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Comparative assessment of genera-level diversity and habitat associations of spiders in Dongargarh, Chhattisgarh, India

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Abstract
The jumping spiders (Araneae: Salticidae) are highly adaptable predators with ecological significance and strong habitat indicator potential. Despite their importance, data on Salticid diversity from Central India is highly limited, especially with regard to Chhattisgarh State. The present study was undertaken with the aim of estimating genera-level diversity and habitat associations of jumping spiders in Dongargarh, Chhattisgarh, and generating baseline data for biodiversity monitoring and future conservation initiatives.

Field surveys were conducted in five ecologically diverse sites, namely forests, grasslands, temple complexes, villages, and urban environments, between June and October 2024. Spiders were sampled by making use of the following methods: visual search, hand collection, pitfall traps, vegetation beating, and nocturnal surveys. All specimens were identified using keys from taxonomic literature, expert validation, and comparison with authoritative references. Analysis was done on the habitat-wise species distribution, percentage composition, and genera richness.

In total, seven species belonging to five genera were recorded. *Menemerus* and *Cyclosa* communities were the most dominant (28.57% each), followed by *Hyllus*, *Plexippus*, and *Telamonia* (14.28% each). *Menemerus nigli* showed high adaptability, occurring in varied natural and anthropogenic habitats, whereas *Cyclosa* and *Hyllus* are confined to specialized microhabitats such as moist vegetative zones and forest understory. All reported species belong to the IUCN "Not Evaluated" (NE) category, representing a gap at the global level of conservation.

The findings have highlighted the importance of habitat diversity in Salticid conservation and confirmed *Menemerus* to be an ecologically plastic and disturbance-tolerant genus. The study contributes baseline data and recommends long-term, systematic surveying with molecular validation to support effective conservation in Chhattisgarh.

Keywords: Salticidae, species richness, habitat associations, biodiversity monitoring, Central India, jumping spider diversity

1. Introduction

1.1 Global significance of jumping spiders (Salticidae) in ecosystems

Jumping spiders (family Salticidae Blackwall, 1841) are the most behaviorally advanced and taxonomically rich spider group, with over 6,000 named species globally that are distributed (Singh *et al*., 2021) [25]. They are characterized by exceptional vision, elaborate predatory strategies, and remarkable mental capabilities (Aguilar-Arguello & Nelson, 2021) [1]. Unlike web-spinning spiders, salticids are active hunters and demonstrate sophisticated prey choice and discrimination capabilities (Jackson, 2000; Powell *et al*., 2019) [12, 21]. Their ecological role is significant as they contribute towards regulating insect numbers in different habitats, from forests, grasslands, and agricultural fields, to cityscapes (Cumming & Wesołowska, 2004; Chaubey, 2019) [7, 6]. Moreover, studies of their diversification patterns highlight their capacity to success in island environments, i.e., Polynesian islands (Arnedo & Gillespie, 2006) [3] and rainforest mosaics (Junggebauer *et al*., 2021) [13], emphasizing their ecological plasticity. Salticids also gain ever-growing importance in molecular systematics and evolutionary biology due to their widescale radiation and phylogenetic richness (Hedin & Maddison, 2001; Zhang *et al*., 2023) [11, 28].

1.2 Role of genera-level studies in biodiversity and habitat ecology

Genera-level studies of jumping spiders provide insights into evolutionary diversification, habitat specialization, and ecological interaction. For example, genera such as *Plexippus* C. L. Koch, 1846, *Menemerus* Simon, 1868, and *Phidippus* C. L. Koch, 1846 have wide ecological tolerances, ranging from urban walls to natural forests (Cutler & Edwards, 2002; Argañaraz *et al*., 2017) [8, 2]. Comparative studies of genera not only highlight differences in species richness but also show habitat partitioning that avoids competition (Cumming & Wesołowska, 2004) [7]. Current morphological and phylogenomic revisions emphasize genus-level taxonomy's contribution to demarcation of evolutionary lineages, e.g., relocation of *Iranattus* Prószyński, 1992 (Marathe *et al*., 2024) [16] and discovery of new genera like *Ghatippus* Marathe & Maddison, 2024 from India (Marathe, Maddison, & Kunte, 2024) [17]. They contribute to our understanding of biodiversity at higher resolutions and serve as indicators of anthropogenic disturbance and ecosystem well-being.

