

**ASSESSMENT OF SPIDER ASSEMBLAGES AND THEIR RESPONSES
TO GRAZING REGULATION IN THE GREAT INDIAN BUSTARD
HABITAT OF DESERT NATIONAL PARK, RAJASTHAN**

Thesis submitted in fulfilment of the requirements for the degree of
DOCTOR OF PHILOSOPHY IN ZOOLOGY

Under the Faculty of Science
UNIVERSITY OF CALICUT

by
Tripathi Rishikesh Balkrishna

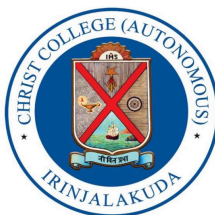


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I, **Tripathi Rishikesh Balkrishna**, hereby declare that the work embodied in the thesis titled, "*Assessment of Spider Assemblages and Their Responses to Grazing Regulation in the Great Indian Bustard Habitat of Desert National Park, Rajasthan*" submitted to the **University of Calicut** in partial fulfilment of the requirements for the award of the Degree of **Doctor of Philosophy in Zoology** is a bonafide record of the research work carried out by me under the supervision of **Dr. Usha Bhagirathan**, Assistant Professor, Department of Zoology, **Sree Kerala Varma College, Thrissur** and **Dr. Sudhikumar A. V.**, Associate Professor, Department of Zoology, **Christ College (Autonomous), Irinjalakuda**, affiliated to the University of Calicut. No part of the thesis has formed the basis for the award of any degree, diploma, or other similar title of any university. The contents of the thesis have undergone a plagiarism check using iThenticate software at C.H.M.K. Library, University of Calicut, and the similarity index was found to be within the permissible limit. I also declare that this thesis is free from AI-generated content.

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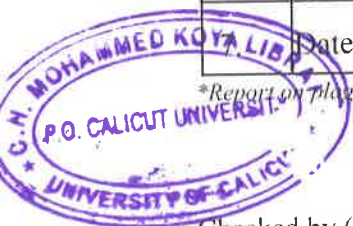
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With Love and Gratitude

*To Mummy and Papa, my constant stars,
and to the Leica M205 microscope, the silent witness of discovery.*

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CONTENTS

	Abstract	1-2
Chapter 1	Introduction.....	3-15
	1.1. Thar Desert and Desert National Park Wildlife Sanctuary: An Overview	3
	1.2. On Ground Realities: Grazing, Habitat Degradation, and Biodiversity Loss	4
	1.3. Conservation Efforts	6
	1.4. Role of Enclosures in Conservation Efforts	8
	1.5. Spiders as Bioindicators: Enhancing Ecological Studies	9
	1.6. Research Objectives	12
	1.7. Delimitations	13
	1.8. References	13
Chapter 2	Literature Review	16-28
	2.1. Spider Diversity and Ecology in Arid Ecosystems	16
	2.2. Spider study in Rajasthan and the Thar Desert	18
	2.3. Impact of Grazing on Arthropod Communities with Special Emphasis on Spiders	19
	2.4. Spiders as Bioindicators of Ecosystem Health	22
	2.5. References	22
Chapter 3	Study Area and Methodology	29-47
	3.1. Study Area	29
	3.1.1. Thar Desert	29
	3.1.2. Desert National Park Wildlife Sanctuary	29
	3.2. Geophysical and Climatic Features	30
	3.2.1. Topography and Soil	30
	3.2.2. Climate	31
	3.3. Vegetation and Wildlife	31
	3.3.1. Flora	31
	3.3.2. Fauna	32
	3.4. Methodology	34
	3.4.1. Selection of Enclosures and Outside Areas	34
	3.4.2. Pilot Study	35

3.4.3	Sampling Design	35
3.5.	Data Collection	37
3.5.1.	Species Information	37
3.5.2.	Habitat Information	37
3.5.3.	Collection Methods	38
3.6.	Digital Documentation of Live Spiders	40
3.7.	Preservation and Storage of Spiders	40
3.8.	Morphological Identification	41
3.9.	Data Analysis	43
3.9.1.	Spider Richness and Abundance Plot	43
3.9.2.	Rarefaction and Extrapolation Curves	43
3.9.3.	Pearson Correlation Matrix Analysis of Habitat Variables	44
3.9.4.	Mixed-Effects Models for Habitat Influence	44
3.9.5.	Boxplot Analysis of Species Richness in Enclosures	45
3.9.6.	Multivariate Analysis	45
3.10.	References	46
Chapter 4	Results	48-21
4.1.	Catalogue and Taxonomic Notes on the Spiders of Desert National Park	48
4.2.	Spider Diversity Across Habitats	170
4.3.	Comparison of species richness and diversity indices among habitats	171
4.4.	Evaluation of species richness using estimators	174
4.5.	Seasonal Changes in spider richness and abundance	174
4.5.1.	Spider Species Richness	174
4.5.2.	Spider Relative Abundance	176
4.6.	Ecological Drivers of Spider Assemblages	177
4.6.1.	Correlation analysis of habitat variables	177
4.6.2.	Drivers of Spider Species Richness	179
4.6.3.	Drivers of Spider Species Abundance	182
4.7.	Species richness across sites	184

4.8.	Multivariate Analysis of Spider Assemblages	185
4.8.1.	Principal Component Analysis (PCA)—inside enclosure	185
4.8.2.	Canonical Correspondence Analysis (CCA)—inside enclosure	185
4.8.3.	Principal Component Analysis (PCA)—inside-outside enclosure	187
4.8.4.	Canonical Correspondence Analysis (CCA)—inside-outside Enclosure	189
4.9.	Guild structure	192
4.9.1.	Guild Categories and Characteristics	192
4.10.	References	196
Chapter 5	Discussion.....	212-217
5.1.	Species Diversity and Community Composition	212
5.2.	Habitat Features Shaping Spider Diversity	213
5.3.	Seasonal and Environmental Influences	213
5.4.	Grazing Regulation and Spider Assemblages	214
5.5.	Implications for Conservation	215
5.6.	References	216
Chapter 6	Summary and Conclusion	218-220
Chapter 7	Recommendations	221
	Appendices.....	222-236

LIST OF FIGURES

Figure	Title	Page
3.1	Map of sampling locations within and around Desert National Park	30
3.2	Survey grids and sampling layout	37
3.3	Habitat images of study sites	39
4.1	<i>Argiope lobata</i> (Pallas, 1772)	52
4.2	<i>Larinia</i> sp. 1	54
4.3	<i>Neoscona theisi</i> (Walckenaer, 1841)	57
4.4	<i>Cheiracanthium melanostomum</i> (Thorell, 1895)	58
4.5	<i>Cithaeron praedonius</i> O. Pickard- Cambridge, 1872	60
4.6	<i>Castianeira zetes</i> Simon, 1897	62
4.7	<i>Emblyna</i> sp. 1	63
4.8	<i>Stegodyphus pacificus</i> Pocock, 1900	65
4.9	<i>Stegodyphus thar</i> sp. nov.	66
4.10	<i>Sahastata ashapuriae</i> Patel, 1978	68
4.11	<i>Berlandina bishnoi</i> sp. nov.	70
4.12	<i>Cryptodrassus ovalus</i> sp. nov.	71
4.13	<i>Megamyrmaekion caudatum</i> Reuss, 1834	75
4.14	<i>Micaria ignea</i> O. Pickard-Cambridge, 1872	77
4.15	<i>Minosiella intermedia</i> Denis, 1958	78
4.16	<i>Trichothyse jodhpurensis</i> (Gajbe, 1993)	82
4.17	<i>Hersilia sukshma</i> sp. nov.	85
4.18	<i>Draposa</i> sp. 1	86
4.19	<i>Evippa rajasthanica</i> Tikader & Malhotra, 1980	88
4.20	<i>Hippasa agelenoides</i> (Simon, 1884)	90
4.21	<i>Hogna</i> sp. 1	91
4.22	<i>Wadicosa fidelis</i> (O. Pickard-Cambridge, 1872)	93
4.23	<i>Ero</i> sp. 1	95

Figure	Title	Page
4.24	<i>Oecobius thar</i> Tripathi, Sudhikumar & Sherwood, 2023	97
4.25	<i>Uroctea thaleri</i> Rheims, Santos & van Harten, 2007	98
4.26	<i>Oxyopes orange</i>	102
4.27	<i>Peucetia viridis</i> (Blackwall, 1858)	103
4.28	<i>Palpimanus godawan</i> Tripathi & Sankaran, 2023	105
4.29	<i>Thanatus fabricii</i> (Audouin, 1826)	109
4.30	<i>Artema atlanta</i> Walckenaer, 1837	111
4.31	<i>Prodidomus bastawade</i> sp. nov.	114
4.32	<i>Aelurillus</i> sp. 1	116
4.33	<i>Aelurillus</i> sp. 2	117
4.34	<i>Afraflacilla miajlaensis</i> Tripathi, Jangid, Prajapati & Siliwal, 2022	118
4.35	<i>Bianor albobimaculatus</i> (Lucas, 1846)	119
4.36	<i>Cyrba ocellata</i> (Kroneberg, 1875)	120
4.37	<i>Heliophanus abditus</i> Wesołowska, 1986	122
4.38	<i>Iranattus rectangularis</i> Prószyński, 1992	124
4.39	<i>Langona</i> sp. 1	125
4.40	<i>Menemerus marginatus</i> (Kroneberg, 1875)	126
4.41	<i>Mogrus rajasthanensis</i> Caleb, Chatterjee, Tyagi, Kundu & Kumar, 2017	128
4.42	<i>Mogrus harappan</i> sp. nov.	129
4.43	<i>Plexippus minor</i> —Male Wesołowska & van Harten, 2010	131
4.44	<i>Plexippus minor</i> —Female Wesołowska & van Harten, 2010	132
4.45	<i>Rudakius ludhianaensis</i> (Tikader, 1974)	134
4.46	<i>Thyene imperialis</i> (Rossi, 1846)	135
4.47	<i>Scytodes</i> sp. 1	136
4.48	<i>Scytodes</i> sp. 2	137
4.49	<i>Cebrennus</i> sp. 1	140
4.50	<i>Olios kiranae</i> Sethi & Tikader, 1988	141
4.51	<i>Pseudomicrommata</i> sp. 1	143

