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Author Affiliation:
Department of Zoology, Bidhannagar College, EB-2, Sector 1, Salt Lake, Kolkata-700064, West Bengal, India

***Corresponding Author**:
Department of Zoology, Bidhannagar College, EB-2, Sector 1, Salt Lake, Kolkata-700064, West Bengal, India; Email: somu25_2@rediffmail.com

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Functional diversity of some spiders (Arachnida: Araneae) in forest landscapes of Bethuadahari, West Bengal, with a new record from India

Shuvadeep Sen, Md. Reaz Mondal, Arka Kumar Akuli, Somnath Mandal*

ABSTRACT

The spiders located on both sides of the transects in the forest areas of Bethuadahari were recorded without collection of any specimens. Systematic analysis of the spider habitus photographs revealed an assemblage of 32 spider species, belonging to 23 genera and 10 families. Documentation of *Argiope cameloides* Zhu & Song, 1994 under family Araneidae is being reported for the first time from India extending its geographical distribution range from China. Based on the number of species, Araneidae was most dominant with eleven species under six genera followed by Salticidae with eight species under six genera. Spiders were found to inhabit tree or shrub foliage, tree bark and leaf litter within 9ft above the ground. Guild Structure analysis revealed a diverse assemblage of spider guilds with seven distinct foraging strategies. Orb-web weavers were the most dominant guild represented by 44% of species, followed by stalkers (25%), Scattered line weavers (13%), Ambush hunters (9%), Foliage runners (3%) and Space web weavers (3%) and ground runners (3%).

Keywords: Diversity, Guild structure, stalkers, Araneidae, Salticidae.

1. INTRODUCTION

Spiders, belonging to the order Araneae, are among the most ecologically significant terrestrial arthropods due to their role in natural pest control and their utility as bioindicators of habitat health (Foelix, 2011; Nyffeler and Birkhofer, 2017). Through their predation on pest species, they contribute to crop protection and help limit the transmission of insect-borne diseases. The spiders significantly influence food web interactions by acting as a natural check against excessive insect population growth that could otherwise disturb ecological balance (Marc et al., 1999; Samiayyan, 2014). Renowned archaeologists Pocock and Gravely started systematic documentation of spider fauna of India in early 20th century and later Tikader and coworkers, working

under the Zoological Survey of India, added enormous amount of information (Tikader, 1982 and 1987; Tikader and Malhotra, 1980a). Presently, 1979 species of spiders belonging to 511 genera in 63 families are known (Caleb and Sankaran, 2025) from India. Saha et al. (2024) have contributed considerably on taxonomic characterization of spiders from the state of West Bengal. Recent reports on rich spider faunal diversity in agro ecosystems suggests their potential in integrated Pest Management (Smitha and Sudhikumar, 2020).

Regional faunal documentation and ecological studies along with discovery of many new species and range extension have progressed significantly in India during past two decades (Caleb and Mathai, 2014a,2014b; Sudhikumar et al., 2005; Kumar et al., 2018). Recent report on diversity of insects of the order Coleoptera from Bethuadahari wildlife sanctuary in India suggested rich arthropod diversity in the area (Basu et al. 2017). The forests of Bethuadahari consisting of diverse vegetation provide favourable environment and microhabitats for a wide range of spider species. Therefore, survey on spider diversity along with their habitat and guild structure carried out in this study may contribute to baseline data essential for future ecological assessments and conservation planning.

2. MATERIALS AND METHOD

Study area

Spider specimens were located, their activity was observed and they were documented in two different study sites: Bethuadahari Wildlife Sanctuary (23°35'N, 88°23'E) and Jugpur forest area (23°58'N, 88°41'E, 5 m above sea level). Both the sites are under Nakashipara CD block in the Krishnanagar Sadar subdivision of the Nadia district of the state of West Bengal, India (Figure 1). The sanctuary and the Jugpur forest area are tropical moist deciduous forests harboring large trees like Teak (*Tectona grandis* Linn. F.), Arjun (*Terminalia arjuna* (Roxb.)), Siris (*Albizia lebbeck* (L.) Benth.), Sissoo (*Delbergia sissoo* Roxb.), Sal (*Shorea robusta* Gaertn.), Mahogany (*Swietenia macrophyla* King), and Ficus (*Ficus* spp.). The middle and lower canopies are covered mainly with Bael (*Aegle marmelos* (Linn)), Jamun (*Syzigium cumini*), Atha (*Annona squamosa* Linn), Minjiri (*Cassia* sp.) and Hamjam (*Polyalthia suberosa* (Roxb.)). The shrubs *Colocasia* spp., *Cassia* spp. and *Ageratum* spp. are most abundant. The ground is covered with patches of leaf litter, sparse grasses and bare soil. The sanctuary was established on 19 August 1998 with 67 hectares of land to preserve a portion of the central Gangetic alluvial zone (Basu et al. 2017).