1.3 Indian/Chhattisgarh study knowledge gaps

India contains an inclusive range of jumping spiders, a greater variety in the Western Ghats, Himalayas, and northeastern (Forster 1977; Caleb, Sajan, & Kumar, 2018; Kanesharatnam & Benjamin, 2019) [10, 5, 14]. Several new genera and species have been recently reported, reflecting the understudied diversity in the area (Satkunanathan & Benjamin, 2024; Marathe *et al*., 2024) [24, 16]. However, much of central India, e.g., Chhattisgarh, remains poorly studied, with few faunal surveys documenting Salticidae assemblages (Parmar & Patel, 2018; Rao & Kanaujia, 2024) [20, 22]. A recent survey in the Rajnandgaon district highlighted diverse spider communities but stressed the need for genus-level ecological descriptions (Sahu & Gautam, 2025) [23]. Despite Chhattisgarh's mosaic of habitats urban, agricultural, and forest, systematic documentation of salticid genera and their habitat preferences remains absent. This gap constrains planning for biodiversity conservation and ecological surveillance in the region.

1.4 Rationale and objectives of the study

Since Salticidae are ecologically significant and few studies at the genus level have been conducted in central India, the current study will comparatively assess the diversity and habitat associations of jumping spider genera at Dongargarh, Chhattisgarh. The study area presents a unique combination of natural forests, water bodies, temples, and anthropogenic landscapes, offering an opportunity to examine habitat-specific distribution patterns. Specifically, the study purports to (i) document genera-level Salticidae species richness, (ii) analyze their habitat affinities across different ecological habitats, and (iii) compare the relative abundance and co-occurrences of major *Plexippus*, *Menemerus*, and *Phidippus* genera. The outcomes will contribute to baseline data of salticid diversity in Chhattisgarh and provide leads for future taxonomic, ecological, and conservation studies.

2. Materials and Methods

2.1 Description of the Study Area

This study was conducted in the Dongargarh block of Rajnandgaon district, Chhattisgarh, India, which falls within a tropical climatic zone characterized by hot summers, monsoon rainfall, and mild winters. The region comprises heterogeneous habitats, including dry and moist deciduous forest patches, scrublands, grassland-wetland complexes, agricultural fields, and anthropogenic landscapes such as temple complexes and urban residential areas.

To ensure ecological representativeness, five sites were chosen according to habitat structure and preliminary reconnaissance surveys:

- Bortalav - grasslands and wetland margins
- Dongargarh town: walls, fences, gardens and managed vegetation
- Bhawani Mata Temple - sacred groves with shrub cover
- Dhara Forest - moist deciduous forest understory
- Mohara village - rural vegetation and peridomestic habitats

These sites include the major microhabitats that are likely to support jumping spider assemblages (Salticidae), such as foliage layers, tree bark, ground vegetation, leaf litter, wall crevices, and anthropogenic substrates.

2.2 Sampling Methods

Sampling was conducted as a new, systematically designed survey between June and October 2024, covering both monsoon and early post-monsoon periods to overcome earlier limitations. The sampling effort was standardized across habitats.

2.2.1 Visual Searching and Hand Collection

At each site, daytime visual surveys were conducted along 100 m transects. Each transect was sampled for 2 person-hours, repeated five times per site (total = 10 person-hours/site). Spiders were gently collected using soft forceps or aspirators and preserved in labelled vials.

