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Assessment of spider diversity and their ecological guild structure in fragmented forest and adjoining residential area in the Unakoti hill range of Tripura, India

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Abstract
The present study was conducted to explore the spider diversity and their ecological guild structure of fragmented forest and adjoining residential area in the Unakoti hill range under Unakoti district of Tripura, India. A total of 36 species belonging to 28 genera under 13 families were recorded from the selected habitats. Araneidae was the dominant family constituting of 11 species under 8 genera, followed by Salticidae (10 species), Nephilidae (3 species).The family Oxyopidae and Theridiidae each with two species. The remaining 8 families *viz.* Hersiliidae, Sparassidae, Pisauridae, Thomisidae, Zoropsidae, Corinnidae, Cheiracanthiidae and Pholcidae with one species were recorded. Guild structure analysis of the observed spiders revealed five functional groups *viz*.orb web builders, Stalkers, Ambushers, Space- web builders and Ground runners. The knowledge generated from the present study gives valuable information on diversity of spider species of Unakoti hill area and also can be used for future research on spider fauna of Tripura.

Keywords: Spider diversity, Fragmented forest, Guild structure, Unakoti hill, Tripura

Introduction
Spiders (Order: Araneae) are known as one of the most diverse and abundant fauna among animal kingdom (Lone *et al*., 2015; Radermacher *et al*., 2020) [10, 21]. This incredible diversity plays a critical role in maintaining ecological balance in diverse ecosystems (Mhaske and Pokale, 2025) [25].The main drivers of fragmentation of natural forest which leads to environmental changes in tropical region is deforestation and use of modern sophisticated instruments in agriculture practices (Gibbs *et al*., 2010; Maji, 2025) [8, 11] and these are associated with loss of biodiversity (Fitzherbert *et al*., 2008) [7] and many ecosystems function (Dislich *et at*., 2017) [6]. Spiders are generalist predators, contributing significantly in ecological food chain including biological pest control (Chandrakar and Bharti, 2025) [30]. Due to anthropogenic activities like deforestation, urbanization etc. the natural habitat of the spider reducing day by day in terrestrial ecosystem (Parmar, 2024) [17]. According to the latest available literature a total of 53, 648 species of spider have been reported worldwide (WSCA, 2025) [32]. So far in India there are 1686 spider species were recorded from different study (Sankaran, 2023) [23]. They have a unique population attributes, distribution pattern and prefer different types of habitat. Besides these, they have a well-known role in many ecosystems (Wise, 1993; Branco and Cardoso, 2020) [31, 2] and act as a natural bio control agent for a great number of insects, including crop pests and ensuring ecological sustainability (Nyffeler and Birkhofer, 2017; Michalko *et al*., 2019) [14, 12].Their behavioral traits-like web-building, foraging strategies and habitat specificity-make them ideal candidates for use as bioindicators in environmental monitoring (Pearce and Venier, 2006) [18]. Fragmentation can affect biodiversity in many ways including spider diversity. The habitat-specific species are quickly disappear with a minute level of ecological changes in the surrounding conditions and their community structure reflects habitat heterogeneity at global climate as well as local-scale changes under the impact of various factors (Argañaraz *et al*., 2020) [1].
The impact of habitat heterogeneity on density and diversity of spider is found to be in both natural as well as agro ecosystems (Hore and Uniyal, 2008) [9].Due to insectivorous foraging

habit spiders promote the diversity and stability of the natural enemy community and act as a pest control agent (Sunderland 1999; Polchaninova and Prokopenko, 1999) [27, 20].Now-a-days because of forest fragmentation and deforestation diversity of the spider fauna reduce notably and as a result complex food chain structure became vulnerable(Caleb, 2020) [3].The extensive study on spiders is essential to understand biodiversity patterns of a particular ecosystem (Salunkhe, 2025) [22].The entire north east region of India is considered as hotspot of biodiversity including Tripura state. But till date not much attention was given for exploration of spider diversity status particularly in the study area.

Materials and Methods

Study area: The study area lies in the Unakoti district of Tripura. Unakoti hill is famous for ancient rock-cut sculptures and recently added to UNESCO's tentative World Heritage list and one of the important tourist destination of Tripura, northeast India. The study area is monsoon type of climate and the temperature varies from 10^0C to 38^0C during study period. The highest and lowest temperature recorded in the month of June and December respectively; June to September is the main rainfall season in the study area. The area is characterized by low land moist deciduous, tropical evergreen and semi-evergreen forest and by undulating hilly terrain with small perennial streams. Some of important tree species available in the study area are *Shorea robusta*, *Schima wallichii*, *Tectona grandis*, *Heava brasiliensis* etc.