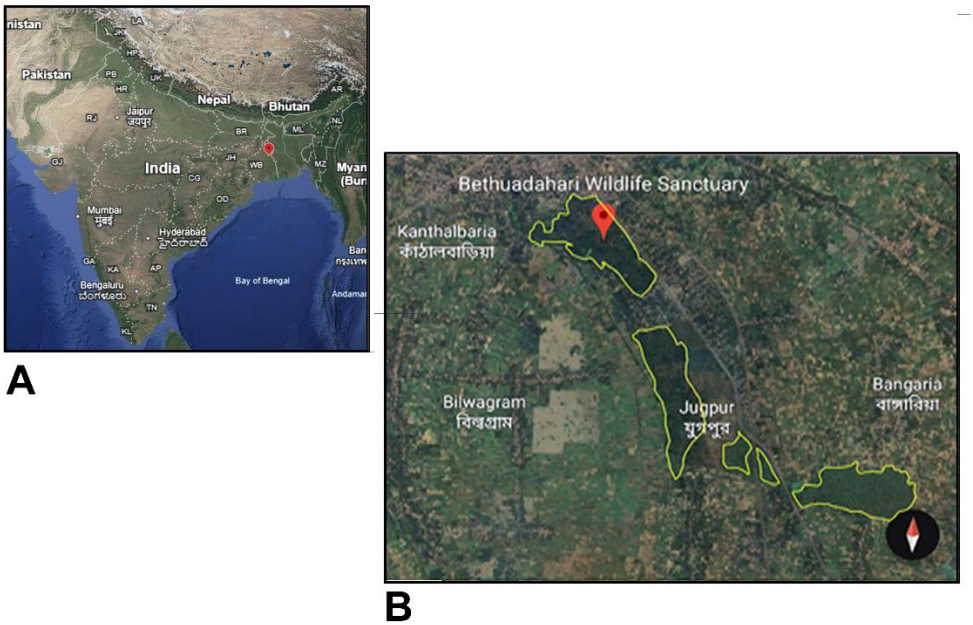

Figure 1: A – Location of study area in India, B - Map showing forest area in Bethuadahari.

Method

The field study was conducted three times between December 2024 and May 2025. Spiders were located by walking slowly along designated forest transects and observing individuals in their natural microhabitats, without causing disturbance to their surroundings. Special care was taken to avoid disrupting their behavior or habitat. The spiders were documented photographically without collecting

and disturbing as much as possible. Habitat of each specimen was recorded along with the measurement of its mean height above the ground. Each spider was identified from its photographs based on morphometric descriptions and illustrations in the literature cited in Table 1, and the current scientific name assigned in the World Spider Catalogue (2025), version 26 was accepted.

