International Journal of Integrative Biological Sciences (IJIBS)

(An International Peer-Reviewed (Refereed) Journal)
Website-https://ijibs.nobleinkresearch.com/1
Email- editor@ijibs.nobleinkresearch.com

Seasonal Dynamics and Habitat Distribution of Spider Communities in Prayagraj

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Received: 13 April 2026, Revised: 16 May 2026, Accepted: 17 June 2026, Available Online: 30 June, 2026

Abstract

Spiders (Order: Araneae) are significant generalist predators and are becoming increasingly recognized as useful bioindicators due to their sensitivity to environmental changes. The present study is on species diversity and ecological importance of spider communities in two different habitats of Prayagraj, Uttar Pradesh, Dhoomanganj and Chandrashekhar Azad Park. Specimens were collected by hand picking, sweep netting and pitfall trapping and identified by morphological study using standard taxonomic references. In Dhoomanganj 10 families/304 persons were found while in Chandrashekhar Azad Park 4 families/37 persons were found. The diversity indices revealed that Dhoomanganj had higher species richness and evenness (Simpson's Diversity Index = 0.933; Shannon-Wiener Index = 2.82) than Azad Park (Simpson's Diversity Index = 0.72; Shannon-Wiener Index = 1.26). Lycosidae family was most dominant particularly in Dhoomanganj showing favourable microhabitat for the ground dwelling species. Presence of diverse ecological association in studied sites indicates structural and environmental complexity. The results confirm the usefulness of spiders as bioindicators of habitat quality and underline the necessity of preserving the green spaces of cities to maintain ecological balance. Further, this study provides baseline data on urban spider biodiversity of the Prayagraj region for subsequent ecological and conservation studies.

Keywords: Spider diversity, Bioindicators, Prayagraj, Ecological aspect

1. Introduction

Spiders are tiny, carnivorous predators that belong to the Class Arachnida of the Phylum Arthropoda. The spider is an air-breather and its body is divided into two distinct parts: the cephalothorax and abdomen (Nichat et al., 2025). Spiders are found throughout the world, except for some extreme niches such as the Arctic and Antarctica. Spiders are on almost every plant, on dead leaves on the forest floor, on trees in winter. They are found in different locations such as under bark, under stones, under fallen logs, among foliage, in domestic habitats, on grass leaves and in subterranean burrows (Pai & Halarnkar, 2018).

Humans often have a negative view of spiders, even though they play a crucial role in agriculture by controlling insect pests. Because they are generalist predators, they have great value in controlling insect populations in agroecosystems. Populations and species abundances of spider communities in agricultural fields can be comparable to those of natural environments. Spiders, however, have not always been considered as important biological control agents because their ecological role in pest control needs to be documented further. Spiders are increasingly appreciated as ecological indicators due to their extreme sensitivity to environmental conditions and disturbances in the habitats (Rajeevan et al., 2019). The order Araneae is the seventh most diverse animal group in the world after five major insect orders (Coleoptera, Lepidoptera, Hymenoptera, Diptera and Hemiptera) and the Arachnid subclasses (Singh et al., 2022). This is a highly diverse order of arthropods that is female-dominated and predatory (Rajeevan et al., 2019). There are more than 52,865 species of spiders spread across many taxa and families (World Spider Catalog, 2025). In India, 1,971 species comprising 500 genera from 61 families have been reported (Sen et al., 2024).

Spiders are important predators of terrestrial arthropods and are well known for their web spinning and their specialized trap building abilities. Spiders are of interest to naturalists for the way they build webs, used for catching various kinds of invertebrates. Ants are the predominant food source for many species living on the ground, followed by houseflies, mosquitoes, beetles, butterflies, and honeybees (Prakash & Prakash, 2013). They have two neurotoxic poison glands in their cephalothoraxes that may contain chemicals for pharmaceutical and non-polluting biopesticides. Wandering spiders, ambush spiders, web-building spiders, and communal spiders are examples of how spiders are often classified according on their lifestyle. The biggest challenges to spider survival are habitat loss from extensive land-use conversion, deforestation, and increased human settlement (Pai & Halarnkar, 2018).