The study was conducted during February, 2021 to March, 2022 in different habitat types *viz*. undisturbed forests, rubbers plantation sites, human disturb area like garages, storage area and home garden etc. The field observation was done during 7:00 hrs-11:00 hrs and 3:00 hrs-5:00 hrs. in weekly basis during the three seasons of the year such as summer, monsoon and winter. Sample was photographed using smart mobile phone during field observation for identification purposes. During aerial sampling and ground collecting few samples were brought to the laboratory for details taxonomic study. The specimens were identified using taxonomic key of spiders (Tikader, 1987; Sebastian and Peter, 2009) [28, 24] and designation of spider guild was based on the ecological characteristic known for the family (Young and Edwards, 1990; Uetz *et al*., 1999; Cardoso *et al*., 2011) [33, 29, 4]. The taxonomy and nomenclature followed is as per the world spider catalogue by Platnick (2014) [19].

Results and Discussion

Thirty six species of spiders belonging to 13 families were recorded during the present study with the highest number of species 11 belonging to Araneidae.Salticidae is represented by 10 species. Oxyopidae and Theridiidae each with two species, while Hersiliidae, Sparassidae, Pisauridae, Thomisidae, Zoropsidae, Corinnidae, Cheiracanthiidae and Pholcidae with one species were recorded [Table-1, Figure-1and Photo plate-1&2]. Spiders preferred to live in different habitats. Species belonging to Oxyopidae and Theridiidae and Araneidae families were mainly found in vegetation. Oxyopids were mainly found on the grasses. Theridiids are usually found at the bottom of leaves. On the other hand, Thomisid spiders were found on flowering plants.

Table 1: Systematic list of spider species recorded during the study period

Family	Sl. No.	Species	Guild structures
Araneidae	1	*Gasteracantha kuhli* (Koch, 1837)	Orb- web builders
	2	*Gasteracantha dalyi* (Pocock, 1900)	Orb -web builders
	3	*Gasteracantha hasselti* (Koch, 1837)	Orb - web builders
	4	*Araneus ventricosus* (Kock, 1878)	Orb- web builders
	5	*Araneus diadematus* (Clerck, 1758)	Orb -web builders
	6	*Araneus mitificus* (Simon, 1886)	Orb -web builders
	7	*argiope aemula (walckenaer, 1841)*	Orb -web builders
	8	*Argiope anasuja* (Thorell, 1887)	Orb- web builders
	9	*Argiope pulchella* (Thorell, 1881)	Orb- web builders
	10	*Cyrtophora cicatrosa* (Stoliczka, 1869)	Orb web builders
	11	*Larinioides sclopetarius* (Clerck, 1757)	Orb web builders
Salticidae	12	*Menemerus bivittatus* (Dufour, 1831)	Stalkers
	13	*Telamonia dimidiate* (Simon, 1899)	Stalkers
	14	*Rhene flavigera* (Koch, 1846)	Stalkers
	15	*Leucauge decorate* (Blackwall, 1864)	Orb web builders
	16	Leucauge venusta (Walckenaer, 1842)	Orb web builders
	17	*Opadometa fastigata* (Simon, 1877)	Orb web builders
	18	*Tylorida sp.*	Orb web builders
	19	*Salticus scenicus* (Clerck, 1757)	Stalkers
	20	*Heliophanus sp.*	Stalkers
	21	*Plexippus paykulli* (Audouin, 1826)	Stalkers
Nephilidae	22	*Nephila kuhli* (Doleschall, 1859)	Orb web builders
	23	*Nephila pilipes* (Fabricius, 1793)	Orb web builders
	24	*Nephilengys sp.*	Orb web builders
Oxyopidae	25	*Oxyopes javanus* (Thorell, 1887)	Stalkers
	26	*Peucetia viridians* (Hentz, 1832)	Ambushers
Hersiliidae	27	*Hersilia savignyi* (Lucas, 1836)	Ambushers
Theridiidae	28	*Chrysso sp.*	Space- web builders
	29	*Steatoda sp.*	Space- web builders
Sparassidae	30	*Heteropoda venatoria* (Latreille, 1802)	Ambushers
Pisauridae	31	*Dolomedes sp.*	Ambushers
Thomisidae	32	*Thomisus onustus* (Walckenaer, 1805)	Ambushers
Zoropsidae	33	*Zoropsis spinimana* (Dufour, 1820)	Ambushers
Corinnidae	34	*Castianeira sp.*	Ground runners
Cheiracanthiidae	35	*Cheiracanthium inclusum* (Hentz, 1847)	Stalkers
Pholcidae	36	*Holocnemus pluchei (Scopoli, 1763)*	Space- web builders