3. RESULTS AND DISCUSSION

A total of 32 species of spiders belonging to 23 genera belonging to 10 families were documented during this study (Table 1, Figures 2, 3, and 4). By Species, the family Araneidae was most abundant, with 11 species (34.38%), followed by Salticidae with 8 (25%) species, Theridiidae with 4 (12.5%) species, Oxyopidae and Uloboridae with 2 (6.25%) species each. The families Dictynidae, Hersiliidae, Lycosidae, Tetragnathidae, Thomisidae were represented by only one species (3.13%) each. Both the family Aranidae and Salticidae were represented by six genera each (Figure 5). Guild structure analysis following Uetz et al. (1999) and Caleb (2020) revealed that the sampled spiders belong to seven functional groups based on their foraging behavior. The dominant guild was the Orb-web weavers with fourteen species, followed by Stalkers with eight species, Scattered-line weavers with four species, Ambush hunters with three species, Foliage runners with one species, ground runners with one species, Space weavers with one species (Figure 6). The spiders were found to exploit 11 different habitat types. The table 2 indicates that 78.57% of species under the guild orb-web weavers inhabit trees or shrubs forming vertical webs, 14.29% of species forming horizontal webs under tree foliage, and only one species *Cyrtophora cicatrosa* (Stoliczka, 1869) forming tent webs in bushes. The Majority of stalkers (75%) were found on shrub foliage within 2 to 6 ft above the ground. Two stalkers *Euophrys* sp. and *Menemerus bivittatus* were found mostly on tree foliage and tree bark respectively. The preferred habitat of scattered-line weavers was bush or tree foliage within six feet above the ground. All the ambush hunters were found to forage on bush foliage within 1 to 5 ft. Foliage runners and ground runners were found to forage on tree bark and leaf litter respectively. Space web weavers were found in bush foliage within 1 to 4 ft (Table 2).

Table 1. List of spiders observed in forest areas of Bethuadahari with identification references.

	Genus / Species	I.D. Reference
	I. Araneidae	
1	*Araneus viridisomus* Gravely, 1921	Caleb and Mathai (2014c)
2	*Argiope cameloides* Zhu & Song, 1994	Wang etal. (2021)
3	*Argiope pulchella* Thorell, 1881	Tikader (1970)
4	*Cyclosa hexatuberculata* Tikader, 1982	Tikader (1982)
5	*Cyclosa insulana* (Costa, 1834)	Tikader (1982)
6	*Cyclosa quinqueguttata* (Thorell, 1881)	Tikader (1982)
7	*Cyclosa spirifera* Simon, 1889	Tikader (1982)
8	*Cyrtophora cicatrosa* (Stoliczka, 1869)	Tikader and Bal (1981)
9	*Eriovixia laglaizei* (Simon, 1877)	Tikader (1982)
10	*Eriovixia poonaensis* (Tikader & Bal, 1981)	Tikader and Bal (1981)
11	*Neoscona mukerjei* Tikader, 1980	Tikader and Bal (1981)
	II. Dictynidae	
12	*Anaxibia rebai* (Tikader, 1966)	Tikader (1966)
	III. Hersiliidae	
13	*Hersilia savignyi* Lucas, 1836	Caleb et. al. (2017)
	IV. Lycosidae	
14	*Lycosa wroughtoni* Pocock, 1899	Tikader and Malhotra (1980b)

	V. Oxyopidae	
15	*Hamadruas sikkimensis* (Tikader, 1970)	Sen etal. (2015)
16	*Oxyopes pankaji* Gajbe & Gajbe, 2000	Gajbe 2008
	VI. Salticidae	
17	*Asemonea tenuipes* (O. Pickard-Cambridge, 1869),	Fathima et al. (2021)
18	*Euophrys sp.*	Dhali et al. (2014)
19	*Menemerus bivittatus* (Dufour, 1831)	Dhali et al. (2017)
20	*Myrmarachne melanocephala* MacLeay, 1839	Caleb and Mathai (2022)
21	*Myrmarachne prava* (Karsch, 1880)	Caleb and Mathai (2022)
22	*Myrmarachne spissa* (G. W. Peckham & E. G. Peckham, 1892)	Tripathi et al. (2023)
23	*Phintella vittata* (C.L. Koch,1846)	Dhali et al. (2017)
24	*Telamonia dimidiata* (Simon, 1899)	Roy et al. (2016)
	VII. Tetragnathidae	
25	*Leucauge decorata* (Blackwall, 1864)	Sen et al. (2015)
	VIII. Theridiidae	
26	*Ariamnes sp*. Thorell, 1869	Caleb (2020)
27	*Latrodectus elegans* Thorell, 1898	Kananbala et al. (2012)
28	*Meotipa multuma* Murthappa, Malamel, Prajapati., Sebastian & Venkateshwarlu,2017	Murthappa et al. (2017)
29	*Meotipa picturata* Simon, 1895	Murthappa et al. (2017)
	IX. Thomisidae	
30	*Indoxysticus minutus* (Tikader, 1960)	Tikader and Malhotra (1980a)
	X. Uloboridae	
31	*Uloborus glomosus* (Walckenaer, 1841)	Walckenaer (1841)
32	*Uloborus khasiensis* Tikader, 1969	Tikader (1969)