Additionally, recent evaluations of campus green spaces and specialty gardens around Prayagraj have shown that localized microhabitat architecture and floral availability significantly influence urban spider assemblages (Pandram et al., 2026a; Pandram et al., 2026b).

2. Review of Literature

Research on spider diversity and baseline data on their conservation status was conducted in the northeastern Gariaband region (Chhura) by Nichat et al. (2025). 55 species from 42 genera and 11 families were found in trees, bushes, grasslands, and surface microhabitats over a three-month survey period. The emergence of the prominent families Araneidae and Salticidae, which have a high species richness, confirms the function of spiders as trustworthy ecological bioindicators.

The jumping spider Pseudomogrus sudhii from the Thar Desert in Rajasthan was reported by Logunov et al. (2022), which is the first official record of the genus Pseudomogrus Simon, 1937 in India.

Web-building spiders and hunting/trapdoor spiders are the two main functional ecological groupings of spiders based on their foraging behavior, according to Fauzi et al. (2022). Using the Visual Encounter Survey (VES) method, they conducted a quantitative survey around Mount Galunggung and found 17 different species of spiders, with Leucauge celebesiana being the most common taxon. 36 species from 11 families were examined by Dubey et al. (2021) at the Central Ordnance Depot (C.O.D.) in Jabalpur, Madhya Pradesh. A secure microclimate that facilitates high local spider variety is created by the installation's limited public access and copious amounts of greenery. Smitha and Sudhikumar (2020) carried out a detailed analysis of the spider fauna in cashew farms at the Cashew Research Station in Madakkathara, Kerala. Salticidae and Araneidae were the most species-rich families with 63 species found in 52 genera and 14 families. Guild structure study revealed six distinct feeding guilds: ground runners, ambushers, orb-web builders, foliage runners, scattered line weavers, and stalkers. Singh et al. (2020) researched the range of the yellow sac spider family Cheiracanthiidae in India by generating an updated inventory of 38 species from two genera. Besides highlighting regional distribution tendencies, their results showed that over half of the recorded species are endemic to the country.Rajeevan et al. (2019) investigated the diversity of spider fauna in certain Western Ghats settings (North Wayanad region, Kerala). By documenting 150 species from 20 families and 73 genera, they were able to identify seven functional eating groups. Their results show a direct correlation between local species richness and floral variety and environmental preservation across survey sites.

Pandram et al. (2026a) investigated some guilds in urban settings and found that crab spiders (Thomisidae) on blooming plants on the University of Allahabad campus exhibited significant diversity and microhabitat preferences. Similar to this, studies of salticid community structures and dominance patterns in semi-natural urban garden niches highlight how essential localized floral design is for maintaining populations of predatory arthropods (Pandram et al., 2026b).

3. Materials and Methods

3.1 Study Area Situated at an altitude of 98 meters (322 feet) in southern Uttar Pradesh, Prayagraj lies at the confluence of the Ganges and Yamuna rivers. The region experiences a typical north-central Indian humid subtropical climate (Source: https://prayagraj.nic.in/about-district/).

3.2 Study Site Fieldwork took place across two distinct locations in Prayagraj: Dhoomanganj and Chandrashekhar Azad Park. These sites were chosen to capture varying gradients of urbanization and green space management, providing a range of microhabitats for comparative analysis.

3.3 Climate The average annual temperature in Prayagraj hovers around 26°C, ranging from roughly 14°C during winter (January) to 34°C during summer/monsoon transitions. June records peak temperatures ranging between 27.0°C and 42.3°C, whereas January represents the coolest month, with temperatures fluctuating between 5.8°C and 23.8°C.

