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Journal of Threatened Taxa



10.11609/jott.2022.14.6.21127-21330

www.threatenedtaxa.org

26 June 2022 (Online & Print)

14 (6): 21127-21330

ISSN 0974-7907 (Online)

ISSN 0974-7893 (Print)

Open Access





ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

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Cover: *Euphaea pseudodispar* shot at Kalindi River, Thirunelly, Wayanad district, Kerala. © Muneer P.K.



A pioneering study on the spider fauna (Arachnida: Araneae) of Sagar District, Madhya Pradesh, India

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Abstract: The present investigations were carried out to elucidate the spider fauna of the Sagar district of Madhya Pradesh. A total of 1,505 spider specimens were documented from various sites of the study area. A total of 74 species grouped under 58 genera and 22 families are reported. The family Araneidae was the most common, accounting for 31% of the overall population followed by Salticidae, which accounted for 15% of the overall population. Spiders belonging to seven guild structures were identified which were then classified on the basis of their dietary habits. Further research is needed to analyze the behavior, biology and web patterns of these ubiquitous creatures.

Keywords: Agroforestry, Araneidae, forest habitat, guild structure, orb weavers, Salticidae, spider diversity.

मध्य प्रदेश के सागर जिले के मकड़ी के जीवों को स्पष्ट करने के लिए वर्तमान जांच की गई। अध्ययन क्षेत्र के विभिन्न स्थलों से कुल 1,505 मकड़ी के नमूनों का दस्तावेजीकरण किया गया। कुल 74 प्रजातियों को 58 पीढ़ी या जेनरा और 22 परिवारों के अंतर्गत वर्गीकृत किया गया है। परिवार अरानिडे सबसे आम था, कुल आबादी का 31% हिस्सा साल्टिसीडे के बाद था, जो कुल आबादी का 15% था। सात गिल्ड संरचनाओं से संबंधित मकड़ियों की पहचान की गई थी, जिन्हें बाद में उनकी आहार संबंधी आदतों के आधार पर वर्गीकृत किया गया था। इन सर्वव्यापी प्राणियों के व्यवहार, जीव विज्ञान और वेब पैटर्न का विश्लेषण करने के लिए और अधिक शोध की आवश्यकता है।

Editor: John T.D. Caleb, ERI, Loyola College, Chennai, India.

Date of publication: 26 June 2022 (online & print)

Citation: Sethy, T.R. & J. Ahi (2022). A pioneering study on the spider fauna (Arachnida: Araneae) of Sagar District, Madhya Pradesh, India. *Journal of Threatened Taxa* 14(6): 21227–21238. <https://doi.org/10.11609/jott.7807.14.6.21227-21238>

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Funding: None.

Competing interests: The authors declare no competing interests.

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Author contributions: TRS did majority of the collection of spiders from different study sites of Sagar district. She photographed and identified spiders in the laboratory. She prepared the manuscript and data analysis. JA helped in writing, compilation and data analysis of this paper.

Acknowledgements: TRS is thankful to the University Grants Commission, New Delhi for providing fellowship and to the head, Department of Zoology for providing laboratory facilities.

INTRODUCTION

Spiders are remarkable primitive arthropods of the class Arachnida that live in every ecosystem on the planet, from Arctic islands to dry desert regions (Foelix 2011). They are members of the order Araneae, which are commonly known as spiders. Spiders can play an essential role in managing the populations of terrestrial arthropods. Because of their small body size, quick reproduction period, and great sensitivity to temperature and moisture changes, they are good biological monitors of ecosystem changes and habitat adjustments (Napiórkowska et al. 2021). Spiders are not only ecologically significant, but also commercially beneficial (Koneri & Nangoy 2017). Spider silk and venom have become essential industrial commodities, particularly in the pharmaceutical industry. They are also beneficial in decreasing the negative effects of pesticide and insecticide overdoses (Jose et al. 2018).