Table 2: Guild structure and habitat distribution of spiders found in forest areas of Bethuadahari

Guild	Habitat	Mean Height (Ft)	Spider Species
Orb web weavers	Vertical web in tree or shrub	1 to 4	*Leucauge decorata* (Blackwall, 1864)
		3 to 5	*Argiope cameloides* Zhu & Song, 1994
			Cyclosa spirifera Simon, 1889
		2 to 5	*Argiope pulchella* Thorell, 1881
		2 to 4	*Cyclosa hexatuberculata* Tikader, 1982
		4 to 6	*Eriovixia laglaizei* (Simon, 1877)
		2 to 6	*Cyclosa insulana* (Costa, 1834)
		5 to 7	*Cyclosa quinqueguttata* (Thorell, 1881)

		4 to 7	*Eriovixia poonaensis* (Tikader & Bal, 1981)
		3 to 5	*Araneus viridisomus* Gravely, 1921
		2 to 5	*Neoscona mukerjei* Tikader, 1980
	Horizontal web under tree foliage	3 to 6	*Uloborus glomosus* (Walckenaer, 1841)
			Uloborus khasiensis Tikader, 1969
	Tent web in bushes	2 to 4	*Cyrtophora cicatrosa* (Stoliczka, 1869)
Scattered line weaver	Bush Foliage	2 to 4	*Latrodectus elegans* Thorell, 1898
	Tree foliage	4 to 6	*Ariamnes sp.* Thorell, 1869
		2 to 6	*Meotipa multuma Murthappa*, Malamel, Prajapati., Sebastian& Venkateshwarlu,2017
		3 to 4	*Meotipa picturata* Simon, 1895
Space web	Bush foliage	1 to 4	*Anaxibia rebai* (Tikader, 1966)
Ambush hunter	Foraging on bush Foliage	2 to 5	*Hamadruas sikkimensis* (Tikader, 1970)
		1 to 4	*Oxyopes pankaji* Gajbe and Gajbe, 2000
		1 to 3	*Indoxysticus minutus* (Tikader, 1960)
Stalkers	Tree foliage	7 to 9	*Euophrys* sp.
	Tree bark	4 to 7	*Menemerus bivittatus* (Dufour, 1831)
	Shrub Foliage	3 to 5	*Phintella vittata* (C.L. Koch,1846)
		3 to 6	*Myrmarachne melanocephala* MacLeay, 1839
		2 to 6	*Myrmarachne prava* (Karsch, 1880)
		3 to 6	*Myrmarachne spissa* (G. W. Peckham & E. G. Peckham, 1892)
		2 to 6	*Asemonea tenuipes* (O. Pickard-Cambridge, 1869), Male; Female
		4 to 6	*Telamonia dimidiata* (Simon, 1899)
Ground runner	Leaf Litter	0 to 0.1	*Lycosa wroughtoni* Pocock, 1899
Foliage runner	Tree bark	3 to 8	*Hersilia savignyi* Lucas, 1836

Figure 2: Habitus of Spiders of the family Araneidae; A - *Araneus viridisomus* Gravely, 1921 Female in dorsal view | B - *Araneus viridisomus* Gravely, 1921 Adult female in day retreat | C-*Argiope cameloides* Zhu & Song, 1994 | D - *Argiope pulchella* Thorell, 1881 Male | E - Argiope *pulchella* Thorell, 1881Female | F - *Cyclosa hexatuberculata* Tikader, 1982 | G - *Cyclosa insulana* (Costa, 1834) Juvenile | H - *Cyclosa insulana* (Costa, 1834) Sub- Adult | I - *Cyclosa insulana* (Costa, 1834) Adult | J - *Cyclosa quinqueguttata* (Thorell, 1881) | K - *Cyclosa spirifera* Simon, 1889 | L - *Cyrtophora cicatrosa* (Stoliczka, 1869) | M-*Eriovixia laglaizei* (Simon, 1877) | N-*Eriovixia poonaensis* (Tikader & Bal, 1981) | O-*Neoscona mukerjei* Tikader, 1980 Juveniles in colony.