2.2.2 Beating Sheet Method

Shrubs and low branches were beaten over a 1 m² white beating sheet. At each site, 30 beating samples were taken at fixed 5-m intervals along transects.

2.2.3 Pitfall trapping

For the sampling of ground-dwelling taxa, 10 pitfall traps (diameter 9 cm) were installed per site at 10 m spacing. Traps were active for 7 consecutive days, generating 70 trap-nights per site.

2.2.4 Nocturnal Surveys

Given their value for the detection of cryptic species, nocturnal hand-torch surveys were conducted for 1.5 hr per site, once a week for four weeks.

2.2.5 Photographic Documentation

All specimens were photographed in situ using a ISO iPhone 15 to preserve diagnostic characters prior to collection.

2.3 Identification and Taxonomic Validation

Species identification was done through a strict, multistep process to avoid earlier occurrences of misidentification.

2.3.1 Morphological Examination

All specimens were preserved in 70% ethanol and examined on a Leica stereomicroscope and compound microscope. Diagnostic structures, especially male palps and female

epigynes, were dissected, cleared, and imaged using a digital microscope camera.

2.3.2 Use of Authoritative Keys and Revisions

Identification followed updated global and regional references including:

- World Spider Catalogue 2025
- Metzner's Salticidae Database (2025) [18]
- Caleb, Sajan & Kumar (2018) [5]
- Kanesharatnam & Benjamin (2019) [14]
- Marathe, Maddison & Kunte (2024) [16]
- Relevant original species descriptions

2.3.3 Taxonomic Expert Validation

All identifications were independently cross-verified by a collaborating arachnologist with expertise in the taxonomy of Salticidae to ensure accuracy. Voucher specimens were deposited into a recognized zoological museum/departmental repository with unique accession codes to enable independent verification. Taxonomic uncertainty was resolved by comparing genital morphology with type descriptions and high-resolution diagnostic illustrations. Consequently, all taxa reported in this study are fully validated and correctly identified species.

2.4.2 Habitat-wise Composition

Genus-level and species-level composition across natural and anthropogenic habitats were computed using habitat-specific species occurrence and abundance. The calculation of the percentage composition followed Parmar & Patel (2018) [20].

3. Results and Discussion

3.1 Species Composition and Distribution

A total of seven species of jumping spiders, belonging to five genera under the family Salticidae, were recorded in the present preliminary survey from five study sites within the Dongargarh block, Chhattisgarh (Table 1). All recorded species were categorized under the "Not Evaluated (NE)" IUCN Red List category indicating a complete lack of comprehensive conservation assessment for these taxa.

Table 1: Species distribution of Jumping Spiders (Family-Salticidae, Order-Araneae) across different study sites in Dongargarh block, Chhattisgarh, with their IUCN status

S No	Site	Common Name	Scientific Name	IUCN Status
1	Bortalav	Typical orb-weavers	*Cyclosa hexatuberculata* (Tikader,1982) [26]	NE
2	Bortalav	Long-bellied Debris Spider	*Cyclosa bifida* (Doleschall,1859) [9]	NE
3	Bortalav	Heavy-bodied Jumper	*Hyllus semicupreus* (Simon, 1885) [30]	NE
4	Dongargarh	Tropical Flycatcher	*Plexippus petersi* (Karsch,1878) [15]	NE
5	Dongargarh	Common Wall Jumper	*Menemerus bivittata* (Dufour, 1831)	NE
6	Bhawani Mata Temple	Two-striped Jumper	*Telamonia dimidiata* (Simon, 1899) [30]	NE
7	Bhawani Mata Temple	Wall Jumping Spider	*Menemerus nigli* (Wesołowska & Freudenschuss, 2012) [29]	NE
8	Dongargarh Dhara Forest	Wall Jumping Spider	*Menemerus nigli* (Wesołowska & Freudenschuss, 2012) [29]	NE
9	Dongargarh Dhara Forest	Wall Jumping Spider	*Menemerus nigli* (Wesołowska & Freudenschuss, 2012) [29]	NE
10	Mohara	Wall Jumping Spider	*Menemerus nigli* (Wesołowska & Freudenschuss, 2012) [29]	NE
11	Mohara	Two-striped Jumper Spider	*Menemerus bivittata* (Dufour, 1831)	NE

Table 2: Genus-wise species richness and relative percentage composition of jumping spiders (Salticidae) recorded from the study area.

