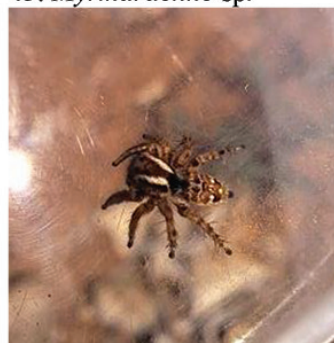
37. *Afraflacillia* sp.38. *Brettus* sp.39. *Carrhotus viduus*40. *Carrhotus sannio*41. *Chrysilla volupe*42. *Hasarius adansoni*43. *Hyllus semicupreus*44. *Menemerus bivittatus*45. *Myrmarachne* sp.46. *Plexippus paykulli*47. *Stenaehurillus megamalai*48. *Stenaehurillus lesserti*

Fig. 4 Spider species recorded in the GRI campus (Contd.)



Fig. 4 Spider species recorded in the GRI campus (Contd.)

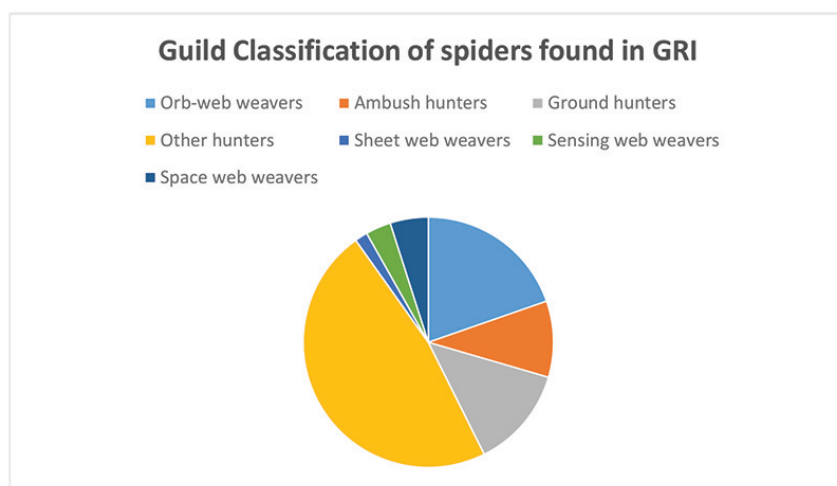
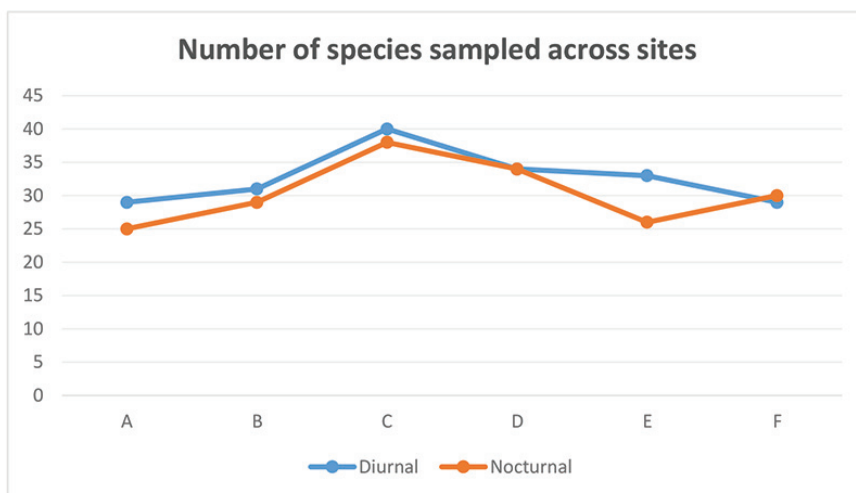
61. *Uloborus* sp.**Fig. 4** List of images of species identified in GRI campus**Fig. 5** Guild classification of spiders found in GRI**Fig. 6** Number of species sampled across sites

Table 2. Alpha diversity and evenness indexes of all six sites in GRI

Sites	A	B	C	D	E	F
Taxa_S	30	31	46	44	37	35
Individuals	934	769	961	1288	825	942
Dominance_D	0.08128	0.0979	0.08573	0.1408	0.1434	0.1375
Simpson_1-D	0.9187	0.9021	0.9143	0.8592	0.8566	0.8625
Shannon_H	2.761	2.691	2.951	2.425	2.396	2.435
Evenness_e^H/S	0.5272	0.4759	0.4158	0.2569	0.2968	0.326
Chao-1	31.2	31	47.88	51.86	44.5	37.14

Alpha diversity indices were calculated among all 6 sites (Fig. 3; Table 2). Species richness ranged from 30 (Site A) to 46 (Site C). Site C exhibited the highest Shannon diversity ($H_2 = 2.951$), indicating a comparatively even distribution of individuals among species. In contrast, Sites D, E, and F showed higher total abundance but lower evenness, with dominance values peaking in Sites D (0.1408) and E (0.1434). Observed richness closely matches with the Chao-1 estimates.