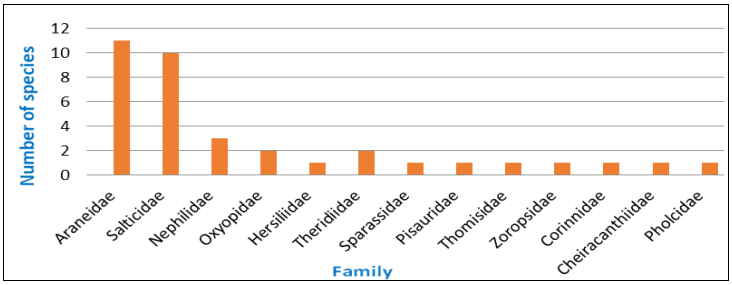

Fig 1: Graphical representation of family- wise species

Photo plate 1: Sl. No. 1-20 spider species

Photo plate 2: Sl. No. 21-36 spider species

The spiders belonged to five functional groups based on their foraging mode. Orb-web builders were the dominant feeding guild with 50%, followed by stalker 22.22%, ambushers 16.66%. The dominant guild (orb-web builders) was composed of 18 species of the families, Araneidae, Salticidae and Nephilidae. Stalkers constituted 8 species under the families, Salticidae, Oxyopidae and Cheiracanthiidae [Figure-2]. The data on different foraging guilds of spiders are presented in Table 1 and Figure 2. Spider species are found in heterogenous habitat *viz* tree, shrub and ground places. Forest and riparian zones support rich guilds of orb weavers, jumping spiders, and ambush predators, regulating herbivore insects and maintaining ecosystem health (Dave and Trivedi, 2024) [5].

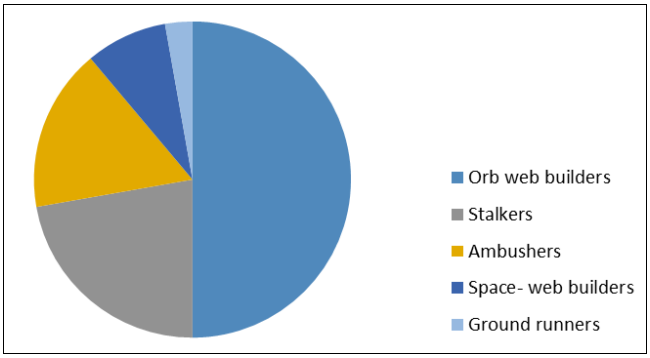

Fig 2: Graphical representation of ecological guild structure of different species

Higher species diversity is an indicator of a healthier and complex community because a greater variety of species allows more interactions, hence greater system stability which in turn indicates good environmental conditions (Nadal, 2022)[13]. In the present study, a total of 36 species were recorded and Araneidae was the most dominant family constituting 11 species under 8 genera. The result of the present study showed that the findings of the study are line with the other study of the north east part of India (Singh *et at*., 2012; Pandit, 2019; Pal and Chandrakar, 2025) [26, 16, 15]. A higher dominance of foraging guild specialists Araneidae was observed across all localities.

Conclusion

From the present study it has been noticed that the study site is harbour a large number of spider species. Many factors such as crop type, seasonal patterns, landscape complexity, and climatic conditions are directly associated with diversity pattern of the species composition. Araneidae, Salticidae, Tetragnathidae, and Lycosidae become dominant and ecologically important in various habitats. The results of the present study highlight the habitat structure and environmental factors may be crucial in determining the composition of spider community of the study area. Therefore, documenting spider diversity patterns can be providing important information to justify the conservation significance of the ecosystem. There is a need to study the seasonal variation of the spider fauna in this region along with conservation of suitable habitat structure for many species of spider fauna.

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