Figure	Title	Page
4.52	<i>Tetragnatha javana</i> (Thorell, 1890)	144
4.53	<i>Tetragnatha nitens</i> (Audouin, 1826)	145
4.54	<i>Euryopsis episinoides</i> (Walckenaer, 1847)	147
4.55	<i>Latrodectus geometricus</i> C. L. Koch, 1841	148
4.56	<i>Latrodectus indicus</i> sp. nov.	150
4.57	<i>Steatoda albomaculata</i> (De Geer, 1778)	151
4.58	<i>Steatoda erigoniformis</i> (O. Pickard-Cambridge, 1872)	152
4.59	<i>Azarkina rehmani</i> gen. sp. nov.	154
4.60	<i>Bassaniodes tristrami</i> (O. Pickard-Cambridge, 1872)	155
4.61	<i>Diaea thar</i> sp. nov.	156
4.62	<i>Runcinia</i> sp. 1	157
4.63	<i>Thomisus unidentatus</i>	159
4.64	<i>Thomisus</i> sp. 1	159
4.65	<i>Tmarus</i> sp. 1	161
4.66	<i>Uloborus</i> sp. 1	162
4.67	<i>Zodarion</i> sp. 1	164
4.68	Spider diversity across habitats. Rényi profiles (left), Species richness (right)	170
4.69	Sample and coverage-based rarefaction and extrapolation curves	173
4.70	Sample completeness curves depicting coverage for rarefied and extrapolated	173
4.71	Seasonal variation in spider species richness and relative abundance	175
4.72	Seasonal trends in mean spider abundance (left) and species richness (right)	177
4.73	Pearson correlation matrix	178
4.74	Predicted species richness: inside enclosure	180
4.75	Predicted species richness: inside-outside enclosure	181
4.76	Predicted relative abundance: inside enclosure	183
4.77	Predicted relative abundance: inside-outside enclosure	184

Figure	Title	Page
4.78	Boxplot showing the distribution of log-transformed species richness inside-outside enclosures	185
4.79	Canonical Correspondence Analysis (CCA) ordination diagram: inside enclosures	188
4.80	Canonical Correspondence Analysis (CCA) ordination diagram: inside–outside enclosures	190
4.81	Scree plots of PCA for environmental variables	191
4.82	Hierarchical clustering of spider families from DNP based on UPGMA analysis using the Jaccard Index	194
4.83	Radar chart illustrating the composition of spider guilds based on relative abundance	195

LIST OF TABLES

Table	Title	Page
3.1	Selected enclosures for sampling with geographic and physical characteristics	36
4.1	Comprehensive annotated checklist of spider taxa documented in the Desert National Park Wildlife Sanctuary	165
4.2	Estimates of spider diversity across six selected habitats	174
4.3	Spider families are categorized by their respective guilds	193

ABBREVIATIONS

AER	–	Anterior Eye Row
ALE	–	Anterior Lateral Eye
AME	–	Anterior Median Eye
CCA	–	Canonical Correspondence Analysis
CI	–	Confidence interval
DNP WLS	–	Desert National Park Wildlife Sanctuary
GHC	–	Grass height in centimetres
ICC	–	Intraclass correlation coefficient
IQR	–	Interquartile range
mm	–	Millimetre
mod2, mod3, mod4	–	Mixed-effects model identifiers
PCA	–	Principal Component Analysis
PC 1-5	–	Principal components
PER	–	Posterior Eye Row
PLE	–	Posterior Lateral Eye
PLS	–	Posterior lateral spinnerets
PME	–	Posterior Median Eye
p	–	Probability value (significance level)
q = 0, 1, 2	–	Orders of Hill Numbers
R ²	–	Coefficient of determination
SD	–	Standard deviation
sp.	–	Species (when an exact species name is undetermined)
sp. nov.	–	Species nova (newly described species)
WSC	–	World Spider Catalog

ABSTRACT

Arid ecosystems such as the Thar Desert are shaped by complex interactions between biotic and abiotic factors, with livestock grazing being one of the most influential drivers. Spiders, as dominant predatory arthropods, play a critical role in structuring invertebrate communities and serve as sensitive bioindicators. This study assessed spider assemblages and their responses to grazing regulation within the Great Indian Bustard habitat of Desert National Park, Rajasthan. Field surveys were conducted across enclosures and open-access areas for grazing using standardized sampling methods, which yielded a total of 16,775 individuals representing 29 families, 80 genera, and 114 species. Lycosidae, Salticidae, and Thomisidae were the dominant families, while grasslands harbored the highest diversity, and barren habitats supported the lowest. Analyses of alpha diversity revealed significantly higher species richness and evenness within grazing enclosures, highlighting the positive role of regulated grazing in maintaining vegetation structures conducive to spider assemblages. Beta diversity, on the other hand, indicated distinct community turnover between grazed and ungrazed sites, with several habitat specialists restricted to protected enclosures. Species accumulation and coverage-based rarefaction confirmed a robust sampling effort. Several noteworthy findings emerged from this work, including the description of multiple new species such as *Stegodyphus thar*, *Latrodectus indicus*, *Afraflacilla miajlarensis*, underscoring the underestimated diversity of arid-zone spiders. Overall, the study demonstrates that moderate regulation of grazing supports higher spider diversity and assemblage stability, thereby providing critical insights for biodiversity conservation in desert ecosystems and strengthening the role of spiders as ecological indicators for assessing habitat quality in the fragile Great Indian Bustard landscape.

Keywords: Spiders, Grazing regulation, Desert ecosystems, Biodiversity conservation, Great Indian Bustard habitat

സംഗ്രഹം

ജൈവികവും അജൈവികവുമായ ഘടകങ്ങളുടെ സങ്കീർണ്ണമായ പ്രതിപ്രവർത്തനങ്ങളാൽ രൂപപ്പെട്ടവയാണ് മാർ മരുഭൂമിപോലുള്ള വരണ്ട ആവാസവ്യവസ്ഥകൾ. ഈ പ്രതിപ്രവർത്തനങ്ങളിൽ ഏറ്റവും നിർണായകസ്വാധീനം ചെലുത്തുന്ന ഒന്നാണ് കുന്നുകാലികളുടെ മേച്ചിൽ. ആർത്രോപോഡ വിഭാഗത്തിലെ പ്രബലരാണ് ഇരപിടിയന്മാരായ ചിലന്തികൾ. ഇവ അകശേരുകി ജീവസമൂഹത്തെ രൂപപ്പെടുത്തുന്നതിലും ആവാസവ്യവസ്ഥാവ്യതിയാനങ്ങളെ സൂചിപ്പിക്കുന്നതിനുള്ള ജൈവസൂചികകളായും പ്രവർത്തിക്കുന്നു. രാജസ്ഥാനിലെ മരുഭൂമി ദേശീയോദ്യാനത്തിലെ ഇന്ത്യൻ ബസ്റ്റാർഡ് പക്ഷിയുടെ ആവാസവ്യവസ്ഥയിൽ, മേച്ചിൽ നിയന്ത്രിക്കുമ്പോൾ ചിലന്തി സമൂഹങ്ങളിലുണ്ടാകുന്ന മാറ്റങ്ങളെ വിലയിരുത്തുന്നതിന് വേണ്ടിയുള്ളതാണ് ഈ പഠനം. മേച്ചിൽനിയന്ത്രിത-അനിയന്ത്രിത മേഖലകളിലെ പര്യവേഷണങ്ങളിൽ കഴിക്കേണി ഉപയോഗിച്ചും അതാത് ആവാസവ്യവസ്ഥകൾക്കനുസരിച്ചുള്ള മറ്റ് ശേഖരണ രീതികൾ അവലംബിച്ചും 29 കുടുംബങ്ങളിൽ പെടുന്ന, 80 ജനുസ്സുകളിൽനിന്നും 114 ചിലന്തി ഇനങ്ങളെ ഈ പഠനത്തിൽ കണ്ടെത്തി. ചെന്നായ്യിലന്തികൾ, ചാട്ടചിലന്തികൾ, ഞണ്ടുചിലന്തികൾ, നീളൻഞണ്ടുചിലന്തികൾ എന്നിവയാണ് എണ്ണത്തിലും വൈവിധ്യത്തിലും മുന്നിട്ടുനിൽക്കുന്ന കുടുംബങ്ങൾ. ചിലന്തിവൈവിധ്യം പൂർമേടുകൾ, കുറ്റിക്കാടുകൾ, കൃഷിയിടങ്ങൾ എന്നിവ അവരോഹണക്രമത്തിലാണ് ഈ പഠനത്തിലൂടെ രേഖപ്പെടുത്തുന്നത്. ആൽഫാ വൈവിധ്യത്തിലെ വിശകലനത്തിലൂടെ മേച്ചിൽപ്പുറങ്ങളിലെ ചിലന്തിവൈവിധ്യം മേയാത്ത സ്ഥലങ്ങളെ അപേക്ഷിച്ച് വളരെ കൂടുതലാണെന്നു കണ്ടെത്തി. ഇത് നിയന്ത്രിതമായ മേച്ചിൽ ചിലന്തിസമൂഹത്തിന് അനുകൂലമായ സസ്യഘടന നിലനിർത്തുന്നതിൽ നിർണായകമായ പങ്ക് വഹിക്കുന്നുണ്ടെന്ന് സൂചിപ്പിക്കുന്നു. വിവിധ സ്പീഷീസുകളുടെ സാന്നിധ്യം വിലയിരുത്തുന്ന സ്പീഷീസ് അക്യുമുലേഷൻ, സ്പീഷീസ് സമൃദ്ധി അളക്കുന്ന റെയർഫാക്ഷൻ വിശകലനം എന്നിവ വഴി, ശേഖരിച്ച വിവരങ്ങൾ കൃത്യവും വിശ്വസനീയവുമാണെന്ന് ഉറപ്പിച്ചു. ഈ പഠനത്തിൽ നിരവധി ശ്രദ്ധേയമായ കണ്ടെത്തലുകൾ ഉണ്ടായി. അതിൽ പ്രധാനപ്പെട്ടവ *സ്റ്റെഗോഡൈഫസ് മാർ*, *ലാറ്ററോടെക്ടസ് ഇൻഡിക്കസ്*, *അഗ്രാഹ്ലാസില്ലാ മായ്ജ്ജാറെൻസിസ്* തുടങ്ങിയ പുതിയ സ്പീഷീസുകളുടെ വിവരണം, കൂടാതെ *അസാർക്കിന* എന്ന ജനുസ്സിനെ ഇന്ത്യയിൽ ആദ്യമായി രേഖപ്പെടുത്തിയത് എന്നിവയാണ്. ഈ കണ്ടെത്തലുകൾ മരുഭൂമിപോലുള്ള വരണ്ടപ്രദേശങ്ങളിലെ ചിലന്തികളുടെ വൈവിധ്യം മുൻപ് കണക്കാക്കിയിരുന്നതിനേക്കാൾ വളരെ കൂടുതലാണെന്ന് വ്യക്തമാക്കുന്നു. അതോടൊപ്പം, ഇന്ത്യൻ ബസ്റ്റാർഡ് പക്ഷിയുടെ ആവാസകേന്ദ്രത്തിന്റെ പരിസ്ഥിതിപരമായ ഗുണനിലവാരം വിലയിരുത്തുന്നതിനുള്ള ഒരു സൂചകമായി ചിലന്തികൾക്ക് വലിയ പങ്ക് വഹിക്കാൻ സാധിക്കുമെന്നും വ്യക്തമാക്കുന്നു.