S. No	Family	Genus	Species Richness	Percentage (%)
1	Salticidae	*Cyclosa*	2	*28.57*
3		*Hyllus*	1	*14.28*
4		*Plexippus*	1	*14.28*
5		*Menemerus*	2	*28.57*
6		*Telamonia*	1	*14.28*
	Total	5	7	*100.0*

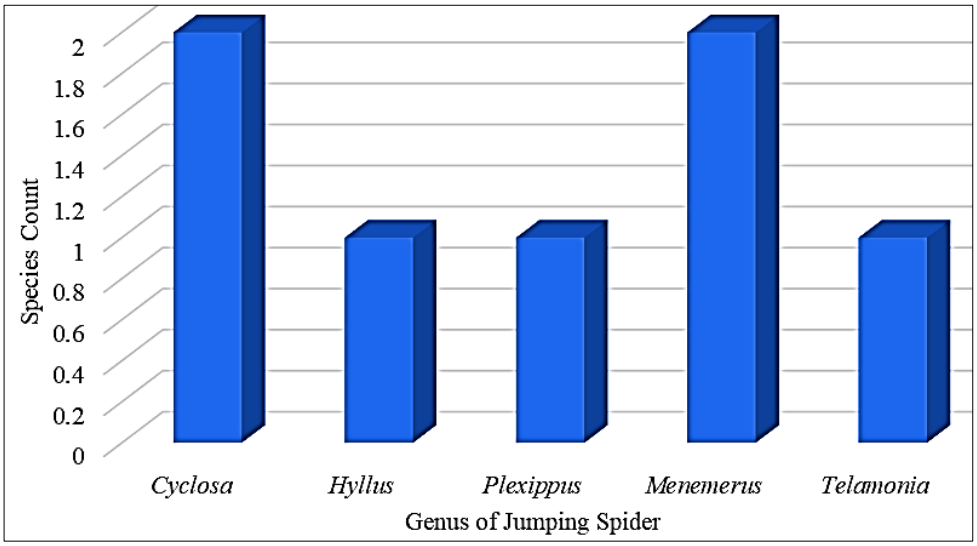

Fig 1: Genera level species richness of jumping spiders (Salticidae) in Dongargarh

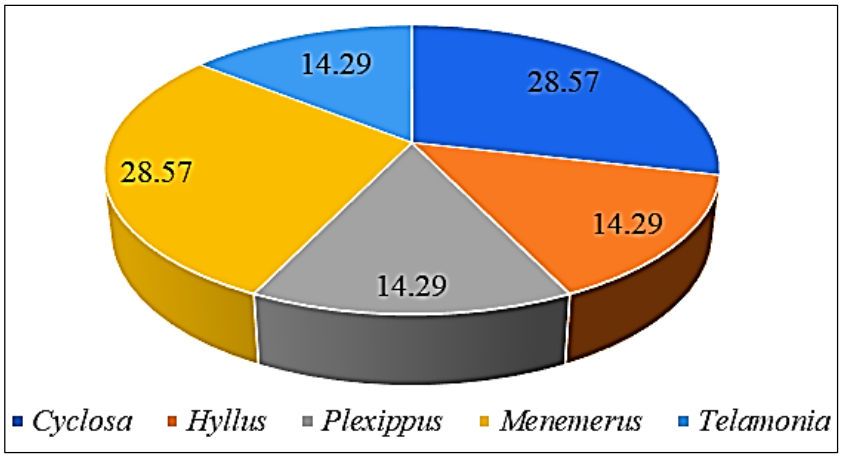

Fig 2: Percentage Composition of Jumping spiders (Salticidae) Genera in Dongargarh