Figure 3: Habitus of the spiders of the family Dictynidae (A), Hersilidae (B), Lycosidae (C), Oxyopidae (D and E), Salticidae (F – O); A - *Anaxibia rebai* (Tikader, 1966) Adult female beside her retreat guarding egg sacs | B - *Hersilia savignyi* Lucas, 1836 | C - *Lycosa wroughtoni* Pocock, 1899 | D - *Hamadruas sikkimensis* (Tikader, 1970) | E - *Oxyopes pankaji* Gajbe & Gajbe, 2000 | F - *Asemonea tenuipes* (O. Pickard-Cambridge, 1869) Male | G - *Asemonea tenuipes* (O. Pickard-Cambridge, 1869) Female | H - *Euophrys sp.* |I - *Menemerus bivittatus* (Dufour, 1831) Male | J - *Menemerus bivittatus* (Dufour, 1831) Female | K - *Myrmarachne melanocephala* MacLeay, 1839 Female | L-*Myrmarachne prava* (Karsch, 1880) Female | M-*Myrmarachne spissa* (G. W. Peckham & E. G. Peckham, 1892)Female; N - *Phintella vittata* (C.L.Koch,1846); O - *Telamonia dimidiata* (Simon, 1899).

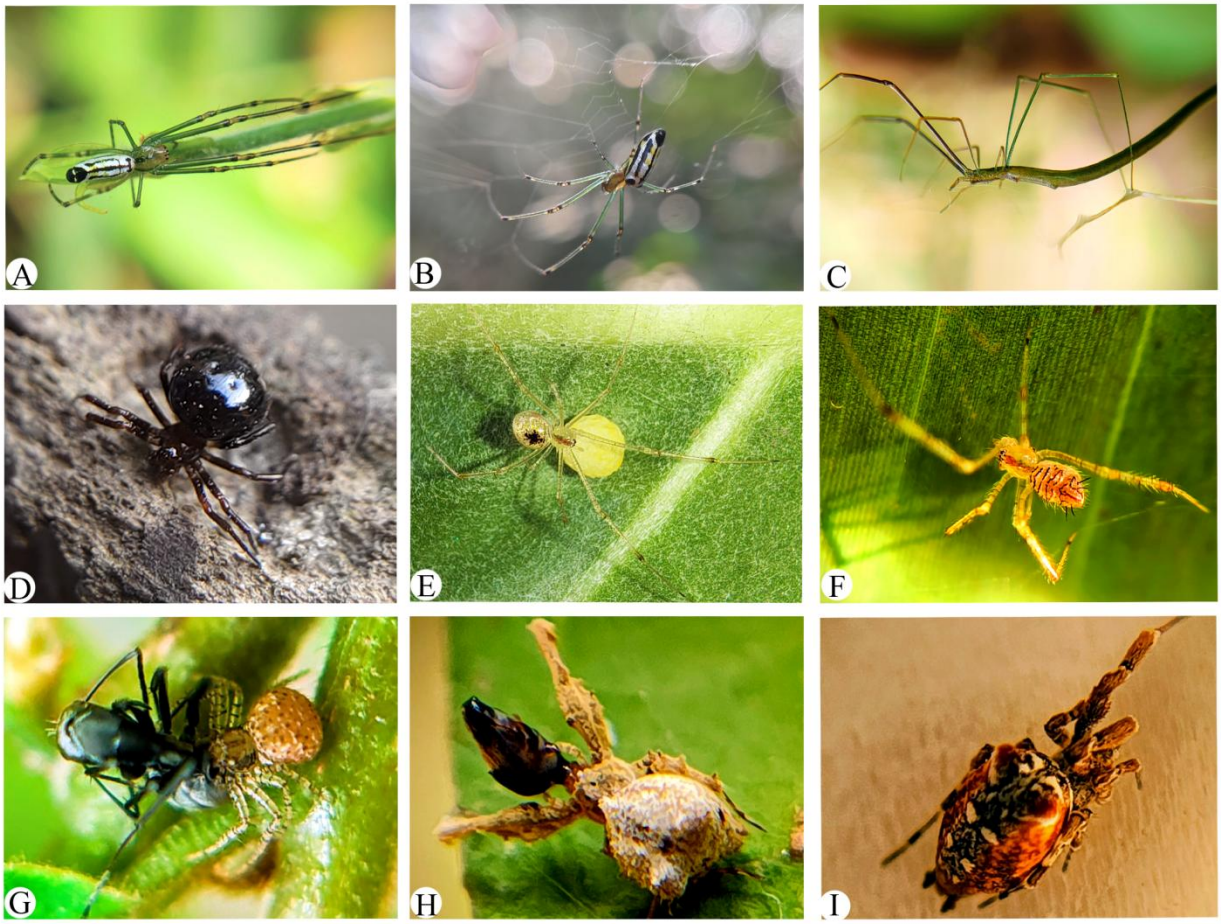

Figure 4: Habitus of spiders of the family Tetragnathidae (A and B), Theridiidae (C-F), Thomisidae (G), Uloboridae (H and I); A - *Leucauge decorata* (Blackwall, 1864) Sub-adult | B-*Leucauge decorata* (Blackwall, 1864) Adult female | C - *Ariamnes sp.* |D - *Latrodectus elegans* Thorell, 1898 | E - *Meotipa multuma* Murthappa, Malamel, Prajapati, Sebastian & Venkateshwarlu, 2017 Female with egg sac | F - *Meotipa picturata* Simon, 1895 | G - *Indoxysticus minutus* (Tikader, 1960) Feeding on ant | H - *Uloborus glomosus* (Walckenaer, 1841)Feeding on her prey | I - *Uloborus khasiensis* Tikader, 1969.

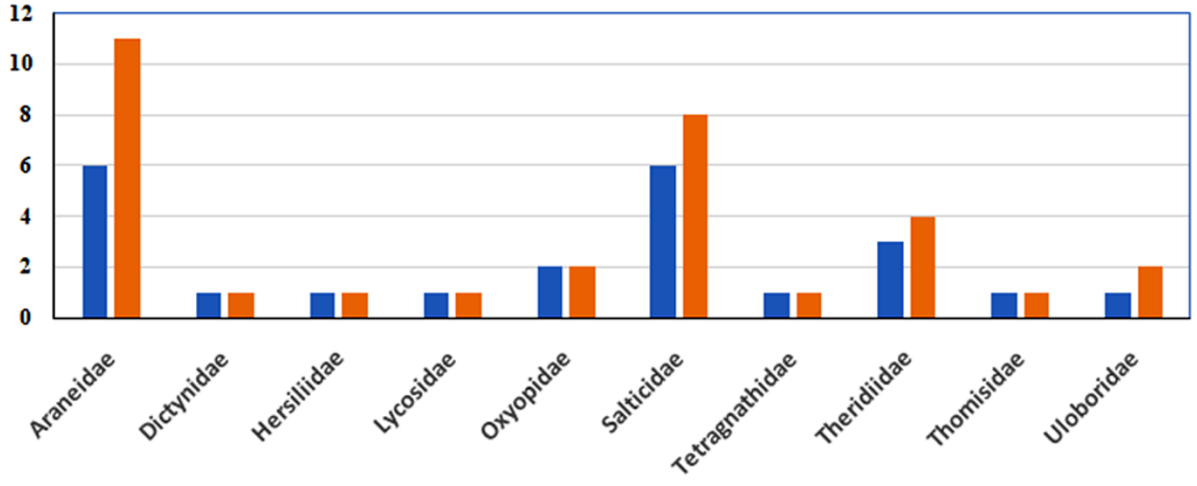

Figure 5: The number of genera and species representing each family of spiders.