പ്രധാന വാക്കുകൾ: ചിലന്തികൾ, മേച്ചിൽനിയന്ത്രണം, മരുഭൂമി, ജൈവവൈവിധ്യസംരക്ഷണം, ഇന്ത്യൻ ബസ്റ്റാർഡ് പക്ഷിയുടെ ആവാസകേന്ദ്രം

CHAPTER 1 INTRODUCTION



Biodiversity loss represents one of the most critical environmental concerns of the 21st century, as extinctions and habitat destruction are occurring at an unprecedented rate (MEA, 2005). Over the past half-century, humans have changed these ecosystems more rapidly and extensively than in any comparable period in human history, largely to meet increasingly growing demands. Human-induced factors pose significant threats to ecosystems worldwide. Organisms uniquely adapted to specific environmental conditions are more vulnerable to climate change (IPCC, 2014); arid and semi-arid ecosystems, which have species unique to survive under extreme conditions, are the most susceptible to these forces. In India, the Thar Desert, home to the critically endangered Great Indian Bustard (*Ardeotis nigriceps*; herewith, GIB), exemplifies this issue (IUCN, 2024). Habitat degradation due to overgrazing, agricultural expansion, and infrastructure development is the main threat to this iconic species (Dutta et al., 2017; Singh et al., 2006).

1.1. Thar Desert and Desert National Park Wildlife Sanctuary: An Overview

Rajasthan is the largest state in India and marks the eastern edge of the world's vast arid and semi-arid belt. More than 50% of this state lies within the Great Indian Desert, also known as the Thar Desert, the most densely populated desert in the world, with 83 people/sq. km (Khan, Dular & Solomon, 2003). It was once known as the 'Thar Parker Desert' after a district in Sindh, Pakistan, before partition. In India, the Thar Desert extends beyond Rajasthan's borders, covering parts of Gujarat, Punjab, and Haryana. Over time, agricultural activities have transformed large parts of the desert landscape in Punjab and Haryana. Through canal irrigation, these activities are currently modifying parts of Rajasthan as well (Dutta et al., 2017).

An effort was made to protect this sensitive ecosystem by implementing measures starting from the 1980s through establishing the Desert Wildlife Sanctuary. A year later, the Rajasthan government declared it the Desert National Park (herewith, DNP) to preserve the desert's unique plants and animals. Unfortunately, that did not work out too well. In 1988, the Ministry of Environment and Forests designated the DNP as a Biosphere Reserve, aiming to preserve the desert's natural ecosystem. Today, the Desert National Park (DNP) covers 3,162 square kilometers across the Jaisalmer and Barmer districts (Sivaperuman & Rathore, 2009). Although designated as a national park and a wildlife sanctuary, it does not receive the same level of protection as other parks do. Approximately 200 square kilometers are under strict management by the Forest Department, while the rest of the area remains an open, unmanaged landscape with more than 50,000 people residing in it (Dutta & Jhala, 2014). The DNP is not a contiguous grassland but a network of separate areas identified and designated for protection after locating GIB breeding grounds, other critical desert species, and habitats essential for conservation.

1.2. On-Ground Realities: Grazing, Habitat Degradation, and Biodiversity Loss

The Thar Desert, positioned at the eastern boundary of the Sahara-Iranian desert, has witnessed dramatic environmental transitions from xeric to mesic conditions over millennia (Dutta et al., 2022). Once semi-arid and receiving more rainfall, the Thar has been largely arid for the past 250,000 years due to weakened monsoons and extensive sand deposition. Historically, this harsh climate limited human settlement, with only nomadic hunter-gatherers inhabiting the region. However, the 20th century brought transformative change with the construction of the Indira Gandhi Canal, which spurred agricultural expansion, increasing cultivated land fourfold (Dutta et al., 2018; Singh, Joshi & Singh, 1972). This shift, though economically beneficial, has

placed immense pressure on the desert's fragile ecosystem, threatening endemic species. By promoting mesic conditions, the canal system has led to the invasion of non-native plants and the loss of xerophytic flora vital to indigenous wildlife. During the colonial era, these grasslands were seen as unproductive wastelands due to policies driven by human overuse. This reclassification aimed to promote more "productive" endeavours like agriculture and renewable energy (Dutta et al., 2018). Consequently, over time these habitats underwent significant transformations, leading to the loss of crucial environments for iconic species such as the GIB and numerous other wildlife species indigenous to the Thar Desert, and the presence of non-native species is evident (Dutta et al., 2018; Dutta et al., 2022).

In the past, the cultivation in the Thar Desert was generally limited to once a year, typically coinciding with the monsoon. This approach allowed wildlife to coexist, as there were substantial gaps in cultivation, ensuring available land for both wildlife and livestock (Dutta et al., 2022). However, gradual shifts occurred as grasslands were progressively subjected to mechanized farming techniques and inorganic farming practices. These changes ultimately resulted in the decline of pastures (Rahmani, 1997). The growing reliance of livestock on these grasslands for sustenance exacerbated the situation, further contributing to the loss of vegetative cover. Compounding these issues were forestry policies, including the Desert Development program, which led to poorly planned plantations encroaching upon the grasslands. This cumulative effect culminated in a reduction of habitats critical for grassland specialists (Kher & Dutta, 2021). The consequences of these transformations have been profound. Habitats vital for the survival of specialized grassland species began to dwindle, exacerbating the challenges faced by these species.

1.3. Conservation Efforts

With numerous threats and pressures facing the GIB, various conservation efforts are underway to protect this critically endangered species. Key initiatives are highlighted below.

1. **Status of Critically Endangered:** GIB are listed as critically endangered on the IUCN Red List, suggesting that there is an immediate need for dedicated conservation action, including habitat restoration and breeding programs to save the species (IUCN, 2024). Schedule I of the Indian Wildlife Protection Act provides the highest level of protection against hunting, trade, and disturbance. Appendix I of CITES helps curb international trade in GIBs and their body parts (BirdLife International, 2024). International conservation efforts, such as those under the Convention on Migratory Species (CMS), are focused on protecting the migratory routes of GIBs and improving habitat conditions to help prevent further decline.
2. **GIB Sanctuaries:** The establishment of GIB sanctuaries, such as DNPWLS, has been an essential part of conservation efforts aimed at protecting the species (Dutta et al., 2017). Extensive surveys to assess the status, distribution, and ecology of the GIB provide vital baseline data that inform strategies for its conservation. These surveys revealed critical information that facilitated the creation of dedicated sanctuaries for the species, some of which are large protected areas, while others are smaller reserves specifically focused on key breeding sites (Dutta, Rahmani, & Jhala, 2010).
3. **Research:** GIB is on the brink of extinction, but concerted conservation efforts are offering hope. Protecting its grassland habitat, reducing fatal powerline

collisions with diverters, and increasing populations through captive breeding are critical actions undertaken. Satellite tracking helps identify key habitats, while local communities, empowered through awareness programmes and ecotourism, are becoming vital partners in conservation. Advocacy has strengthened legal protections, and recovery plans guide efforts from nest protection to predator control, all aimed at giving this remarkable bird a fighting chance (Dutta et al., 2017, 2018 & 2022).

4. **Development of Policies:** Major policies focus on habitat conservation and threat mitigation, engaging the communities. These initiatives are driven by coordinated efforts among government agencies, conservationists, and local communities. In this regard, some key policies have been established, including creating protected grasslands, where grazing is controlled to meet the needs of the livestock without destroying the habitat. Policies on bustard mortality relate to bird diverters for the undergrounding of power lines in critical habitats that can cause fatal collisions (Sumandrita, 2020; Uddin & Dutta, 2021; Dutta et al., 2022). Captive breeding programmes, supported by the National Bustard Recovery Plan, are ex-situ breeding efforts to help increase the population of the GIB (Dutta et al., 2023). Community involvement policies will reach out to the locals through education and ecotourism, making them key conservation players.
5. **Capacity Building and Outreach:** Awareness programmes are being conducted to increase understanding of the GIB's critical conservation status among local communities and stakeholders. The programmes include training of the field staff of DNP for identification and survey techniques. Briefing about conservation activities ongoing for the protection of GIB. Preparation and

distribution of outreach materials (posters, books, t-shirts & brochures) to locals. Several interactive sessions have been conducted in schools around DNP, enabling kids to have a better understanding of the significance of desert ecosystems. These programmes help to generate a feeling of responsibility and ownership over bustard habitats by engaging local communities in conservation efforts. Media campaigns through social media and documentaries, among other advertising materials, are further helping spread awareness nationally with an appeal for public policy support for the species (Dutta & Jhala, 2014; Dutta et al., 2017 & 2022).