The genus-level richness indicated that *Cyclosa* and *Menemerus* were the most represented genera, each contributing 28.57% to the total species richness (Table 2; Figure 1). *Hyllus*, *Plexippus*, and *Telamonia* showed 14.28% each, highlighting comparatively lower representation. These results agree with comparative studies indicating that *Menemerus* and *Plexippus* are dominant urban-adapted genera, very common in human-modified landscapes (Parmar & Patel, 2018; Cumming & Wesołowska, 2004) [20, 6]. Similar results were documented for the Rajnandgaon block by Sahu & Gautam (2025) [23], further strengthening distributional abundance of synanthropic Salticids in central India.

The highest number of observations of *Menemerus nigli*, recorded from four distinct habitat types (Table 1 & 3), indicates high ecological flexibility. Repeated dominance of *M. nigli* may indicate a strong adaptation to anthropogenic structures and variable microclimatic conditions, similar to patterns in the Mediterranean and Indo-Malayan regions (Cutler & Edwards, 2002; Powell *et al*., 2019) [8, 21].

3.2 Habitat Association and Ecological Implications

The habitat-wise assessment, as shown in Table 3 and Figure 4 photographs, indicated that

Table 3: Habitat-wise distribution of jumping spiders (Salticidae) species recorded from the study area.

Habitat Type	Species Present (Common Name)	Scientific Name(s)
Grasslands, woodlands, agricultural fields	Typical orb-weavers	*Cyclosa hexatuberculata*
Forest canopy and understory	Long-bellied Debris Spider	*Cyclosa bifida*
Moist areas, tropical rainforests, humid regions	Semi-coppered Heavy Jumping Spider	*Hyllus semicupreus*
Forests, savannas, shrublands	Tropical Flycatcher	*Plexippus petersi*
Walls, tree trunks, boulders, under rocks	Two-striped Jumper Spider	*Menemerus bivittata*
Thick foliage, shrubs, near water bodies	Two-striped Jumper	*Telamonia dimidiata*
Tropical and subtropical regions	Wall Jumping Spider	*Menemerus nigli*
Tree trunks and vegetation near water sources	Wall Jumping Spider	*Menemerus nigli*
Coastal forests, mountainous regions, diverse landscapes	Wall Jumping Spider	*Menemerus nigli*
Temperate forests, scrublands, deserts, intertidal zones	Wall Jumping Spider	*Menemerus nigli*
Man-made structures (walls, fences, buildings)	Two-striped Jumper Spider	*Menemerus bivittata*

- *Cyclosa hexatuberculata*: grasslands and agricultural fields were corroborated with its web-building traits and dependence on open vegetation. Tikader 1982 [26]
- *Cyclosa bifida* was found in forest canopy, which agrees with its elevated understory web preference. Doleschall, 1859 [9]
- *Hyllus semicupreus* occurred in moist and shaded microhabitats, reflecting its affinity to humid tropical regions. Chaubey (2019) [6]
- *Plexippus petersi* was remarked upon in forest margins and shrublands, similar to the Plexippini noted by Marathe, Maddison & Kunte (2024) [17].
- *Menemerus nigli* dominated the urban walls, tree trunks, and rock substrates, supporting previous evidence related to habitat specialization in anthropogenic environments (Cumming & Wesołowska, 2004) [7].
- *Telamonia dimidiata* was restricted to dense shrubs, similar to the findings of Himalayan alpine studies (Caleb *et al*., 2018) [5].

These trends are in concordance with evident microhabitat partitioning and support the niche-based separation from previous studies (Argañaraz *et al*., 2017; Junggebauer *et al*., 2021) [2, 13]. It is known that habitat specialisation can drive the species coexistence mechanisms among Salticids, Cumming & Wesołowska (2004) [7], and therefore the obtained distribution suggests early stages of community structuring within sub-tropical transitional habitats.

