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Species diversity of spiders (Araneae: Arachnida) from Ajitmal subdistrict of Auraiya district, Uttar Pradesh, India

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Abstract
A total of 52 species of spiders belonging to 16 families and 38 genera were recorded in the Ajitmal tehsil of district Auraiya, Uttar Pradesh, India during the present study. Among them, the family Araneidae included almost one-third of the species (34.6%) followed by Salticidae (13.46%) and rest of the families comprised less than 10% of the species. Such surveys are vital for conservation of these creatures which are helpful for natural pest control and regarded as good indicators of habitat quality.

Keywords: spiders, araneae, fauna report, Ajitmal tehsil, Auraiya district

Introduction
The members of the order Araneae (Arachnida: Arthropoda) are commonly known as spiders. They are most abundant and cosmopolitan in distribution. In terrestrial ecosystem, they play a vital role as predator. All spiders are predatory mostly on insect pests regulating their population in nature. In agricultural habitat they play a major role in checking down the population of pest insects, particularly of rice, maize, cotton, pulses etc.[1,2,3]. The spiders can easily be identified by having two body segments: Prosoma (cephalothorax) and opisthosoma (abdomen). Mouthparts are of chelicerate type and they possess spinnerets which produce silk which is used to build webs, protective eggsac and also to wrap prey. Unlike insects and crustaceans, spiders do not have antennae. The number of simple eyes varies 4 to 8 and its arrangement on the head is of taxonomic importance. Globally, 49,583 species have been described under 4,238 genera belonging to 131 families [4]. India having a very rich biodiversity and a tropical climate with biodiversity hotspots, has the best account so far only 1893 species belonging to 484 genera in 60 families [5], while, Singh and Singh [6] listed 2344 species described under 596 genera comprising 65 families, though in this list, several species were considered cases of misidentification by the authors. However, there exist many species in the wild and museums that still await description and classification. Despite recent research works on the diversity and distribution of spiders in India, their number is insufficient as compared to the other parts of the world. For the sustainable management and conservation of biodiversity of the animal species of any region of the world, their proper documentation is vital as it helps in monitoring the rate of loss of species. Preparation of checklist of species is an essential component of systematic documentation. Hence, in view of increasing intensity of anthropogenic threats to biodiversity, a cataloguing and appropriate documentation of biodiversity, especially on ignored groups like spiders, is desirable immediately [7]. Several workers have documented the diversity of spider fauna of different districts of Uttar Pradesh [8]. Recently, spider fauna of Bidhuna tehsil (subdistrict) of Auraiya district was studied by us [9]. In this paper, spider diversity of another tehsil, Ajitmal, of Auraiya district was studied and presented.

Materials and Methods
Study site
The study area is Ajitmal tehsil of Auraiya district of Uttar Pradesh which has been carved out from Etawah district in 1997. Auraiya district (latitude: 26°21’ to 27°10’ N; longitude: 78°45’ to 79°45’ E) is located in the south-western part of Kanpur division. North of this district lies district Kannauj, on the East Kanpur Dehat, on the south is district Jalaun, while on the west is district Etawah. River Yamuna and Kunwari separate the district from Jalaun. Auraiya district comprises 3 tehsils: Auraiya, Bidhuna and Ajitmal. The Auraiya district covers an area of 2,054 km^2, of which more than one-third is rural area. Two rivers, Yamuna (112 km) and Senger flow through the district. It lies entirely in the Indo-Gangetic Plain. On the basis of factors like geology, soil, topography, climate and natural vegetation the district has been divided into three regions: Arind-Ahneya Plain, Senger Plain and Chambal-Yamuna ravines [9]. Ajitmal tehsil came in existence in 2014. Area under forest is insignificant and only few patches of small forests are spread in Ajitmal tehsil. There are several parks and gardens in Ajitmal tehsil. There are 112 villages and 65 Panchayats in the tehsil. The climate of the tehsil is humid subtropical. The winter season from mid November to February is followed by the summer season from March to mid June. The period from mid June to the end of September is the south-west monsoon season and the

October and the first half of November constitute the post-monsoon season. Summer is very hot, temperature may reach up to 46 °C while in winter it may drop to 3 °C. More than 80% of the total annual rainfall is received during July to October. Different places of the tehsil were chosen for sampling in different habitats during August, 2019 to December, 2021 (Figure 1).