British explorers began studying spiders in India in the latter half of the 19th century and taxonomists from India carried on the work (Siliwal et al. 2005). Presently, about 50,040 spider species classified into 4,250 genera and 131 families are described worldwide (WSC 2022) and India has 1,904 spider species classified under 490 genera and 60 families (Caleb & Sankaran 2022). The spider fauna of Madhya Pradesh was studied by various workers beginning from Tikader (1980, 1982a,b), Tikader & Malhotra (1980), and Gajbe (1987–2003) in which they described several species from the families Thomisidae, Philodromidae, Lycosidae, Araneidae, and Gnaphosidae. Patil et al. (2013, 2016) studied spiders from Rani Veerangana Durgawati Wildlife Sanctuary and from the Nauradehi Wildlife Sanctuary, respectively. However, there is no information available so far on the spider fauna of Sagar district in Madhya Pradesh and thus the present work was carried out.

MATERIALS AND METHODS

Study area

Sagar district is located in the north central region of Madhya Pradesh and covers an area of 10,252 km². It lies between 23.16–24.45 °N & 78.06–79.35 °E (Figure 1). The major part of the district is enclosed by the Deccan trap lava flows and Vindhayan sandstones in the eastern region (Pareta & Pareta 2013). The climate is quite harsh, with maximum temperatures of 45 °C in summer and minimum temperatures of 6 °C in winter. The annual rainfall ranges 1,050–1,100 mm. It has a total

forest area of 2,75,924.38 ha, with 1,91,607.32 ha of reserved forests and 84,317.06 ha of protected forests (ISFR 2019).

Sampling sites

Three different habitats were selected: forest (Malthone, Dhana 1 and Shahgarh range), agricultural (Patheriya Jat, Rajaua, Deori) and agroforestry (Rehli, Dhana 2, and Rahatgarh). The surveys were conducted during October 2017 to October 2021. A total of 42 quadrates with 20m x 20m dimensions were established in selected sites of the district.

Collection

Spider specimens were collected by active visual searching, vegetation beating, net sweeping, and hand picking following Sørensen et al. (2002). All surveys were conducted from 8000 h to 1200 h, with an opportunistic night time survey conducted as well. Spiders were collected and photographed with a DSLR camera (Canon

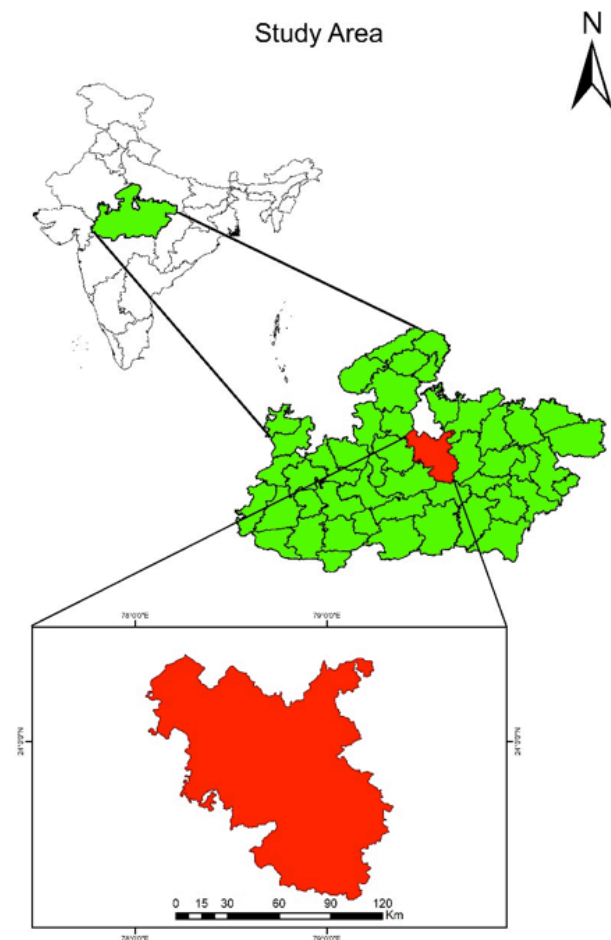


Figure 1. Map of Sagar District (Madhya Pradesh).

EOS 200D) before being put back into their natural environment. The collected specimens were preserved in 30 ml glass vials in 70% ethyl alcohol with proper labeling.