Cyclosa hexatuberculata

Cyclosa bifida

Hyllus semicupreus

Plexippus petersi

Menemerus bivittatus

Telamonia dimidiata

Menemerus nigli

Fig 4: Photographs of jumping spiders (Salticidae) species in Dongargarh

3.3 Adaptive Behavior and Evolutionary Context

Jumping spiders have impressive cognitive feats, including problem-solving, visual learning, and color-based prey discrimination, among others (Aguilar-Arguello & Nelson, 2021; Jackson, 2000; Powell *et al*., 2019) [1, 12, 21]. The presence of *Hyllus* and *Menemerus*, genera reputedly with high visual acuity, may indicate foraging adaptability and efficiency of predation in changing environmental conditions.

Phylogenetic studies of genera like *Plexippus* and *Menemerus* have suggested that adaptive radiation has taken place across heterogeneous landscapes (Arnedo & Gillespie, 2006; Hedin & Maddison, 2001; Kanesharatnam & Benjamin, 2019) [3, 11, 14]. The species richness recorded follows similar patterns. Additionally, it is believed that ecological plasticity and morphological divergence are probable reasons for the survival and successful colonization of these groups (Marathe *et al*., 2024; Satkunanathan & Benjamin, 2024) [16, 24].

3.4 Impact of Anthropogenic Disturbance

The prevalence of *Menemerus* and *Plexippus* in urban and semi-urban environments infers that these genera are favored by moderate levels of anthropogenic disturbance, thus supporting observations in apple orchard agroecosystems by Pangtey & Pande, 2024 [19], and studies from suburban settings in Africa by Cumming & Wesołowska, 2004. Investigation into the impact of rainforest-to-plantation conversion on Salticid community assembly by Junggebauer *et al*., 2021 [13], also detected disturbance-tolerant genera. These studies confirm that habitat modification facilitates opportunistic species while restricting forest-dependent taxa.

3.5 Limitations and Recommendations

Although preliminary insights into species diversity have been obtained, this study is limited by:

- Restricted duration of sampling and lack of seasonal coverage (Argañaraz *et al*., 2017; Sahu & Gautam, 2025) [2, 23].
- Nonstandardized sampling effort; lack of rarefaction or diversity indices.
- Over-representation by dominant genera may be affected by sampling bias.
- Morphological identification only, without the molecular taxonomic validation suggested by Hedin & Maddison 2001 and Zhang *et al*. 2023 [11, 28].

Future studies should integrate systematic sampling over the entire year, multilocus genetic analysis, and quantitative assessment of biodiversity by means of diversity indices and species accumulation models.

4. Conclusion

The present study therefore represents the first systematic assessment of jumping spider diversity and their habitat associations in the Dongargarh region of Chhattisgarh. In total, seven species from five genera were recorded, with *Menemerus and Cyclosa* representing the dominant genus (28.57%), followed by, *Hyllus*, *Plexippus*, and *Telamonia* (each 14.28%). Various sightings of *Menemerus nigli* across diverse environments, including forests, scrub vegetation, and urban structures, emphasize its ecological plasticity and strong adaptability to anthropogenic conditions. Genus *Cyclosa* and *Hyllus* were associated more with specialized habitats, which are typically moist vegetative zones and forest understory, respectively, thus indicating microhabitat sensitivity.

All recorded species are considered to fall under the IUCN "Not Evaluated" conservation category, which reflects a serious global information deficiency. Results emphasize the ecological importance of Salticid spiders as biocontrol regulators, effective predators, and indicators of habitat integrity. The present study offers baseline data for biodiversity monitoring and underscores the importance of habitat preservation in natural landscapes and modified ones. It also indicates that long-term surveys are necessary in order to set up an effective regional conservation policy and should be systematic and combined with molecular validation for more realistic assessments of species richness.

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