3.4 Sampling Methods

Standardized collection protocols were deployed to capture diverse spider guilds:

- **Hand-picking Method:** Here, Spiders were collected by searching beneath rocks, logs, surface crevices, loose bark of dead trees, and structural surfaces of buildings (Oyewole & Oyelade, 2014).
- **Sweep-net Method:** Here the applied across herbaceous vegetation and low shrubs where hand-picking was unfeasible, utilizing a standard sweep net with a 38 cm diameter (Oyewole & Oyelade, 2014).
- **Pitfall Trapping:** The Open containers were installed flush with the ground surface to capture ground-dwelling wandering spiders. Containers were charged with 70% ethanol as a preservative to prevent escape and tissue degradation.

3.5 Preservation

Collected specimens were transferred into glass vials containing 70% ethanol and labeled with precise collection dates and site metadata for downstream taxonomic verification (Smitha & Sudhikumar, 2020).

3.6 Identification of Specimen

Specimens were examined under a stereomicroscope and identified based on key morphological traits using taxonomic keys, the World Spider Catalog (2025), and standard literature (Rajeevan et al., 2019; Smitha & Sudhikumar, 2020). Digital documentation was achieved using DSLR and smartphone cameras (Vivo T1).

4. Observation

Table 1: Specimens collected from Dhoomanganj, Prayagraj (UP)

S.No.	Family	Genus	Species	No. of Individuals	General Name
1	Thomisidae	*Thomisus*	*spectabilis*	4	Crab spiders
2	Theridiidae	*Episinus*	*angulatus*	3	Cobweb spiders
3	Pisauridae	*Pisaurina*	*mira*	6	Nursery web spiders

4	Oxyopidae	*Oxyopes*	*salticus*	10	Lynx spiders
5	Tetragnathidae	*Tetragnatha*	*obtusa*	5	Long-jawed orb weavers
6	Salticidae	*Evarcha*	*falcata*	12	Jumping spider
		Euophrys	*frontalis*	10	White-Palped Jumping Spider
7	Lycosidae	*Pardosa*	*milvina*	23	Wolf spiders
		Pardosa	*agrestis*	20	Field Wolf Spider
		Pardosa	*amentata*	15	Spotted Wolf Spider
		Piratula	*insularis*	12	Pirate Wolf Spider
		Trochosa	*ruricola*	18	Rustic Wolf Spider
		Trochosa	*terricola*	30	Ground Wolf Spider
		Hogna	*radiata*	35	European Wolf Spider
		Rabidosa	*punctulata*	15	Dotted Wolf Spider
		Alopecosa	*kochi*	10	Koch's Wolf Spider
		Arctosa	*leopardus*	10	Leopard Bear-Spider
8	Araneidae	*Zygiella*	*atrica*	6	Orb-weaving spiders
		Cyclosa	sp.	15	Trashline Orb weavers
9	Dictynidae	*Argenna*	sp.	5	Mesh-web spiders
10	Eresidae	*Stegodyphus*	*sarasinorum*	40	Velvet spiders

Table 2: Specimens collected from Chandrashekhar Azad Park, Prayagraj (UP)

S.No.	Family	Genus	Species	No. of Individuals	General Name
1	Oxyopidae	*Oxyopes*	*salticus*	4	Lynx spiders
2	Sparassidae	*Micrommata*	*virescens*	6	Huntsman spiders
3	Eresidae	*Stegodyphus*	*sarasinorum*	15	Velvet spiders
4	Pholcidae	*Pholcus*	*opilionoides*	12	Cellar spiders

5. Results

5.1 Statistical Indices of Specimens Collected from Dhoomanganj, Prayagraj (UP)

5.1(a) Simpson's Index

Table 3: Simpson Index calculation table for Dhoomanganj

- Total Individuals (N) = 304
- Sum of squares ($\sum n\,(n-1)$) = 6,184

$$\text{Simpson's Index } (D) = \frac{\sum n\,(n-1)}{N(N-1)} = \frac{6184}{304 \times 303} = \frac{6184}{92112} \approx 0.067$$