Identification

The preserved specimens were examined under a Quasmo SZB-47A stereomicroscope. Spiders were recognized to the family, genus, and species levels using existing literatures and standard taxonomic keys provided by Pocock (1900); Gravely (1921a,b, 1924, 1931); Tikader (1977, 1980, 1982a); Tikader & Malhotra (1980); Tikader & Biswas (1981); Majumder & Tikader (1991); Gajbe (2004, 2007, 2008); Caleb (2016). The spider guild categorization was based on the dietary habits and ecological traits of the respective families (Höfer & Brescovit 2001).

RESULTS

The Sagar district, Madhya Pradesh is home to a variety of spider species. During the entire study period 1,505 specimens were collected from the study area belonging to 74 species under 22 families (Table 1; Images 1–69). The number of families, genera, species, number of individuals and percentage of number of individuals in particular families are enlisted in Table 2. Araneidae was the dominant family with 19 species from nine genera, followed by Salticidae with 14 species from 13 genera. The seven different guild types include orb-web builders, sheet web weavers, space builders, stalkers, foliage hunters, ambushers, and ground runners

(Figure 2). Orb weavers (14 species) made up the most common feeding guild, accounting for 630 spider specimens (42%) of the overall population, followed by stalkers 373 spiders, 19 species (25%), space builders, 197 spiders, four species (13%), sheet web weavers, 132 spiders, one species (9%), foliage runners 95 spiders, six species (6%), ambushers 48 spiders, eight species (3%) and ground runners with 30 spiders, six species (2%) (Figure 2). During the survey, more spiders were seen in forest and agroforestry habitats than in agriculture habitat. Abundance of spiders was high in 2020 and 2021 (Figure 3).

DISCUSSION

In the present investigations 22 families have been reported from different sites of Sagar district. Gajbe (2007), Patil et al. (2013), and Patil et al. (2016) in their studies reported 24, 7, and 12 families respectively from Jabalpur and nearby places. Gajbe & Gajbe (2004) reported that most spiders which live on the ground or in plants have some form of camouflage. Some of the noteworthy examples of mimics seen in the present study are the ant-mimicking spiders of genus *Myrmaplata*, spiders of genus *Cyclosa* resembling trash, *Tetragnatha* species resembling twigs or reed tips, while *Hersilia* camouflage themselves perfectly with the surroundings. Analyzing the spider diversity patterns in Sagar district environment provides valuable information which can be used to validate the ecosystem's balance. The present study was undertaken with the objective to document the spider fauna of Sagar district and prepare the first