1.4. Role of Enclosures in Conservation Efforts

Enclosures are pivotal to the conservation efforts within the DNPWLS, with the primary goals of minimizing human interference and regulating livestock grazing. These core areas are designed to provide a safe space for the GIB and other wildlife by preventing the disruption caused by human activity and livestock (Islam & Rahmani, 2011; Dutta et al., 2023). Early studies and surveys revealed that within 500 meters of GIB habitats, around 61% of recorded disturbances came from livestock, 13% from human activity, and 13% from vehicles (Jhala et al., 2020). This contrast underscores the necessity of enclosures to mitigate these pressures. Although the enclosures constitute a mere 1.01% of the total area of DNPWLS, they have become critical zones for the GIB population, with approximately 70.17% of the GIBs residing within these protected areas (Dutta et al., 2022 & 2023). The enclosures have shown a high selection rate by GIBs, indicating that they provide favorable conditions compared to the surrounding areas.

The enclosures play a vital role in vegetation recovery by restricting livestock access, which helps to reduce the damage caused by overgrazing (Fenetahun et al., 2021). This protection allows native plant species to regenerate and grow undisturbed, improving vegetation cover and creating a more suitable habitat for the GIB (Rahmani & Islam, 1997). Grazing animals in the Thar Desert goats, sheep, cattle, and camels, have a high impact on vegetation biomass. Enclosure is a highly used and effective technique for the restoration of grassland in arid and semi-arid regions (Hu et al., 2016; Suizi et al., 2019). Studies are essential for the enclosure to be properly managed and for conservation goals to be achieved. Some studies conducted in the study area were limited to estimating the effect of enclosure on bird and mammal communities (Dutta et al., 2022 & 2023). However, limited quantitative research has been conducted on the impacts of livestock grazing on arthropods in the Thar Desert, despite their recognized importance as a key dietary component for the GIB. The interaction between livestock grazing and arthropod populations remains a critical area for study, as it could have implications for the conservation of GIBs, whose diet heavily depends on these small invertebrates. Thus, this study has been conducted to investigate the response of these enclosures to invertebrates.

1.5. Spiders as Bioindicators: Enhancing Ecological Studies

Spiders are closely linked to plant diversity, making them highly sensitive to changes in vegetation structure and composition, as well as the density of plants (Hore & Uniyal, 2008; Lafage et al., 2015). Generally, the relation is positive, and as the plant heterogeneity and density increase, we can see an increase in spider diversity and abundance. But spider richness can vary with adjacent habitats, and spider assemblages also differ between managed or cultivated and natural habitats (Hore & Uniyal, 2008). They play a unique role in the animal kingdom as one of the largest

orders of predatory arthropods (Nyffeler, Olson & Symondson, 2016). Spiders primarily prey on insects like Diptera, Hemiptera, Hymenoptera, Collembola, Coleoptera, Lepidoptera, Orthoptera, and Araneae (Kajak et al., 1968; Nyffeler, 1999). Some spiders occasionally consume plant materials to complement their diet (Nyffeler et al., 2016) and may exhibit cannibalistic behavior, preying upon other spiders (Nyffeler, 1999). Spiders significantly impact terrestrial ecosystems by regulating arthropod populations, consuming an estimated 400-800 million tons of prey annually, predominantly insects (Nyffeler & Birkhofer, 2017). Some larger species even capture small vertebrates such as birds, lizards, and bats, highlighting their adaptability and ecological importance (Nyffeler & Knörnschild, 2013). This broad diet also makes spiders a key food source for many other animals, including birds, amphibians, and small mammals, emphasizing their role in supporting ecosystem food webs (Bristowe, 1941; Wise, 1993). Spiders are highly sensitive to environmental changes; controlled burning, overgrazing, mowing, fertilization, invasive plant species, soil compaction from machinery, habitat fragmentation, and climate variability all change the structure of vegetation, microhabitats, and prey abundance crucial for varied spider populations under all conditions and affect the grassland ecosystem diversity of spiders (Blandenier et al., 2003; Entling et al., 2005). Spider populations are also critical for understanding broader patterns of spatial and temporal biodiversity and serve as effective surrogates for general arthropod diversity (Cardoso, Silva & Oliveira, 2004; Hsieh, 2011). As conservation monitoring tools, spiders give information about the biological value of habitats, often more effectively than vertebrates or higher plants, making them valuable for identifying biodiversity hotspots (Jocqué & Dippenaar-Schoeman, 2006; Mittermeier et al., 1999). Spiders are an excellent indicator of biodiversity since they occupy virtually every habitat type,

from canopies to ground litter, and exhibit a wide array of hunting and foraging strategies. Such ecological diversity allows for reflecting microhabitat conditions and subtle shifts in environmental structure and resource distribution. Changes in the diversity of spiders within landscapes often parallel those of other arthropod groups and reflect broader changes in ecosystem health caused by either land use practices or other disturbances. One can track the trends of spider communities with time and find how such changes might impact ecosystem services, including pest control, pollination, and soil health. These populations serve as an effective surrogate for general arthropod diversity and provide a cost-effective means to assess and monitor biodiversity at local, regional, and global scales.

Additionally, spider webs contribute to environmental monitoring by serving as natural bio-samplers for heavy metals and airborne pollutants, reflecting air quality in their surroundings (Hose, James & Gray, 2002; Xiao-li et al., 2006; Rybak, Sówka & Zwoździak, 2012). The accumulation of pollutants in webs provides a reliable measure of air pollution levels, offering a practical tool for environmental assessments (Ayedun et al., 2013). Through their presence and behaviors, spiders give us invaluable knowledge about ecosystem integrity, both as regulators of prey populations and indicators of habitat health, essential for guiding effective conservation and environmental management strategies.

Spiders can play a significant role in assessing the effects of land-use change. Similar to birds, spider communities are highly responsive to subtle changes in habitat and are sensitive to visible alterations in vegetation structure, land-use intensity, and environmental stressors (Entling et al., 2005). Spiders exhibit various ecological traits in their hunting methods, such as ambush hunting, active hunting, and web-building, along with specific habitat specializations. This makes them excellent indicators of

habitat quality and changes in land use. Due to their sensitivity to vegetation structure and microhabitat conditions, different spider species respond differently to disturbances. Some species are tolerant of changes, while others are more sensitive, depending on the habitat's composition. For instance, some species thrive in open, disturbed areas, while others require dense, undisturbed vegetation.

The study was designed to understand the effectiveness of grazing regulation on the spider community, which was untested at DNPWLS. This study aims to determine whether habitat management focused on GIB, specifically through fencing to reduce livestock grazing, benefits the arthropod assemblages that act as the primary food source for GIB. We selected spiders to address the question due to their predatory roles and well-known ecological indicator roles. By examining this, we sought to address a broader conservation question: Does flagship-centric conservation benefit non-targeted taxa? To achieve this, we compared various community structures, including richness, abundance, and composition, both within the enclosures and in surrounding areas.

1.6. Research Objectives

- Assess the diversity, composition, and species-level identification of spiders in the Thar landscape, including the documentation of new species, if any.
- Examine the response of spider assemblages to livestock grazing regulation by comparing species diversity and abundance patterns between past and recent enclosures and between the enclosure and surrounding areas.
- Correlate spider diversity with habitat characteristics/quality.
- Guild structure and variation in different families of spiders in the Thar Desert.

1.7. Delimitations

This study represents the first comprehensive research on spiders in DNPWLS. Situated on the western border, the area hosts many species from the Saharo-Iranian desert and neighboring countries, where spider studies have been limited. As spider taxonomy is a vast and complex field, many species discovered in this study were new records, and the lack of prior research, combined with the complexities of spider identification, made it challenging to identify them at the species level. Due to the protected status of the area, night sampling was limited to pitfall traps; however, this method was less effective as desert heat quickly evaporated water from the traps, and preservatives like glycerin or ethanol could not be used to protect critically endangered and endangered wildlife. Additionally, grazing animals often drank the water from the traps, leaving many empty by the next day, so pitfall data was excluded from the results to ensure consistency across survey grids. Seasonal extremes, including winter chill, fog, and intense summer heat, also required adjustments to the survey schedule.