5.1(b) Simpson's Diversity Index

$$\text{Simpson's Diversity Index} = 1 - D = 1 - 0.067 = 0.933$$

6.1(c) Shannon-Wiener Index

Table 4: Shannon-Wiener Index parameters for Dhoomanganj

- $\sum(P_i \ln P_i) = -2.828$
- Shannon-Wiener Index (H) = $-(-2.82) = 2.82$

Table 5: Summary of Statistical Indices for Dhoomanganj

S.No.	Index Parameter	Value
1	Simpson's Index (D)	0.067
2	Simpson's Diversity Index ($1 - D$)	0.933
3	Shannon-Wiener Index (H)	2.82

5.2 Statistical Indices of Specimens Collected from Chandrashekhar Azad Park, Prayagraj (UP)

5.2(a) Simpson's Index

Table 6: Simpson's Index calculation table for Chandrashekhar Azad Park

- Total Individuals (N) = 37
- Sum of squares ($\sum n\,(n-1)$) = 384

$$\text{Simpson's Index } (D) = \frac{384}{37 \times 36} = \frac{384}{1332} \approx 0.28$$

6.2(b) Simpson's Diversity Index

$$\text{Simpson's Diversity Index} = 1 - D = 1 - 0.28 = 0.72$$

6.2(c) Shannon-Wiener Index

Table 7: Shannon-Wiener Index table for Chandrashekhar Azad Park

- $\sum(P_i \ln P_i) = -1.267$
- Shannon-Wiener Index (H) = $-(-1.26) = 1.26$

Table 8: Summary of Statistical Indices for Chandrashekhar Azad Park

S.No.	Index Parameter	Value

1	Simpson's Index (D)	0.28
2	Simpson's Diversity Index ($1 - D$)	0.72
3	Shannon-Wiener Index (H)	1.26

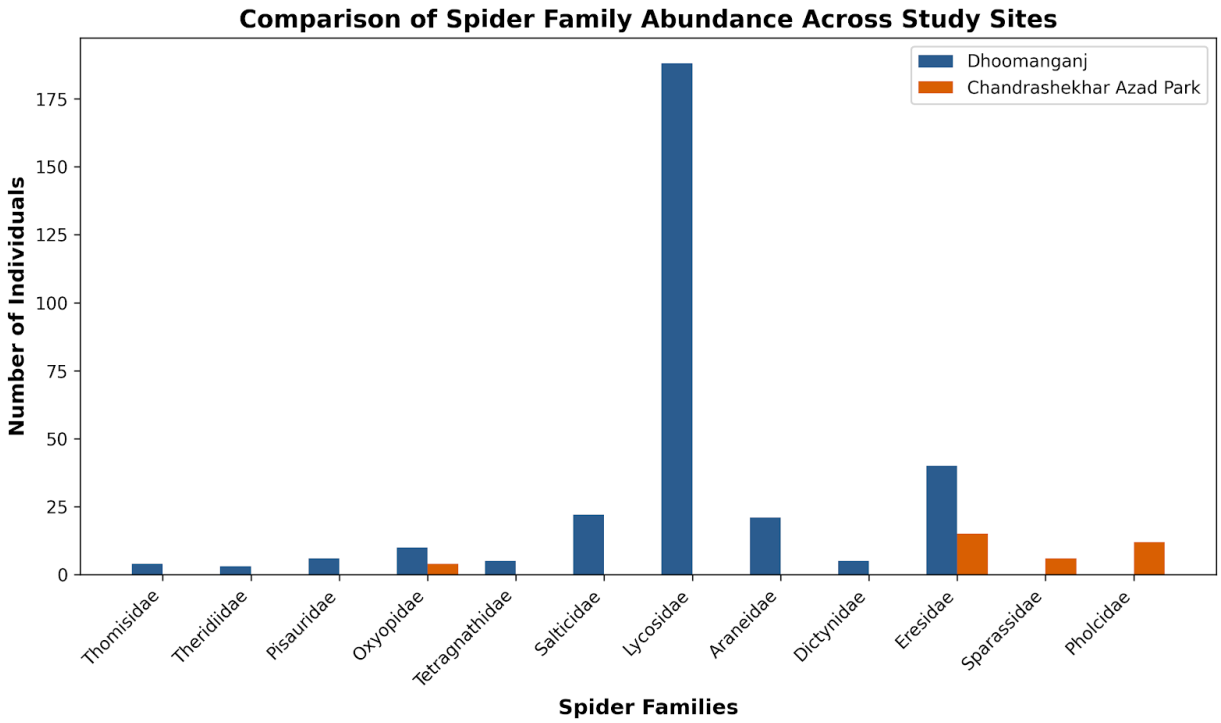

Figure 1: Comparative Abundance Graph.