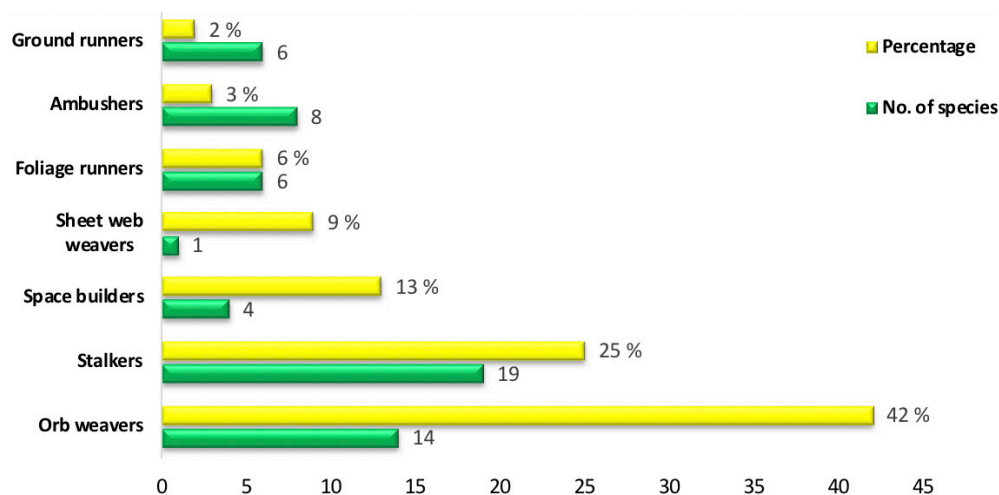


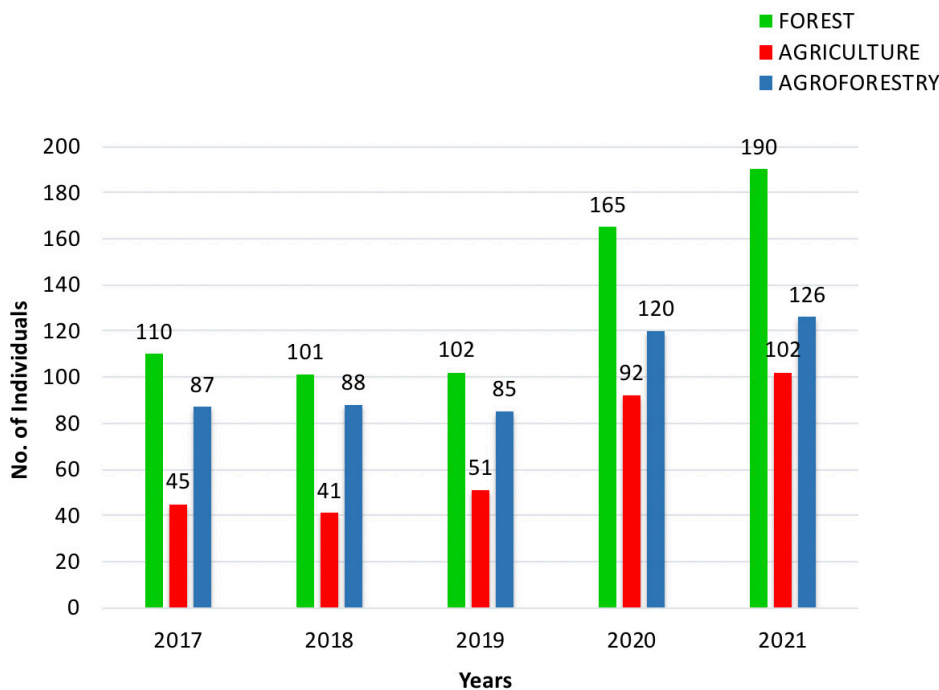
Figure 2. Guild structure and percentile distribution of guilds of spiders of Sagar district, Madhya Pradesh.

Table 1. Checklist of spiders from Sagar district, Madhya Pradesh, India.