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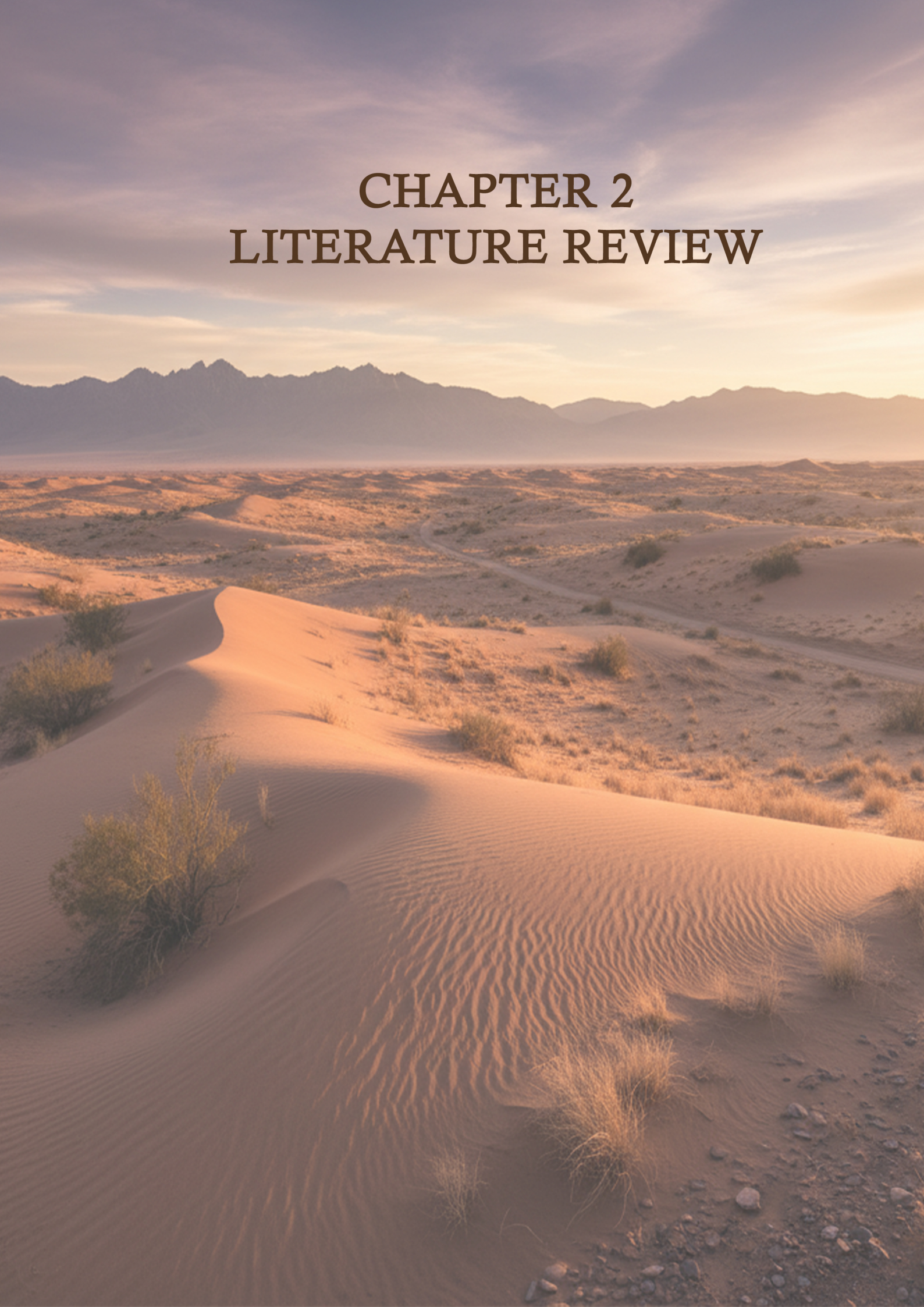
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CHAPTER 2

LITERATURE REVIEW



2.1. Spider Diversity and Ecology in Arid Ecosystems

Spiders rank among the most diverse groups of arthropods, with over 53,000 species described worldwide (World Spider Catalog, 2025). This number continues to grow almost daily or weekly when a new volume of journals is printed across the globe, thanks to the efforts of arachnologists internationally, with approximately 800–1,000 new species being described annually over the past decade. These spiders are classified into 136 families and over 4,500 genera. In India, 2000 species across 510 genera and 62 families have been documented (Caleb & Sankaran, 2025).

Spiders in arid ecosystems have evolved remarkable adaptations to withstand extreme temperatures and water scarcity across diverse habitats. Over the years, our understanding of these adaptations has significantly advanced. For instance, Zamani & Marusik (2018) and Lubin et al. (2020) identified dominant ground-active spider families in desert environments, well-suited to open sandy landscapes. A pioneering study by Moeur & Eriksen (1972) explored how *Lycosa carolinensis*, a wolf spider from the Sonoran Desert, endures extreme heat. Similarly, Riechert & Tracy (1975) highlighted how some spiders actively seek cooler microhabitats, even at higher energy expenditure, to enhance survival and prey availability.

Dr. Yael Lubin has made many contributions to the knowledge about desert spiders, especially their behavioural flexibility. In studies on *Latrodectus revivensis*, she explained how these spiders change their locations with the season and the growth stages (Lubin et al. 1991, 1993). Henschel & Lubin (1992) noted that *Seothyra henscheli* in the Namib Desert constructed smaller capture elements in wind-exposed locations compared to more sheltered areas, likely to improve web stability under harsh conditions. Similarly, Ward & Lubin (1993) found that *Stegodyphus lineatus*

preferentially built webs in dense shrubs, presumably due to increased prey availability. Extensive research has been conducted on adaptations to extreme temperatures. Lubin & Henschel (1990) demonstrated that *Seothyra* species in the Namib Desert exhibited faster prey responses when surface temperatures exceeded 49°C. Additionally, Lubin & Henschel (1996) observed that *Seothyra henscheli* adjusted foraging activities based on food availability, expending less energy when prey was abundant. Henschel (2002) reported that male *Leucorchestris arenicola* travel at night in the Namib Desert primarily to avoid extreme daytime temperatures and reduce predation risk. Darkness offers a safer environment for long-distance mate searches while minimizing exposure to visual predators, and cooler nighttime conditions aid in conserving energy during these extensive movements.

Recent studies have significantly expanded our understanding of desert spider diversity, building upon earlier pioneering works. Dr. Zamani has extensively documented the spider fauna of Iran, contributing valuable insights by reporting seven families, 56 genera, and 260 newly recorded species from the region (Zamani, 2023). Other research has further enriched this knowledge. Schubert (2020) described two *Maratus* species from Australia's desert national parks, while Bayer et al. (2017) introduced *Evippomma rechenbergi*, a newly identified lycosid species from the Moroccan desert. Pluess et al. (2008) recorded 94 spider species in Israel's semi-arid Negev Desert, highlighting dominant families. Further investigations by Pluess et al. (2010) demonstrated that non-crop habitats surrounding wheat fields in the Negev positively influence ground-active spider diversity. More recently, Lubin et al. (2020) documented an impressive 136 species of ground-dwelling spiders in the same region. These findings underscore the remarkable diversity and adaptability of desert spiders. From physiological resilience to behavioural strategies, these arachnids exhibit unique

survival mechanisms in arid environments. Their study not only deepens our understanding of species adaptation but also contributes to broader ecological insights into desert ecosystems.

2.2. Spider study in Rajasthan and the Thar Desert

Existing literature suggests that comprehensive studies on spiders in Rajasthan are lacking, despite the state's unique biogeography, which includes the ancient Aravalli mountain range and a pristine desert ecosystem. Although Dr. Tikader made significant contributions to the study of ground spiders, describing species such as *Gnaphosa jodhpurensis* and *Callilepis rajasthanicus* (Tikader & Gajbe, 1977), these taxa require revision. *G. jodhpurensis* needs redescription and is likely to be transferred to another genus, while this study confirms that *C. rajasthanicus* is a junior synonym of *Minosiella intermedia* Denis, 1958. Additionally, a brief report on *Drassodes lapidosus* feeding on termites was published, though this predation behaviour is common among spiders. Interestingly, *D. lapidosus* is not officially recorded in India (WSC, 2025). Further contributions by Tikader & Malhotra (1980) and Tikader (1982) documented spider species from various parts of Rajasthan; however, many of these taxa have since been synonymized or transferred to different genera, while others require thorough revision. Similarly, Gajbe (1993) described *Megamyrmecon jodhpurensis* from Jodhpur, which was later transferred to *Poecilochroa* (Sankaran & Caleb, 2021) and more recently reassigned to *Trichothyse*. This taxonomic update, forming part of this thesis, represents the first record of *Trichothyse* from India.

Apart from taxonomic studies, a few checklists have documented spider diversity in protected areas such as Jhalana Forest Reserve, Ranthambore National Park, the

Shekhawati Aravalli range, Keoladeo National Park, and Nahargarh Wildlife Sanctuary. However, these checklists report a limited number of species and are often published in low-impact or predatory journals (Chauhan et al., 2009; Sen et al., 2009; Saini et al., 2012; Lawania et al., 2013, 2013b; Kaur et al., 2014; Saha et al., 2015; Lawania & Trigunayat, 2015; Lawania, 2016; Kumari et al., 2016). Notable exceptions include the descriptions of two new Salticidae species by Caleb et al. (2017) and a new jumping spider species by Basumatary et al. 2020 from Ajmer, Rajasthan.

Relatively, spiders are one of the least studied invertebrate groups in the Thar Desert, and only a little knowledge regarding the diversity of spider fauna in this region is available. Despite a few scattered checklists of spiders of the Thar Desert published by regional researchers (Sivaperuman & Rathore 2004, 2009; Tripathi et al. 2020; Kashmeera & Sudhikumar 2019), no potential taxonomic attempts to study the spider fauna of the Thar Desert have been made except Tikader (1966), who described/recorded 13 spider species from the desert areas of Rajasthan and Tripathi et al. (2021), who recently recorded the jumping spider *Menemerus marginatus* (Kroneberg, 1875) from the Desert National Park and Wildlife Sanctuary. Considering the unique features of the Thar Desert, it is anticipated that the region supports diverse forms of spiders, particularly those adapted to live in xeric conditions, and thus a high level of endemism could be expected.

2.3. Impact of Grazing on Arthropod Communities with Special Emphasis on Spiders

Livestock grazing is one of the key drivers of desertification, particularly in arid regions (Okin et al., 2001; Zhao et al., 2005). For example, in Mongolia, extensive

grazing over the past two decades has led to a decline in vegetation cover, plant species richness, and biomass (Munkhzul et al., 2021). This reduction in plant heterogeneity often negatively affects arthropod diversity by decreasing available resources. Insect populations, in particular, face direct competition for food or become incidental prey (Enkhtur et al., 2021). However, some fungi groups, such as coprophilous species, benefit from grazing (van Klink et al., 2015), demonstrating the varied effects of grazing on arthropod communities.

The impact of grazing on spiders is complex and varies depending on habitat conditions. Several studies have reported negative effects. For instance, grazing and trampling have been shown to reduce spider populations (Gibson et al., 1992). However, some spider families, such as Idiopidae and Lycosidae, have been found to thrive in moderately disturbed woodlands (Abensperg-Traun et al., 1996). Abrous-Kherbouche et al. (1997) further documented that spider abundance fluctuates across different grazing and rainfall gradients in tropical and mountain grasslands.