Whittaker's beta diversity was (0.64126) and Bray-Curtis Similarity dendrogram indicate species turnover across the campus and the similarity

Table 3. Gamma diversity and evenness indexes of GRI

Site	GRI
Species	61
Individuals	5719
Dominance_D	0.06589
Simpson_1-D	0.9341
Shannon_H	3.053
Evenness_e^H/S	0.3471
Chao-1	61.75

Table 4. Diversity indexes of Diurnal sampling in GRI

Site	A	B	C	D	E	F
Taxa_S	29	31	40	34	33	29
Individuals	445	411	488	613	433	402
Dominance_D	0.08264	0.09303	0.08585	0.1348	0.1352	0.1569
Simpson_1-D	0.9174	0.907	0.9142	0.8652	0.8648	0.8431
Shannon_H	2.76	2.707	2.9	2.467	2.437	2.334
Evenness_e^H/S	0.5446	0.4833	0.4543	0.3466	0.3466	0.3558
Chao-1	32.75	34.5	41.25	40	40.86	30.43

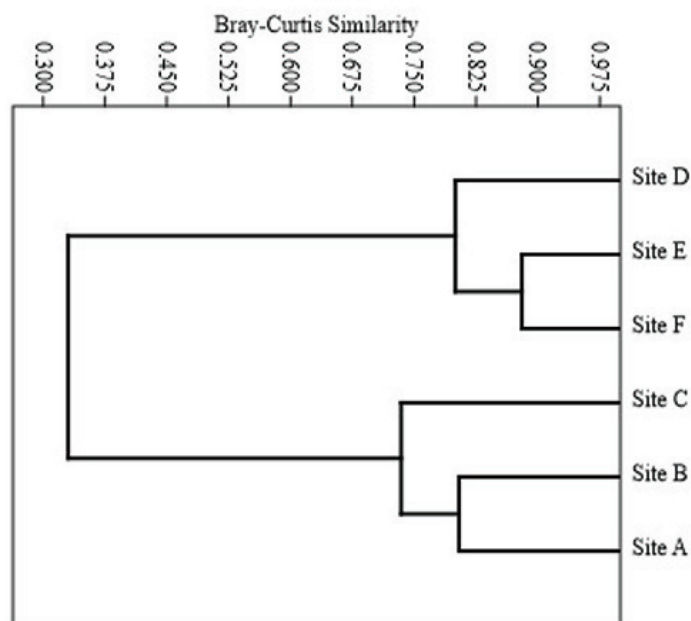


Fig. 7 Bray-Curtis Similarity for Beta Diversity.

Table 5. Diversity indexes of Nocturnal sampling in GRI

Site	A	B	C	D	E	F
Taxa_S	25	29	38	34	26	30
Individuals	489	358	473	675	392	540
Dominance_D	0.0881	0.109	0.08783	0.1497	0.1681	0.1287
Simpson_1-D	0.9119	0.891	0.9122	0.8503	0.8319	0.8713
Shannon_H	2.697	2.613	2.924	2.314	2.248	2.448
Evenness_e ^{H/S}	0.5937	0.4704	0.4901	0.2976	0.3643	0.3854
Chao-1	25.5	32	39.67	37	27.43	35.25

between sites (Fig 7). Gamma diversity comprised 61 species, with Shannon index (H') = 3.053 and Simpson's $(1-D)$ = 0.9341 (Table 3).

Diurnal sampling recorded up to 40 species (Site C), with relatively higher evenness (0.3466–0.5446). Nocturnal sampling produced slightly greater abundances in several sites (e.g., 675 individuals at Site D), though dominance values were marginally

higher at night, particularly in Site E (D = 0.1681) (Fig. 6; Tables 4, 5)

Guild analysis revealed a functionally diverse community (Fig. 5; Table 6). “Other hunters” constituted the most species-rich guild (29 species), followed by orb-web weavers (12 species), ground hunters (8 species), and ambush hunters (6 species).