	Scientific name	Guild
	Araneidae	
1	<i>Argiope aemula</i> (Walckenaer, 1841)	Orb weavers
2	<i>Argiope anasuja</i> Thorell, 1887	Orb weavers
3	<i>Bijoaraneus mitificus</i> (Simon, 1886)	Orb weavers
4	<i>Cyclosa bifida</i> (Doleschall, 1859)	Orb weavers
5	<i>Cyclosa hexatuberculata</i> Tikader, 1982	Orb weavers
6	<i>Cyclosa insulana</i> (Costa, 1834)	Orb weavers
7	<i>Cyrtophora cicatrosa</i> (Stoliczka, 1869)	Orb weavers
8	<i>Eriovixia excelsa</i> (Simon, 1889)	Orb weavers
9	<i>Gasteracantha kuhli</i> C. L. Koch, 1837	Orb weavers
10	<i>Gasteracantha</i> sp.	Orb weavers
11	<i>Neoscona mokerjei</i> Tikader, 1980	Orb weavers
12	<i>Neoscona nautica</i> (L. Koch, 1875)	Orb weavers
13	<i>Neoscona</i> sp. 1	Orb weavers
14	<i>Neoscona</i> sp. 2	Orb weavers
15	<i>Neoscona theisi</i> (Walckenaer, 1841)	Orb weavers
16	<i>Neoscona vigilans</i> (Blackwall, 1865)	Orb weavers
17	<i>Nephila pilipes</i> (Fabricius, 1793)	Orb weavers
18	<i>Nephila</i> sp.	Orb weavers
19	<i>Parawixia dehaani</i> (Doleschall, 1859)	Orb weavers
	Cheiracanthiidae	
20	<i>Cheiracanthium melanostomum</i> (Thorell, 1895)	Foliage runners
	Clubionidae	
21	<i>Clubiona drassodes</i> O. Pickard-Cambridge, 1874	Foliage runners
	Corinnidae	
22	<i>Castianeira</i> sp.	Foliage runners
23	<i>Castianeira zetes</i> Simon, 1897	Foliage runners
	Dictynidae	
24	<i>Nigma</i> sp.	Stalkers
	Eresidae	
25	<i>Stegodyphus sarasinorum</i> Karsch, 1892	Sheet weavers
	Gnaphosidae	
26	<i>Drassodes carinivulvus</i> Caporiacco, 1934	Ground runners
27	<i>Poecilochroa</i> sp.	Ground runners
	Hersiliidae	
28	<i>Hersilia savignyi</i> Lucas, 1836	Ambushers
	Lycosidae	
29	<i>Hippasa fabreae</i> Gajbe & Gajbe, 1999	Ground runners
30	<i>Lycosa shaktae</i> Bhandari & Gajbe, 2001	Ground runners
31	<i>Pardosa</i> sp.	Ground runners
	Oecobiidae	
32	<i>Oecobius putus</i> O. Pickard-Cambridge, 1876	Space builders
	Oxyopidae	
33	<i>Hamataliwa</i> sp.	Stalkers
34	<i>Oxyopes birmanicus</i> Thorell, 1887	Stalkers
35	<i>Oxyopes javanus</i> Thorell, 1887	Stalkers
36	<i>Oxyopes shweta</i> Tikader, 1970	Stalkers
37	<i>Peucetia viridana</i> (Stoliczka, 1869)	Stalkers
	Pisauridae	
38	<i>Perenethis venusta</i> L. Koch, 1878	Ambushers
	Philodromidae	
39	<i>Tibellus elongatus</i> Tikader, 1960	Ambushers
	Pholcidae	
40	<i>Artema atlanta</i> Walckenaer, 1837	Space builders
41	<i>Crossopriza lyoni</i> (Blackwall, 1867)	Space builders
42	<i>Pholcus phalangioides</i> (Fuesslin, 1775)	Space builders
	Prodidomidae	
43	<i>Zimiris doriae</i> Simon, 1882	Ground runners
	Salticidae	
44	<i>Carrhotus</i> sp.	Stalkers
45	<i>Epocilla</i> sp.	Stalkers
46	<i>Harmochirus</i> sp.	Stalkers
47	<i>Hasarius adansoni</i> (Audouin, 1826)	Stalkers
48	<i>Menemerus bivittatus</i> (Dufour, 1831)	Stalkers
49	<i>Myrmaplata platyleoides</i> O. Pickard-Cambridge, 1869	Stalkers
50	<i>Plexippus paykulli</i> (Audouin, 1826)	Stalkers
51	<i>Plexippus petersi</i> (Karsch, 1878)	Stalkers
52	<i>Portia</i> sp.	Stalkers
53	<i>Rhene flavicomans</i> Simon, 1902	Stalkers
54	<i>Siler semiglaucus</i> (Simon, 1901)	Stalkers
55	<i>Stenaelurillus</i> sp.	Stalkers
56	<i>Telamonia dimidiata</i> (Simon, 1899)	Stalkers
57	<i>Thyene</i> sp.	Stalkers
	Scytodidae	
58	<i>Scytodes pallida</i> Doleschall, 1859	Stalkers
	Sparassidae	
59	<i>Gnathopalystes kochi</i> (Simon, 1880)	Foliage runners
60	<i>Heteropoda venatoria</i> (Linnaeus, 1767)	Foliage runners
61	<i>Olios milleti</i> (Pocock, 1901)	Foliage runners
	Tetragnathidae	
62	<i>Guizygiella indica</i> (Tikader & Bal, 1980)	Orb weavers
63	<i>Leucauge decorata</i> (Blackwall, 1864)	Orb weavers
64	<i>Tetragnatha mandibulata</i> Walckenaer, 1841	Orb weavers
65	<i>Tetragnatha</i> sp.	Orb weavers
	Theridiidae	
66	<i>Nesticodes rufipes</i> (Lucas, 1846)	Space builders
	Thomisidae	
67	<i>Camaricus formosus</i> Thorell, 1887	Ambushers
68	<i>Henriksenia</i> sp.	Ambushers
69	<i>Indoxysticus minutus</i> (Tikader, 1960)	Ambushers
70	<i>Runcinia insecta</i> (L. Koch, 1875)	Ambushers
71	<i>Thomisus lobosus</i> Tikader, 1965	Ambushers
	Uloboridae	
72	<i>Uloborus</i> sp. 1	Orb weavers
73	<i>Uloborus</i> sp. 2	Orb weavers
74	<i>Zosis geniculata</i> (Olivier, 1789)	Orb weavers