Beyond spiders, studies have also examined the impact of grazing on other insect groups. Rambo & Faeth (1998) investigated how plant-insect communities respond to grazing, while Rivers-Moore & Samways (1996), Fabricius (1997), and Seymour (1998) highlighted both positive and negative influences of grazing on invertebrate diversity. Broader reviews of grazing impacts on African invertebrates (Woldu & Saleem, 2000) and earlier findings by Skarpe (1991) further emphasize the varied effects of grazing across different ecosystems.

Vegetation structure plays a crucial role in shaping spider assemblages, providing refuge and foraging grounds (Warui et al., 2005). However, research on this topic remains limited in India, particularly in the Thar Desert, where spider diversity and

grazing interactions are poorly understood. While some studies suggest that grazing enhances spider populations and community structure, others report negative effects (Warui et al., 2005).

Grazing has been observed to alter spider community composition, often shifting from web-building to ground-dwelling guilds as grazing pressure increases (Dennis et al., 2001). Generally, orb-web spiders tend to thrive in low to moderately grazed areas but decline in heavily grazed habitats (Macé et al., 2019; Filazzola et al., 2020; Silva & Ott, 2017; Muvengwi et al., 2018). The removal of vegetation cover due to intense grazing particularly affects orb-weaving spiders, which rely on plant structures for web-building, hunting, mating, and predator avoidance (Nogueira & Pinto-da-Rocha, 2016; Neilly et al., 2020). The loss of above-ground plant biomass can significantly reduce their survival and functional capacity in heavily grazed environments (Tälle et al., 2016; Pett & Bailey, 2019; da Silva Bomfim et al., 2021). In contrast, ground-dwelling spiders, which do not depend on vegetation for web construction, may benefit from reduced competition in grazed habitats.

Interestingly, exclusion from grazed areas can also affect grassland orb-weavers, as seen in studies by Oyarzabal & Guimarães (2021). This highlights the complexity of grazing impacts on different spider guilds and underscores the need for further research, particularly in arid landscapes such as the Indian Thar Desert. A deeper understanding of these patterns will help clarify how grazing influences spider communities at the guild level, providing insights into ecosystem management and conservation strategies.

2.4. Spiders as Bioindicators of Ecosystem Health

Spiders are excellent bioindicators because they are sensitive to habitat changes and trophic interactions (Marc et al., 1999). Churchill (1998) in Australian rangelands and Downie et al. (1999) in the UK have shown that spider assemblages reflect vegetation structure and disturbance levels. Some functional groups, such as wandering hunters (e.g., Lycosidae), do well in grazing-induced open areas, whereas web-builders tend to decline with decreasing vegetation complexity (Pearce & Venier, 2006). While these patterns have been documented globally, there is a dearth of bioindicator studies conducted in the Thar Desert.

The Thar Desert is a unique biome that supports several endemic species and serves as a critical habitat for the endangered Great Indian Bustard (*Ardeotis nigriceps*). While conservation efforts in the region primarily focus on vertebrates, invertebrates, particularly arthropods such as spiders, play a vital role in maintaining ecosystem stability by regulating insect populations. Despite their ecological significance, invertebrate conservation remains largely overlooked. Implementing grazing management strategies that balance livestock production and biodiversity conservation, as discussed by Kgosikoma et al. (2013) in African savannas, could be adapted to the Thar Desert, offering sustainable solutions for ecosystem management.

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CHAPTER 3

STUDY AREA & METHODOLOGY



3.1. Study Area

This research focuses on understanding patterns of spider diversity within desert habitats, using the Desert National Park Wildlife Sanctuary as the core study site. The primary objective of this study was to investigate the effect of grazing enclosures on spider assemblages within DNP and to understand how land-use practices influence spider diversity and community composition in desert ecosystems.

3.1.1. Thar Desert

The Thar Desert stands as one of the world's smallest deserts, yet it covers almost 9% of India's total geographical expanse. Extending from the western border of the Aravalli mountains to the Indus River in the neighboring nation of Pakistan, it represents the eastern continuation of the Sahara-Arabian desert. The only river that crosses through the Thar is the Luni, which joins the Arabian Sea through the Rann of Kutch in Gujarat. Thar is the most populated desert, inhabited by 85 persons/km² who largely stay in small villages locally called *Dhanis* and depend on pastoralism and farming for livelihoods. These features create a dynamic matrix of natural and modified habitats, making the Thar Desert a valuable setting for ecological research aimed at studying land use and landscape structure on desert biodiversity.

3.1.2. Desert National Park Wildlife Sanctuary

The Desert National Park Wildlife Sanctuary, hereto DNP WLS (referred to as DNP by locals for decades), is under the World Heritage Convention by UNESCO. Covering an expansive area of 3,162 km², it is positioned roughly between latitudes 25°46' to 26°47' North and longitudes 70°15' to 70°45' East. Notably, 1900 km² of this expanse falls within the Jaisalmer District, while the remaining 1262 km² lies in

the Barmer District. DNP WLS serves as a critical refuge for the critically endangered Great Indian Bustard (*Ardeotis nigriceps*). In fact, the park's establishment primarily focuses on preserving the habitat of this majestic ground-nesting bird, along with two vulnerable Gyps vulture species.

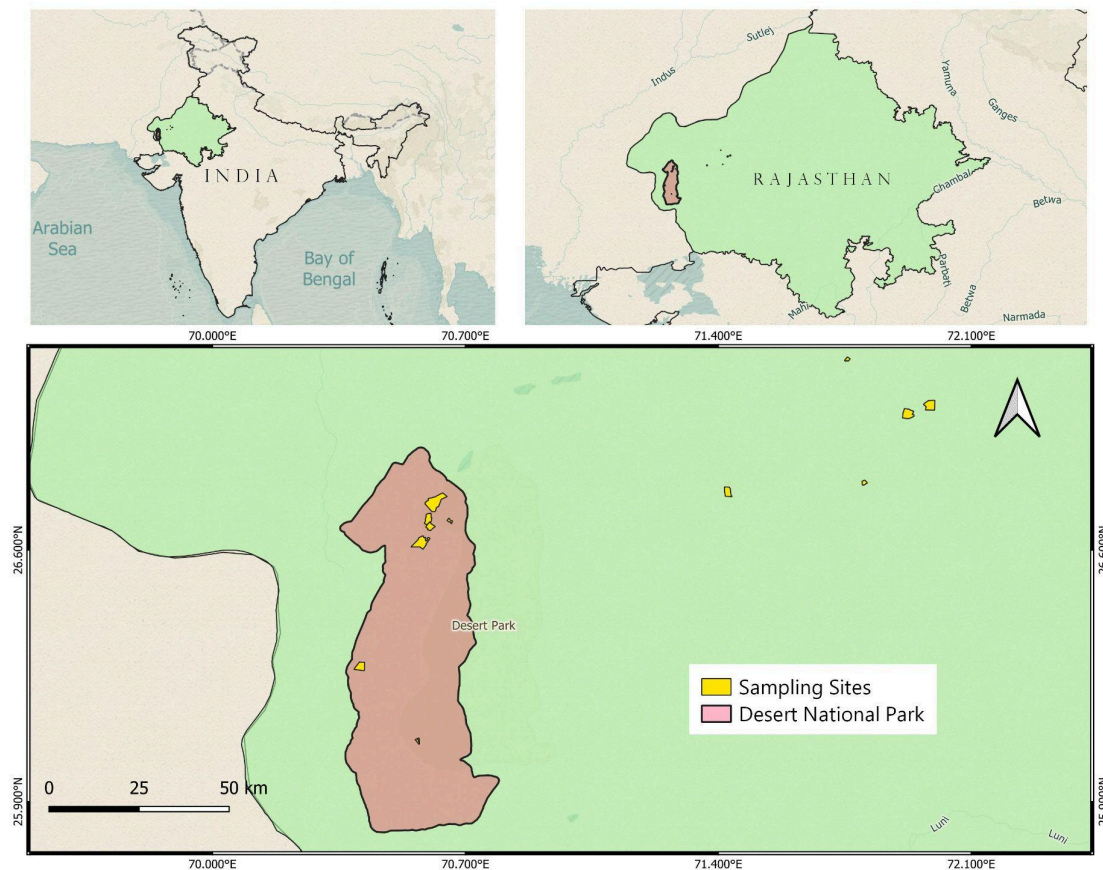


Figure 3.1. Study site map showing the location of sampling sites within and around Desert National Park, situated in western Rajasthan, India.

3.2. Geophysical and Climatic Features

3.2.1. Topography and Soil

The landscape of the Thar Desert is characterized by vast sand dunes (locally referred to as *Dhora*), interspersed with rocky outcrops (*Magra*), gravel plains, and saline lakes. These dunes, which cover nearly 60% of the desert area, are mainly stabilized

by vegetation, but some are mobile due to wind action. The soils are sandy to sandy loam with low organic content, making them less fertile.

3.2.2. Climate

The region falls within the Desert Biogeographic Zone, as Rodgers et al. (2002) identified, with arid conditions in Jaisalmer and Bikaner. Rainfall is both scarce and irregular, with mean annual amounts ranging from 100 to 500 mm, progressively decreasing from east to west, as documented by Pandeya et al. (1977). The climate is characterized by exceedingly hot summers, with temperatures reaching up to 50°C, followed by relatively cold winters with temperatures dropping below 0°C. Dust storms (*Aandhi*) are quite frequent in summer and may be as strong as 136 km/hr. This climatic pattern contributes to a wide diurnal temperature range, as Sikka (1997) highlighted, with temperatures fluctuating significantly between day and night due to the region's dry conditions and clear skies that allow for rapid heat loss after sunset.