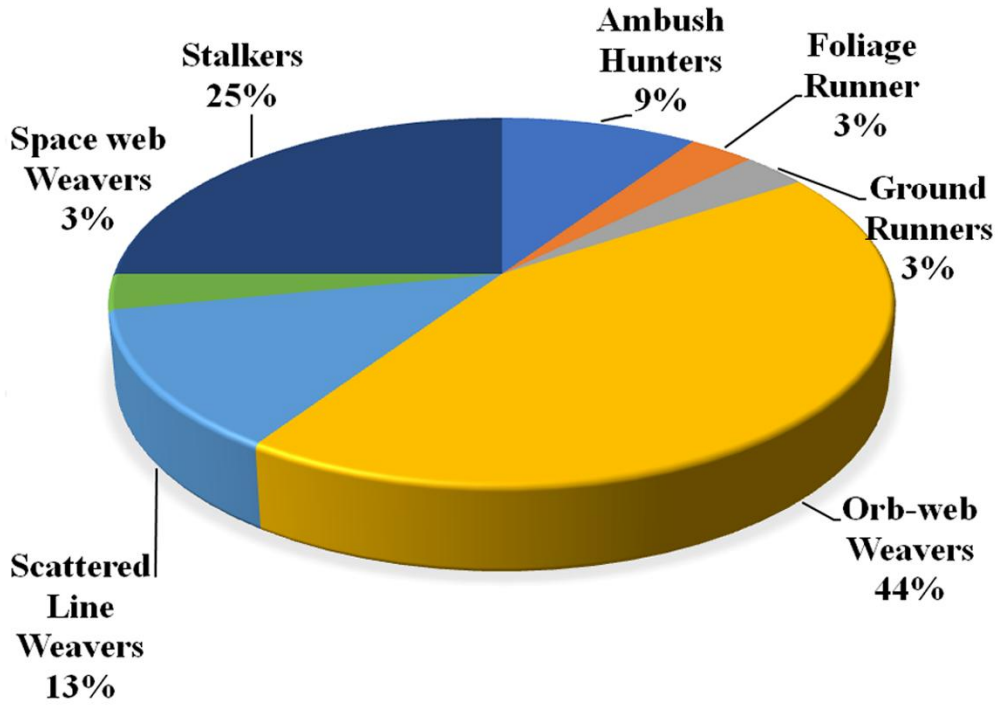

Figure 6: Guild structure of spiders in the forests of Bethuadahari.

The spiders recorded during this study were found to belong to 10 families representing 15.87% of the total 63 families reported from India. The orb-web weaver species *Argiope cameloides* under family Aranidae seems to be a new record for India and West Bengal. Previously it was reported from China only (Wang et al. 2021). Significantly low abundance of male spiders compared to females may be due to cannibalism and female dominance in spiders (Saha et al. 2024). The species under genus *Myrmarachne* exhibiting batesian mimicry towards various ant species were recorded of which *M. melanocephala* Mac Leay, 1839 has been reported to mimic *Tetraponera rufonigra* Jerdon, 1851 (Kumar et al. 2021). A colony of juvenile *Neoscona mukerjei* Tikader, 1980 was observed to form colony of 26 individuals under a broad leaf of *Calotropis* sp. The diurnal behavior of the two species *Eriovixia laglaizei* (Simon, 1877) and *Eriovixia poonaensis* (Tikader & Bal, 1981) were markedly different as the individuals of the *E. laglaizei* were found in their web while those of *E. poonaensis* were resting in their day retreat resembling bird droppings on the upper side of tree leaves.

4. CONCLUSION

The present study documented 32 spider species in their natural microhabitats, especially foliage on tree or shrub in forest areas of Bethuadahari, one of which was recorded for the first time from India. The major function guilds were orb-web weavers and stalkers. This moist deciduous forest is very rich in floral as well as insect diversity seems to be an excellent habitat for spiders. Thus, extensive surveys within this forest landscape may lead to discovery of a large species assemblage, including new species or species range extension, and illuminating their role in maintaining the ecosystem.

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Authors contributions

SS, MRM and AKA collected data and photographically documented the specimen in the field work. SS also carried out identification of the specimen, data analysis and drafting of manuscript. SM finally identified the specimen corrected the manuscript and provided necessary guidance.

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This study has not received any external funding.

Conflict of Interest

The authors declare that there are no conflicts of interests.

Informed consent

Not applicable.

Ethical approval & declaration

In this article, the animal regulations are followed as per the ethical committee guidelines of Department of Zoology, Bidhannagar College, EB-2, Sector 1, Salt Lake, Kolkata-700064, West Bengal, India & animal ethical guidelines of Bethuadahari Wildlife Sanctuary West Bengal, India; the authors observed the functional diversity of some spiders (Arachnida: Araneae) in forest landscapes of Bethuadahari, West Bengal, with a new record from India. The Animal ethical guidelines are followed in the study for species observation, identification & experimentation.

Data and materials availability

All data associated with this study are present in the paper.

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