Table 2. Diversity and abundance of spiders in Sagar district, Madhya Pradesh, India.

	Family	Number of genera	Number of species	No. of Individuals	Percentile distribution of families of spiders of Sagar district, Madhya Pradesh.
1	Araneidae	9	19	472	31
2	Cheiracanthiidae	1	1	14	1
3	Clubionidae	1	1	15	1
4	Corinnidae	1	2	11	1
5	Dictynidae	1	1	11	1
6	Eresidae	1	1	132	9
7	Gnaphosidae	2	2	9	1
8	Hersiliidae	1	1	9	1
9	Lycosidae	3	3	13	1
10	Oecobiidae	1	1	55	4
11	Oxyopidae	3	5	129	9
12	Pisauridae	1	1	8	1
13	Philodromidae	1	1	9	1
14	Pholcidae	3	3	106	7
15	Prodidomidae	1	1	8	1
16	Salticidae	13	14	220	15
17	Scytodidae	1	1	13	1
18	Sparassidae	3	3	55	4
19	Tetragnathidae	3	4	97	6
20	Theridiidae	1	1	36	2
21	Thomisidae	5	5	22	1
22	Uloboridae	2	3	61	4

**Figure 3. Abundance distribution of spiders from 2017 to 2021 of Sagar district, Madhya Pradesh.**

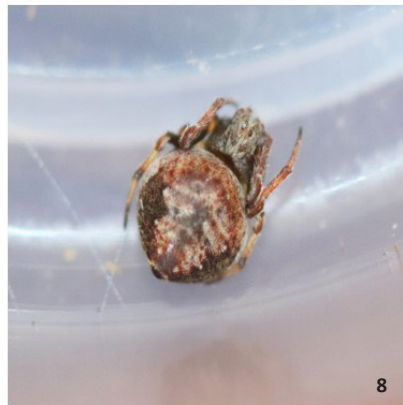


Image 1–12. Spiders of Sagar district, Madhya Pradesh: 1—*Bijoaraneus mitificus* | 2—*Argiope aemula* | 3—*Argiope anasuja* | 4—*Cyclosa bifida* | 5—*Cyclosa hexatuberculata* | 6—*Cyclosa insulana* | 7—*Cyrtophora cicatrosa* | 8—*Eriovixia excelsa* | 9—*Gasteracantha kuhli* | 10—*Neoscona mukerjei* | 11—*Neoscona nautica* | 12—*Neoscona* sp. © Tanmaya Rani Sethy.



Image 13–24. Spiders of Sagar district, Madhya Pradesh: 13—*Neoscona* sp. | 14—*Neoscona theisi* | 15—*Neoscona vigilans* | 16—*Nephila pilipes* | 17—*Parawixia dehaani* | 18—*Cheiracanthium melanostomum* | 19—*Clubiona drassodes* | 20—*Castianeira* sp. | 21—*Castianeira zetes* | 22—*Nigma* sp. | 23—*Stegodyphus sarasinorum* | 24—*Drassodes carinivulvus*. © Tanmaya Rani Sethy.