3.3. Vegetation and Wildlife

3.3.1. Flora

Due to the extreme climatic conditions characterized by high temperatures and low rainfall, evaporation occurs rapidly, resulting in numerous xerophytic plants in Thar. Native plant species have special root systems or unique leaf characteristics that allow plants to withstand extreme conditions. Some plants have smaller leaves, such as *Acacia senegal*, *Zizyphus mauritina*, and *Commiphora wightii*, to reduce water loss. Some plants have hairs or a wax coating on the leaves' surface to reflect light, which can be seen in *Caliotropis procera*. Thorr (*Euphorbia caducifolia*) is the most prevalent cactus species in the Thar Desert, growing in dense clumps and providing

shade to various animal species. Species such as the Khejri tree (*Prosopis cineraria*), the state tree of Rajasthan, and the Khair shrub (*Capparis decidua*) have deep root systems that tap into groundwater. In times of drought, the Khejri tree provides vital food, shelter, and shade, supporting both wildlife and local communities.

There is a close relationship between habitat and vegetation. Dunes and interdunal areas are dominated by *Acacia senegal*, *Prosopis cineraria*, and *Calligonum polygonoides*, which are the commonly found trees in this habitat. Other plants include *Aerva javanica*, *Citrullus colocynthis*, *Crotalaria burhia*, *Dipterygium glaucum*, *Farsetia hamiltonii*, and *Indigofera argentea*. Grasslands and savannahs are mainly dominated by the grass *Lasiurus scindicus* and the tree *Capparis decidua*. Common plants on gravelly or rocky plains include *Cleome vahliana*, *C. gracilis*, *Fagonia indica*, and *Dactyloctenium aristatum*.

In disturbed areas, such as croplands and overgrazed regions, invasive species like *Aerva javanica* and the weedy *Dipterygium glaucum* dominate. Forest plantations by DDNP typically include *Acacia tortilis* and *Tecomella undulata*. *Prosopis juliflora*, commonly planted as a firewood tree, is observed around villages but has not invaded other parts of the desert.

3.3.2. Fauna

The Thar Desert is home to several iconic species, with the critically endangered Great Indian Bustard (*Ardeotis nigriceps*) being the flagship species of the landscape. Historically, this majestic bird was found across 11 Indian states and even parts of Pakistan, but today, over 90% of its population is concentrated in the grasslands of Jaisalmer district. The region also supports a variety of raptors, including the critically endangered red-headed vulture (*Sarcorampus calvus*), white-rumped vulture (*Gyps*

bengalensis), and Indian vulture (*Gyps indicus*). In addition, the Thar is home to notable mammal species such as the Nilgai (*Boselaphus tragocamelus*), Indian Hare (*Lepus nigricollis*), Hedgehog (*Paraechinus aethiopicus*), Chinkara (*Gazella bennettii*), Bengal Desert Fox (*Vulpes bengalensis*), Indian Desert Cat (*Felis lybica ornata*), and a variety of reptiles, including the Spiny-tailed Lizard (*Saara hardwickii*), Desert Monitor Lizard (*Varanus griseus*), Fringe-toed Lizard (*Acanthodactylus cantoris*), Saw-scaled Viper (*Echis carinatus*), Indian Cobra (*Naja naja*), and Persian Dwarf Gecko (*Microgecko persicus*).

The Thar Desert hosts a rich diversity of insect species that are integral to its arid ecosystem. Beetles, including dung beetles (*Scarabaeus sacer*) and darkling beetles (Tenebrionidae), play vital roles in nutrient recycling and decomposition, helping to break down organic matter. Desert locusts (*Schistocerca gregaria*) and grasshoppers act as primary consumers, feeding on vegetation and serving as a food source for other animals. Harvester ants (*Messor* sp.) influence seed dynamics, while butterflies like the plain tiger (*Danaus chrysippus*) and moths such as the hummingbird moth (*Macroglossum stellatarum*) contribute to pollination. Desert termites (*Odontotermes* sp.) enhance soil fertility by breaking down plant material, enriching the soil for future plant growth. True bugs, along with dragonflies and damselflies like the scarlet skimmer (*Crocothemis servilia*), thrive near temporary water sources, where they contribute to the local food web. Pollinators such as carpenter bees (*Xylocopa* species) and hoverflies (Syrphidae) are crucial for sustaining desert flora. In addition, sand flies (*Phlebotomus* sp.) and predators like paper wasps (*Polistes* sp.) exemplify the adaptability of insects to the extreme desert environment. These species play essential roles in nutrient cycling, pollination, and maintaining the structure of the desert food web.

3.4. Methodology

This study aimed to assess the impact of grazing regulation, implemented for the conservation of the GIB, on non-target taxa, particularly spiders. Since arthropods form a significant part of the GIB's diet, understanding the dynamics of arthropod populations was crucial for species conservation. To reduce grazing pressure in specific areas, chain-link fencing was used to create enclosures, but the effects of this intervention on spider populations have been tested in this study. This study sought to fill this gap by evaluating how these enclosures influenced spider diversity and abundance, as spiders are important predators of other arthropods indirectly an ecological indicator. By studying spiders, the researchers can indirectly assess the presence or absence of other arthropod species.

3.4.1. Selection of Enclosures and Outside Areas

Eleven enclosures within the Desert National Park Wildlife Sanctuary (DNP WLS) were selected based on two main criteria: enclosure size (including both large and small enclosures) and the year of fencing construction. This stratified selection allowed for examination of whether enclosure size affected spider community composition, hypothesizing that larger enclosures might support higher spider diversity due to greater habitat availability. Additionally, both newly constructed and older enclosures were included to assess whether the duration of grazing exclusion influenced spider assemblages, with the expectation that older enclosures might provide more stable habitats conducive to spider colonization. Extensive ground-truthing was conducted to map the enclosures precisely. Detailed data, including year of creation, reconstruction history, current condition, area, and precise geographic coordinates, were recorded for each site. These data were essential for

analyzing the effects of temporal and spatial differences among enclosures on spider populations.

3.4.2. Pilot Study

A pilot survey was conducted in the Gajaimata enclosure and its surrounding areas in March 2018 to assess the suitability of selected survey methods. Certain sampling techniques were changed due to the unique habitat of the arid ecosystem, since several common sampling techniques could not be effectively applied in many areas. For example, bush beating was ineffective in regions with short grass, and pitfall traps were unsuitable for rocky areas. Sweeping in barren areas also proved to be unproductive. Consequently, a combination of techniques was used, with visual sampling employed across all habitat types. The survey grid size and the number of sampling points per grid were determined following this reconnaissance phase, with adjustments made to ensure the feasibility of completing the survey across all enclosures before the end of the season.

3.4.3. Sampling Design

The selected enclosures were surveyed by a team of three researchers over three distinct seasons—Summer, Winter, and Monsoon from 2020 to 2022. Sampling was carried out during the morning hours (6 a.m. to 10 a.m.) and evening hours (4 p.m. to 7 p.m.), with timing adjusted to accommodate environmental conditions. Early morning samplings were avoided in winter due to cold and mist, while in summer, sampling was shifted to the cooler hours to avoid the intense afternoon heat.

Sr. no.	Name	Latitude	Longitude	Area (ha)	Year Constructed
1	Sudasri_ACD	26.73744	70.61618	1515	1980
2	Gajaimata	26.68631	70.59709	485	2013
3	Chauhani PPC	26.66566	70.60347	100	2015
4	Chauhani TFC	26.62095	70.57568	400	2011
5	Ramdeora ABC	27.00321	71.98412	883	1987
6	Ramdeora RKVY	26.97958	71.92599	675	2013
7	Miajlar_A	26.27714	70.40639	500	1981
8	Loharki	27.13078	71.75722	100	2015
9	Sipla	26.68081	70.65657	100	2015
10	Guddi	26.78727	71.80534	150	2013
11	Manihari_AB	26.06966	70.5704	120	1983
12	Rasla_A	26.75303	71.43368	500	1988

Table 3.1: Selected enclosures for sampling with geographic and physical characteristics

The study area, comprising selected enclosures and adjacent outside areas, was divided into 0.25 square kilometer grids. Enclosures smaller than 2 sq. km were sampled up to four grids, while larger enclosures had up to eight grids sampled. Sampling effort was standardized between the enclosure and outside areas to ensure comparability. Within each grid, spiders were sampled at five points arranged along a diagonal transect, with a spacing of 100 meters between points. Each sampling point encompassed an area of 78.5 square meters (5 m radius), within which five pitfall traps were placed at a distance of 3 meters from the center, resulting in 25 pitfall traps per grid.

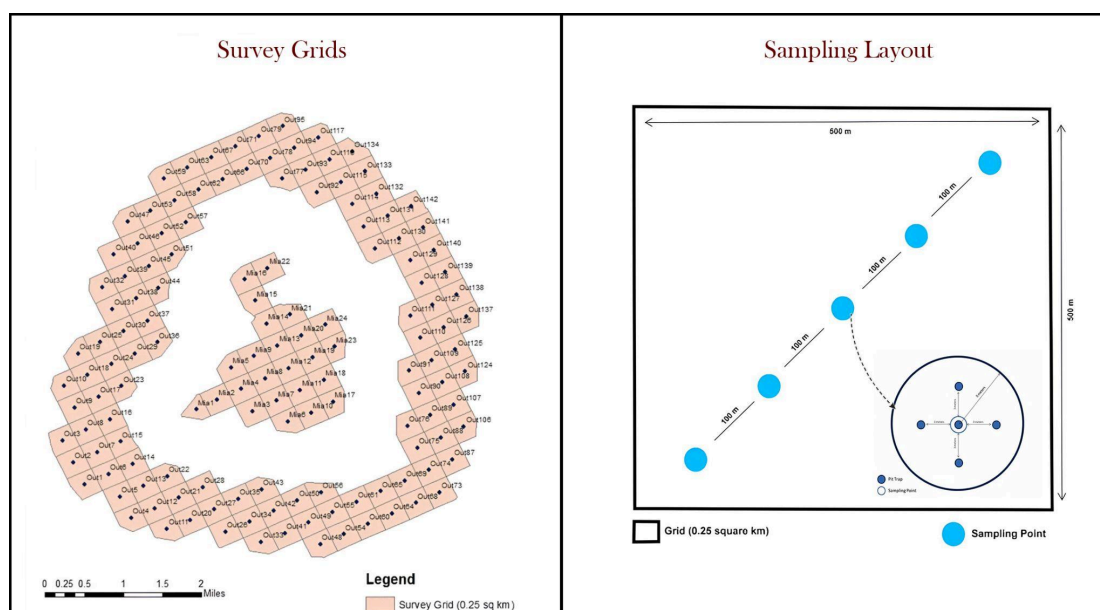


Figure 3.2. Survey grids within and outside the enclosure (left), with a representative grid showing the spatial arrangement of five sampling points in blue (right).