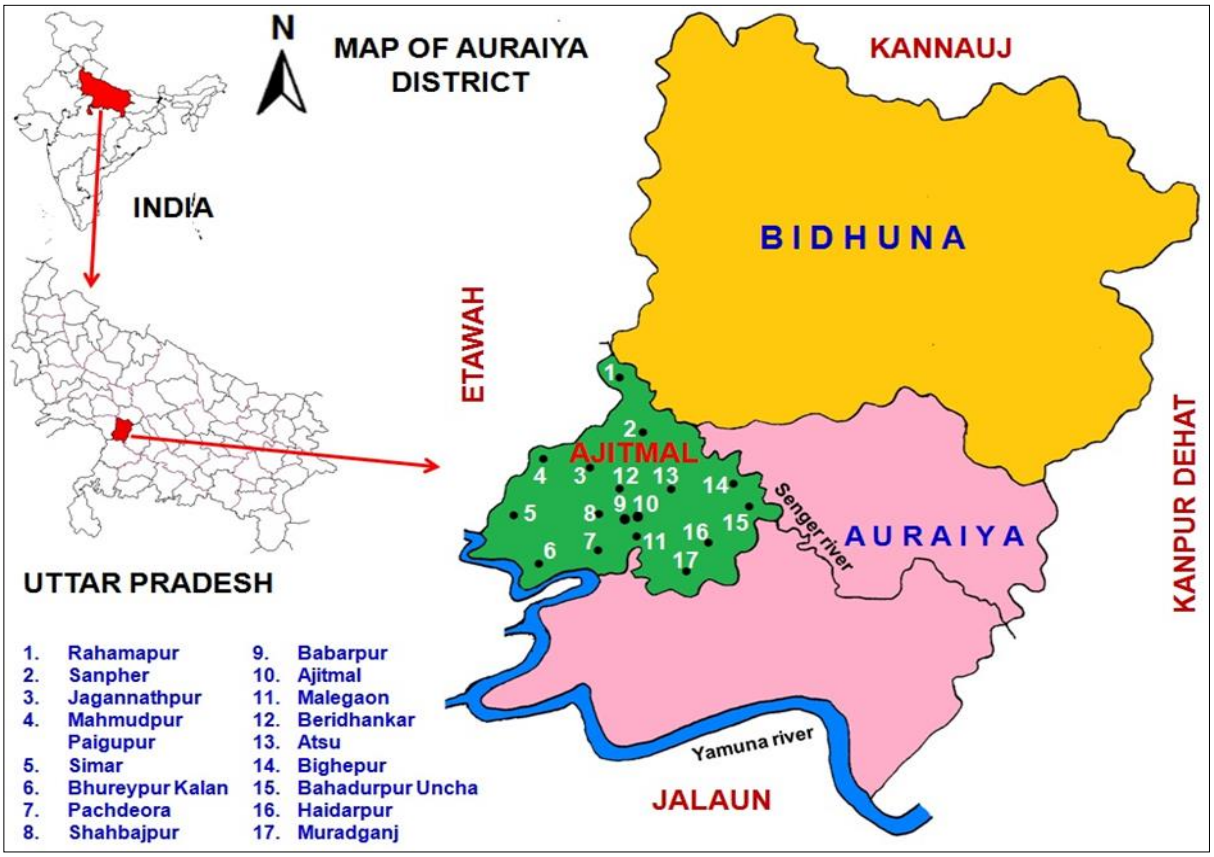

Fig 1: Location of study site in Ajitmal tehsil of Auraiya district, Uttar Pradesh.