Image 25–36. Spiders of Sagar district, Madhya Pradesh: 25—*Poecilochroa* sp. | 26—*Zimiris doriae* | 27—*Hersilia savignyi* | 28—*Hippasa fabrae* | 29—*Lycosa shaktae* | 30—*Pardosa* sp. | 31—*Oecobius putus* | 32—*Hamataliwa* sp. | 33—*Oxyopes birmanicus* | 34—*Oxyopes javanus* | 35—*Oxyopes shweta* | 36—*Peucetia viridana*. © Tanmaya Rani Sethy.



Image 37–48. Spiders of Sagar district, Madhya Pradesh: 37—*Tibellus elongatus* | 38—*Artema atlanta* | 39—*Crossopriza lyoni* | 40—*Pholcus phalangioides* | 41—*Carrhotus* sp. | 42—*Epocilla* sp. | 43—*Harmochirus* sp. | 44—*Hasarius adansoni* | 45—*Thyene* sp. | 46—*Menemerus bivittatus* | 47—*Myrmaplata plateleoides* | 48—*Plexippus paykulli*. © Tanmaya Rani Sethy.

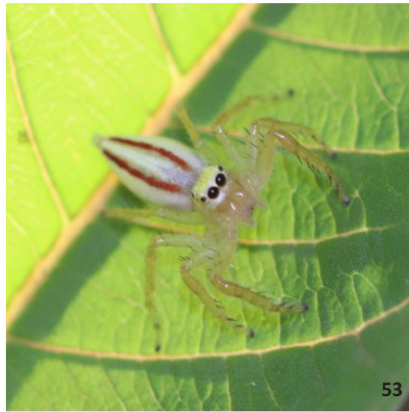


Image 49–60. Spiders of Sagar district, Madhya Pradesh: 49—*Plexippus petersi* | 50—*Rhene flavicomans* | 51—*Siler semiglaucus* | 52—*Stenaelurillus* sp. | 53—*Telamonia dimidiata* | 54—*Scytodes pallida* | 55—*Gnathopalystes kochi* | 56—*Heteropoda venatoria* | 57—*Leucauge decorata* | 58—*Tetragnatha mandibulata* | 59—*Tetragnatha* sp. | 60—*Guizygiella indica*. © Tanmaya Rani Sethy.



Image 61–69. Spiders of Sagar district, Madhya Pradesh: 61—*Nesticodes rufipes* | 62—*Camaricus formosus* | 63—*Thomisus lobosus* | 64—*Indoxysticus minutus* | 65—*Runcinia insecta* | 66—*Henriksenia* sp. | 67—*Uloborus* sp. | 68—*Uloborus* sp. | 69—*Zosis geniculata*. © Tanmaya Rani Sethy.

spider checklist of this area thus, providing a baseline data of spiders that live in the forest, agricultural and agroforest habitats. Spiders however, face risks such as habitat loss due to laterite mining, pollution, and changes in land use practices. Further research needs to be carried out to ensure efficient conservation of spiders.

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NAAS rating (India) 5.64

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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

June 2022 | Vol. 14 | No. 6 | Pages: 21127–21330

Date of Publication: 26 June 2022 (Online & Print)

DOI: 10.11609/jott.2022.14.6.21127-21330

www.threatenedtaxa.org

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– Binu Chullakattil, Pp. 21315–21317

Rediscovery of *Gardena melinarthrum* Dohrn from Sri Lanka

– Tharindu Ranasinghe & Hemant V. Ghate, Pp. 21318–21320

A report on the occurrence of the cicada *Callogaeana festiva* (Fabricius, 1803) (Insecta: Cicadidae) from Mizoram, India

– Khawlhing Marova, Fanai Malsawmdawngliana, Lal Muansanga & Hmar Tlawmte Lalremsanga, Pp. 21321–21323

New distribution records of two species of metallic ground beetles of the genus *Chlaenius* (Coleoptera: Carabidae: Chlaeniini) from the Western Ghats, India

– Duraikannu Vasanthakumar & Erich Kirschenhofer, Pp. 21324–21326

Report of *Euphaea pseudodispar* Sadasivan & Bhakare, 2021 (Insecta: Odonata) from Kerala, India

– P.K. Muneer, M. Madhavan & A. Vivek Chandran, Pp. 21327–21330

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