Table 6. Guild classification of spiders in GRI

Guild	Species	Families
Orb-web weavers	12	Araneidae, Tetragnathidae, Uloboridae
Ambush hunters	6	Idiopidae, Thomisidae
Ground hunters	8	Corinnidae, Lycosidae
Other hunters	29	Cheiracanthiidae, Clubionidae, Oxyopidae, Philodromidae, Pisauridae, Salticidae, Scytodidae, Sparassidae
Sheet web weavers	1	Eresidae
Sensing web weavers	2	Oecobiidae
Space web weavers	3	Pholcidae, Theridiidae

DISCUSSION

The high richness observed in the study demonstrates that semi-managed institutional landscapes can sustain substantial spider diversity. Similar diversity levels have been reported from university campuses and semi-urban habitats in India, highlighting the ecological importance of mosaic landscapes within human-dominated regions (Adarsh and Nameer, 2015; Prajapati *et al.*, 2016; Asima *et al.*, 2020; Caleb 2020; Swapna and Babitha, 2022; Dave and Trivedi, 2024).

The prominence of salticids is consistent with studies from tropical and campus ecosystems, where jumping spiders successfully exploit heterogeneous vegetation and built environments (Adarsh and Nameer, 2015; Prajapati *et al.*, 2016; Asima *et al.*, 2020; Caleb 2020; Dave and Trivedi, 2024). Although species-rich, Salticidae was not the most abundant family. Numerically, Oecobiidae, Pholcidae, and Lycosidae contributed the highest number of individuals, largely due to aggregation of *Oecobius* spp., *Artema atlanta*, and *Hippasa pantherina*. This distinction between species richness and numerical dominance underscores the structural complexity of the campus, where synanthropic web-builders and ground-dwelling hunters coexist.

Alpha diversity indices revealed marked spatial heterogeneity among sites. These built-up areas were characterised by concentrations of a few highly successful species, likely reflecting simplified vegetation structure and localized disturbance. Simpson's diversity values ($1-D = 0.8566-0.9187$) nevertheless indicate generally stable assemblages across sites. The close agreement between observed richness and Chao-1 estimates suggests adequate sampling coverage.

Beta diversity indices (Whittaker's beta diversity and Bray-Curtis similarity) show moderate species turnover across the campus (Table 3; Fig. 7), reflecting habitat heterogeneity among agricultural fields, open grounds, and built structures. Such turnover is typical of mosaic landscapes, where variation in vegetation complexity, soil conditions, and microclimate shapes community composition (Zhang *et al.*, 2018). The abundance of certain spiders is higher in one site than other is due to niche preference and resource availability and higher adaptability to artificial structures (Priyadharshini *et al.*, 2015).

The overall dominance ($D = 0.06589$) is low indicates a diverse and relatively balanced spider community across the campus. Comparable gamma diversity values have been documented from dry

deciduous forests and urban green spaces (Kayal *et al.*, 2024; Kulkarni *et al.*, 2024), reinforcing the conservation value of semi-natural institutional habitats.

Diurnal and nocturnal sampling yielded comparable richness, confirming the importance of time-stratified surveys. Shannon diversity remained consistently high across both periods, suggesting complementary activity patterns rather than strong temporal segregation. Such temporal partitioning likely reduces interspecific competition and enhances coexistence within the assemblage.

Although hunting guilds dominated in species count, web-building guilds, especially space web and sensing web weavers, were numerically abundant due to high densities on building walls and sheltered microhabitats.

Ground hunters such as Lycosidae were strongly associated with open soil and agricultural plots, whereas ambush hunters (Thomisidae) were linked to flowering vegetation. Orb-web weavers reflected adequate vertical stratification within shrubs and trees. Rare guild representatives, including Idiopidae morphospecies, *Scytodes fusca*, and *Hygropoda* sp., indicate the persistence of specialised microhabitats within the campus.

The coexistence of habitat specialists and widespread generalists highlights the ecological significance of the GRI campus as a semi-natural refuge. Species tolerant of anthropogenic settings (e.g., *Plexippus paykulli*, *Oxyopes javanus*) occurred alongside taxa indicative of relatively undisturbed microhabitats. Overall, the integration of spatial, temporal, and functional analyses demonstrates that habitat heterogeneity within the campus sustains a diverse and structurally complex spider community.

The study also reports a total of 27 species and 11 genera which are new distributional records for Dindigul district, highlighting the poorly explored spider diversity in this region. The occurrence of several rarely reported species, including *Stenaelurillus megamalai*, *Eriovixia excelsa*, and *Gnathopalystes flavidus*, indicates that the

campus supports diverse spider assemblage.

These findings provide essential baseline data for long-term biodiversity monitoring and emphasise the importance of incorporating invertebrate conservation into institutional land-use planning and sustainable habitat management strategies.

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