Sampling methods

Spiders were sampled in different habitat types, having different vegetations: grassland, rice field, road side, railway track, gardens, human dwellings etc. at several places in Ajitmal tehsil of Auraiya district. Standard sampling protocols for spider collection were adopted in different selected sampling spots. The detailed descriptions of the collection techniques [9] are as follows:

1. **Using sweep net**: The foliage spiders from low level vegetation of shrubs (up to 2 m in height) were sampled by this method. The sweep net consists of a 90 cm handle; 40 cm ring and the collection were poured on white canvas. The net was emptied at regular intervals to avoid loss and destruction of the specimen. During collection sweep net was moved back and forth to cover all ground layer herbs and shrubs till all vegetation in the sampling plots were swept thoroughly.
2. **Ground hand collection**: This method of sampling is used to collect the spiders, which are found to be visible in the ground, litter, in broken logs, etc.
3. **Aerial hand collection**: This method was used to collect web-building and free-living spiders on the foliage and stems of living or dead shrubs, high herbs, tree trunks etc.
4. **By beating vegetation**: The spiders were collected by beating the vegetation with a stick and collecting the samples on a cloth. The method is used to sample spiders living in the shrub, high herb vegetation, bushes, and small trees and branches.
5. **Litter sampling**: Litter sampling involved sorting of spiders from the litter collection tray.
6. **By using aspirator**: Small spiders were captured by placing an aspirator above or near the spider and sucking it up with mouth.
7. **Pitfall traps**: These traps were commonly used for the collection of ground-dwelling spiders. Web pattern and habitat types were recorded with every encounter. The collected spiders were placed separately in vials with 70% ethyl alcohol for further taxonomic treatment. The collection date, site and habitat were recorded for each sample.

Identification

The adult spiders were identified using available literatures [10-14], websites, etc. and subject experts. Some of the immature stages could not be identified and ignored. The specimens that could not be identified up to species level were excluded from the list.

Results and Discussion

Several hundreds of individuals of spiders belonging to 52 species under 38 genera and 16 families were collected from different areas of Ajitmal subdistrict of Auraiya district, Uttar Pradesh. Table 1 display the species diversity of the collected spiders. Out of 16 families of spiders recorded, Araneidae includes almost one-third of the species (34.6%) followed by Salticidae (13.46%) and rest of the families consist of less than 10% of the total species recorded. Three species, *Hersilia savigny* Lucas, 1836; *Pholcus phalangioides* (Fuessli, 1775) and *Stegodyphus sarasinorum* Karsch, 1892 were recorded at 10 places out of 17 places selected for the survey programme followed by *Argiope anasuja* Thorell, 1887 and *Lycosa mackenziei* Gravely, 1924 (8 places), *Cyclosa insulana* (Costa, 1834) and *Cyrtophora cicatrosa* (Stoliczka, 1869) (7 places) and other species less than at 6 or less places. Maximum number of species (22 species) were collected from Ajitmal (college campus and nearby agricultural fields) followed by nearby place, Babarpur and Atsu (21 species each), and Haidarpur (17 species), Jagannathpur and Malegaon (16 species each), and less number of species in other places. Out of 37 species of spiders recorded in Bidhuna tehsil of Auraiya district (Dixit & Singh, 2022), 31 species were also recovered from Ajitmal tehsil. All these 52 spider species were also recorded in other districts of Uttar Pradesh, viz. Agra [15, 16], Gonda [17], Gorakhpur, Kushinagar and Deoria [3], Lakhimpur Khiri [18-21], Lucknow [22], Mathura [23], Maharajganj and Siddharthnagar [24, 25], Unnao [26], and few other districts [8].