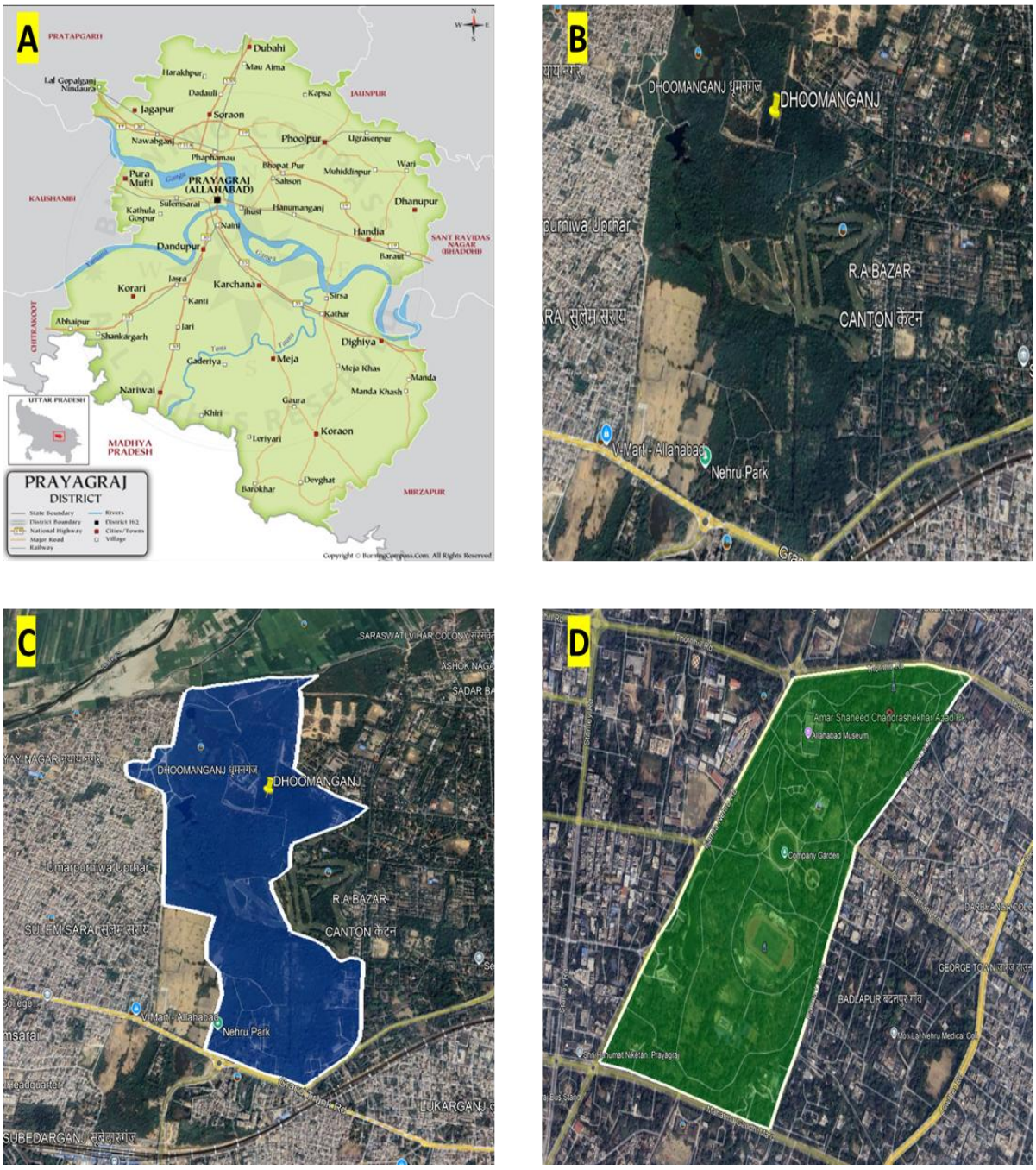

Figure 2: A) Prayagraj district map (source: [www.mapsofindia.com)](http://www.mapsofindia.com) B) Map showing the Dhoomanganj area (source: Google Earth Pro software) C) Mapped area of study site-1 Dhoomanganj, Prayagraj, (UP) D) Mapped area of study site-2 Chandrashekhar Azad Park, Prayagraj, (UP)

6. Discussion

Table 1 shows the wide variety of spiders found in Dhoomanganj, with 304 individuals distributed across ten different families (Thomisidae, Theridiidae, Pisauridae, Oxyopidae, Tetragnathidae,

Salticidae, Lycosidae, Araneidae, Dictynidae, and Eresidae). Notably, with six genera and ten species, the Lycosidae family of wolf spiders showed complete domination. This high abundance suggests that semi-urban matrices have an abundance of appropriate ground microhabitats, moisture retention, and ground-level prey.

On the other hand, 37 representatives of four families—Oxyopidae, Sparassidae, Eresidae, and Pholcidae—were found in Chandrashekhar Azad Park, where Table 2 describes the community structure. Reduced structural complexity at the herbaceous layer level, urban microhabitat pressures, and well-maintained landscape care are responsible for Azad Park's lower population densities and restricted taxonomic dispersion. When diversity indices are compared, there are notable ecological variations between the two locations. With a Simpson's Diversity Index of 0.933 and a Shannon-Wiener Index (H) of 2.82, Dhoomanganj showed greater species richness and evenness. Chandrashekhar Azad Park, on the other hand, showed a lower Simpson's Diversity Index (0.72) and Shannon-Wiener Index (H=1.26). These findings suggest that compared to well-managed urban park environments, semi-urban or transitional green borders have more stable and diversified spider populations. The importance of spiders as bioindicators of environmental health and structural variation is demonstrated by the existence of specialized guilds in Prayagraj's urbanizing environments. Because it allows for a direct side-by-side comparison of individual family counts across multiple categorization locations (Dhoomanganj vs. Chandrashekhar Azad Park), a grouped bar chart was used. There is a prominent representation of both common taxa and habitat-specific occurrences.