Table 1: List of spider diversity of Ajitmal subdistrict of Auraiya district, Uttar Pradesh

	Family/Species	Distribution
1.	Araneidae	
	1. *Araneus diadematus* Clerck, 1757	Ajitmal, Babarpur, Haidarpur, Jagannathpur, Sanpher
	2. *Argiope pulchella* Thorell, 1881	Atsu, Atsu, Bahadurpur Uncha, Pachdeora, Rahamapur
	3. *Argiope anasuja* Thorell, 1887	Babarpur, Bahadurpur Uncha, Haidarpur, Mahmudpur Paigupur, Malegaon, Muradganj, Pachdeora, Sanpher
	4. *Argiope aemula* (Walckenaer, 1842)	Ajitmal, Babarpur, Jagannathpur
	5. *Argiope luzona* (Walckenaer, 1837)	Babarpur, Bighepur, Jagannathpur, Pachdeora, Sanpher
	6. *Bijoaraneus mitificus* (Simon, 1886)	Atsu, Babarpur, Beridhankar, Malegaon, Pachdeora, Shahbajpur
	7. *Cyclosa bifida* (Doleschall, 1859)	Ajitmal, Bahadurpur Uncha, Simar
	8. *Cyclosa insulana* (Costa, 1834)	Atsu, Babarpur, Bhureypur Kalan, Haidarpur, Mahmudpur Paigupur, Malegaon, Sanpher
	9. *Cyrtophora cicatrosa* (Stoliczka, 1869)	Bahadurpur Uncha, Bighepur, Haidarpur, Jagannathpur, Mahmudpur Paigupur, Muradganj, Pachdeora
	10. *Cyrtophora citricola* (Forsskål, 1775)	Atsu, Bahadurpur Uncha, Haidarpur
	11. *Eriovixia excelsa* (Simon, 1889)	Ajitmal, Bahadurpur Uncha,
	12. *Eriovixia laglaizei* (Simon, 1877)	Babarpur, Beridhankar, Muradganj, Pachdeora, Shahbajpur
	13. *Gasteracantha diadesmia* Thorell, 1887	Atsu, Bahadurpur Uncha, Haidarpur, Malegaon, Rahamapur
	14. *Larinia phthisica* (L. Koch, 1871)	Ajitmal, Bahadurpur Uncha,
	15. *Macracantha hasselti* (C. L. Koch, 1837)	Bahadurpur Uncha, Bighepur, Muradganj, Shahbajpur
	16. *Neoscona nautica* (L. Koch, 1875)	Ajitmal, Atsu, Bhureypur Kalan, Mahmudpur Paigupur, Malegaon
	17. *Neoscona theisi* (Walckenaer, 1842)	Haidarpur, Jagannathpur, Malegaon, Muradganj, Shahbajpur, Simar
	18. *Nephila pilipes* (Fabricius, 1793)	Bahadurpur Uncha, Jagannathpur, Mahmudpur Paigupur, Rahamapur
2.	Clubionidae	
	19. *Clubiona drassodes* O. P.-Cambridge, 1874	Ajitmal, Atsu, Bhureypur Kalan, Sanpher
3.	Eresidae	
	20. *Stegodyphus sarasinorum* Karsch, 1892	Atsu, Beridhankar, Bighepur, Haidarpur, Jagannathpur, Mahmudpur Paigupur, Malegaon, Muradganj, Pachdeora, Shahbajpur
4.	Gnaphosidae	
	21. *Urozelotes rusticus* (L. Koch, 1872)	Ajitmal, Beridhankar, Haidarpur, Simar
5.	Hersiliidae	
	22. *Hersilia savigny* Lucas, 1836	Ajitmal, Atsu, Babarpur, Bhureypur Kalan, Haidarpur, Jagannathpur, Mahmudpur Paigupur, Malegaon, Muradganj, Sanpher
6.	Linyphiidae	
	23. *Linyphia* sp.	Babarpur, Bhureypur Kalan, Rahamapur

7.	Lycosidae	
	24. *Hippasa agelenoides* (Simon, 1884)	Beridhankar, Bighepur, Shahbajpur
	25. *Hippasa holmerae* Thorell, 1895	Ajitmal, Bhureypur Kalan
	26. *Lycosa mackenziei* Gravely, 1924	Atsu, Babarpur, Haidarpur, Jagannathpur, Mahmudpur Paigupur, Malegaon, Muradganj, Rahamapur
	27. *Pardosa pseudoannulata* (Bösenberg & Strand, 1906)	Ajitmal, Bahadurpur Uncha, Sanpher
	28. *Wadicosa fidelis* (O.P.-Cambridge, 1872)	Ajitmal, Atsu, Babarpur, Haidarpur, Malegaon, Shahbajpur
8.	Oxyopidae	
	29. *Oxyopes birmanicus* Thorell, 1887	Atsu, Babarpur, Sanpher
	30. *Oxyopes javanus* Thorell, 1887	Ajitmal, Atsu, Bighepur, Mahmudpur Paigupur, Simar
	31. *Oxyopes shweta* Tikader, 1970	Ajitmal, Beridhankar, Rahamapur
9.	Philodromidae	
	32. *Philodromus* sp.	Babarpur, Bhureypur Kalan, Haidarpur, Jagannathpur, Shahbajpur
10.	Pholcidae	
	33. *Artema atlanta* Walckenaer, 1837	Ajitmal, Bighepur, Mahmudpur Paigupur, Pachdeora
	34. *Crossopriza lyoni* (Blackwall, 1867)	Atsu, Babarpur, Bighepur
	35. *Pholcus phalangioides* (Fuessli, 1775)	Ajitmal, Atsu, Bahadurpur Uncha, Bighepur, Haidarpur, Jagannathpur, Mahmudpur Paigupur, Malegaon, Muradganj, Sanpher
11.	Salticidae	
	36. *Hasarius adansoni* (Audouin, 1826)	Ajitmal, Bahadurpur Uncha
	37. *Myrmarachne melanocephala* MacLeay, 1839	Babarpur, Beridhankar, Haidarpur, Jagannathpur, Mahmudpur Paigupur, Malegaon,
	38. *Phintella vittata* (C L Koch, 1846)	Babarpur, Bighepur, Muradganj
	39. *Plexippus paykulli* (Audouin, 1826)	Ajitmal, Beridhankar, Jagannathpur, Rahamapur
	40. *Plexippus petersi* (Karsch, 1878)	Atsu, Bahadurpur Uncha
	41. *Stenaelurillus lesserti* Reimoser, 1934	Malegaon, Muradganj, Shahbajpur
	42. *Telamonia dimidiata* (Simon, 1899)	Ajitmal, Atsu, Haidarpur, Simar
12.	Sparassidae	
	43. *Heteropoda venatoria* (Linnaeus, 1767)	Bhureypur Kalan, Jagannathpur, Malegaon, Pachdeora
13.	Tetragnathidae	
	44. *Leucauge decorata* (Blackwall, 1864	Ajitmal, Babarpur, Muradganj,
	45. *Tetragnatha javana* (Thorell, 1890)	Bahadurpur Uncha, Mahmudpur Paigupur, Malegaon, Rahamapur
	46. *Tetragnatha keyserlingi* Simon, 1890	Atsu, Babarpur, Mahmudpur Paigupur, Sanpher
	47. *Tetragnatha mandibulata* Walckenaer, 1842	Bhureypur Kalan, Muradganj
	48. *Tylorida ventralis* (Thorell, 1877)	Ajitmal, Haidarpur, Muradganj, Rahamapur
14.	Theridiidae	
	49. *Thwaitesia margaritifera* Pickard-Cambridge, 1881	Atsu, Babarpur, Jagannathpur, Shahbajpur
15.	Thomisidae	
	50. *Camaricus formosus* Thorell, 1887	Ajitmal, Beridhankar, Jagannathpur, Malegaon
	51. *Thomisus* sp.	Babarpur, Bighepur, Sanpher
16.	Uloboridae	
	52. *Uloborus* sp.	Atsu, Babarpur, Mahmudpur Paigupur, Rahamapur

Conflict of Interest

The authors declare no conflicts of interest.

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