Dominance of Lycosidae: The graph clearly illustrates the wolf spider family's (Lycosidae) high abundance in Dhoomanganj (188 individuals), in stark contrast to its total absence in the samples from Azad Park. This provides visual evidence for the hypothesis that semi-urban transitional ground habitats provide ground-dwelling wanderers with optimal moisture, soil cover, and prey density. Taxonomic richness divergence: Dhoomanganj’s diversity of 10 families (with large numbers of Eresidae, Salticidae and Araneidae) is in line with its higher diversity (Shannon-Wiener H=2.82). On the other hand, only four families are present in Chandrashekhar Azad Park, an indication that heavy management and altered microclimates can cause ecological stress in urban parks. Nevertheless, in both cases there are robust generalist groups such as Oxyopidae and Eresidae, indicating that some foraging guilds are able to withstand urbanization.

7. Conclusion

This study provides necessary baseline information on the diversity, distribution and community structure of spider populations in Prayagraj's Dhoomanganj and Chandrashekhar Azad Park. The study revealed that semi-urban transitional zones display more species richness and diversity (H=2.82) as compared to highly regulated urban parks (H=1.26). Moreover, community assembly is strongly influenced by microhabitat organization with Lycosidae and web-weaving Eresidae being common on the ground. This study also highlights that the maintenance of vegetative

complexity and urban green spaces is important for the survival of spider biodiversity and ecological balance in an environment of rapidly expanding urban areas.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this research article.

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