3.5. Data Collection

3.5.1. Species Information

During field observations, spider data were recorded, including family, genus, and species identification. When field identification was inconclusive, specimens were collected and transported to the laboratory for detailed taxonomic examination. Associated metadata, such as GPS coordinates, Enclosure ID, Grid ID, observer name, and date and time of observation, were documented for each record.

3.5.2. Habitat Information

Habitat variables were recorded at each of the five sampling points within each grid, within a 20 m radius (Fig. 3.2). Key habitat characteristics included dominant land-cover type (categorized as barren, agriculture, grassland, shrubland, or woodland), terrain type (flat or undulating), and substrate type (rock, gravel, sand, or soil). Vegetation structure was quantified by estimating ground cover percentage and

vegetation height, categorized into nine intervals ranging from 0 to 200 cm (Appendix 7.16). Additional enclosure conditions, such as fence integrity (intact or broken) and the presence or absence of cattle, were also noted, as these factors potentially influence spider assemblages.

3.5.3. Collection Methods

Collection methods were tailored to the arid landscape and varied microhabitats of the study area, with visual searching deployed uniformly across all sites to ensure comprehensive sampling of spider diversity.

Visual searching. Spiders were meticulously searched within their natural habitats using a direct observation method. This involved scanning various microhabitats such as beneath rocks, within leaf litter, and in burrows, depending on the habitat type. This approach allowed for a thorough and representative survey of spider diversity across different niches, ensuring both cryptic and active species were included in the findings.

Beating. For woody plants and large shrubs, a white sheet was placed beneath the branches, which were then gently shaken. Any spiders dislodged from the branches fell onto the sheet and were collected. This method was particularly effective for detecting camouflaged spiders, such as *Tmarus* species and many more, which are otherwise challenging to locate.



Figure 3.3. Habitat images of study sites: **A.** Desert National Park signboard, **B.** fenced enclosure and outside, **C.** protected enclosure with livestock, **D.** sand dune, **E.** scrubland, **F.** enclosure with seasonal vegetation after rainfall, and **G.** same, in winter.

Sweep net. In grassland and shrubland habitats, a sweep net was employed by performing 10 back-and-forth movements through the vegetation. Any spiders caught in the net were carefully collected for further analysis.

Litter shifting. In the desert, where open spaces dominate, litter provides a temporary refuge for spiders. As the litter was carefully moved or shifted, spiders would often emerge and run toward the open space, making them easier to locate and collect. This behaviour facilitated their observation and collection during the survey.

Pitfall trap. A plastic cup was used as a pitfall trap, filled with pre-prepared detergent water. The cup, with a depth of ~10 cm, was placed into the ground so that its rim was level with the surface. After 24 hours, the trapped specimens were collected. If the pitfall trap remained in place for more than a day, it would either dry up due to the heat of the desert or be consumed by livestock.

3.6. Digital Documentation of Live Spiders

Digital photographs of live spiders were captured using a Canon EOS 5D Mark III camera or a Canon 70D, paired with a Canon EF 100mm f/2.8 Macro USM lens. The resulting images were processed using Adobe Photoshop for further refinement and detail enhancement. Images were taken on the field or at base camp under controlled conditions.

3.7. Preservation and Storage of Spiders

Collected spider specimens were immediately transferred into vials labeled with the enclosure name, grid ID, and specific sampling point, with each specimen assigned a unique identification code (e.g., "Sudasri-275-3"). After returning to base camp, spiders were euthanized and preserved in 70% ethyl alcohol—most in 2 ml tubes,

suitable for the small size of desert-dwelling species, with larger individuals (e.g., Sparassidae, Araneidae) stored in 20 ml vials. Specimen labels, printed on archival-safe materials, were affixed inside each vial. All vials were organized in cryoboxes, grouped by enclosure and season. To minimize unnecessary specimen collection and promote conservation ethics, obviously repeated morphospecies were released after field data recording. This systematic protocol ensured thorough documentation and efficient long-term specimen management.

3.8. Morphological Identification

As the first formal taxonomic survey of spiders in the Desert National Park Wildlife Sanctuary (DNPWLS), the study relied heavily on comparative literature from adjacent Saharo-Arabian desert regions, especially Iran, given shared genera and habitat types. Most identification references were obtained via the World Spider Catalog (2025). Detailed morphological examinations were performed using a Leica M205 C stereomicroscope, while wet specimens were imaged with a Leica DMC4500 digital camera controlled through Leica Application Suite (LAS) v4.3.0 for microphotography. All measurements were recorded in millimeters.

Female genitalia were dissected and cleared with 10% potassium hydroxide (KOH) solution for detailed examination. Collected and identified material has been deposited primarily at the National Centre for Biological Sciences (NCBS), Bangalore, with additional samples sent to ZSI-WRC and ZSI-WGRC collections. Undescribed taxa and certain voucher material remain temporarily in the author's reference collection.

A comprehensive, illustrated catalogue of all recorded spider species, including family, genus, and species-level descriptions and live photographs, was prepared to

support ongoing and future biodiversity and ecological research in the region. Each species was categorized as common, uncommon, or rare based on field abundance and was annotated with observations on natural history and habitat associations.



Figure 3.4. Field surveys and sampling in the Thar Desert: A. Vegetation beating for spider collection, B. Visual searching for spiders in a sand dune habitat, C. Same, grassland habitat, and D. Specimen sorting and preservation from pitfall trap collections.

3.9. Data analysis

All data analyses were conducted using a combination of R (version 4.4.2, including RStudio) and PAST software. Data wrangling and statistical analyses used the R packages dplyr 1.1.4 (Wickham et al., 2023), ggplot2 3.5.2 (Wickham et al., 2023), lme4 1.1.37 (Bates et al., 2025), nlme 3.1.368 (Pinheiro et al., 2025), and AICcmodavg 2.3.4 (Mazerolle, 2025). These tools facilitated efficient data management, visualization, and advanced statistical modeling for ecological datasets.

3.9.1. Spider Richness and Abundance Plot

Species richness and relative abundance were summarised as mean $\pm$ standard deviation for each enclosure and season (winter, summer, monsoon). Standard errors were calculated for combined seasonal comparisons. Data visualisation was performed in R using the packages ggplot2, dplyr, and readxl. Separate plots were generated for each season, and merged seasonal plots compared sites inside and outside enclosures. Error bars indicated ± 1 standard error for merged datasets and ± 1 standard deviation for seasonal representations. This approach quantifies temporal and spatial variation in spider communities.

3.9.2 Rarefaction and Extrapolation Curves

Rarefaction and extrapolation analyses of species richness were performed using the iNEXT R package to generate sample-size-based and coverage-based curves. These curves estimated species richness (using Chao1), as well as Shannon and Simpson diversity indices, allowing for standardized comparisons between sample sets of varying size and completeness. Confidence intervals (95%) were constructed using 300 bootstrap replications, per the methods described in Chao, Gotelli, et al. (2014)

and Hsieh et al. (2020). This enabled robust quantification and comparison of spider diversity across habitats and treatments by accounting for unequal sampling effort.

3.9.3. Pearson Correlation Matrix Analysis of Habitat Variables

Prior to model fitting, Pearson correlation analysis was conducted to assess potential multicollinearity among habitat variables. Multicollinearity ($|r| \geq 0.7$) can inflate estimates of variance and undermine statistical inference, necessitating identification and management of strongly correlated predictors. Pairwise Pearson correlation coefficients were calculated for all continuous habitat variables, separately for inside and outside enclosure datasets. These included barren ground, ground vegetation, bush cover, large bush cover, tree cover, and (where applicable) age and area of enclosures. Correlation coefficients ranging from -1 to $+1$ were interpreted, with thresholds guiding variable selection for model inclusion. Results were visualized as correlation matrices wherein color and circle size reflected correlation magnitude and direction, facilitating rapid identification of highly correlated predictor pairs and guiding selection of variables for robust, non-redundant models.

3.9.4. Mixed-Effects Models for Habitat Influence

Categorical variables, such as enclosure ID, landcover, terrain, substrate, season, and enclosure status (inside/outside), were coded as factors. Continuous predictors, including barren cover, ground vegetation, bush, large bush, tree cover, age, and area, were treated as numerics. The primary response variable, species richness, was log-transformed $\log(\text{richness}+1)$ to ensure normality and stabilize variance. Linear mixed-effects models (LMMs) and generalized linear mixed-effects models (GLMMs) were fitted (lme4 package), with “enclosure” as a random intercept to account for repeat sampling within units and non-independence. Candidate model

sets were constructed by varying combinations of predictors, and model selection was guided by the lowest Akaike Information Criterion (AIC). Model fit was evaluated via marginal and conditional R², and partial effects of predictors were extracted and visualized using *ggeffects* and *ggplot2*. Pairwise Pearson correlations (*corrplot* package) supported variance inflation diagnostics, and random effect variance was interpreted for enclosure-level patterns.

3.9.5. Boxplot Analysis of Species Richness in Enclosures

To compare spider species richness between inside and outside enclosures, sampling sites were categorized accordingly, and their corresponding richness values were compiled. The distribution and central tendency of species richness for each group were visualized using boxplots, generated in [Past 4.03] with notched boxes to facilitate visual assessment of potential differences in median values. This visual approach enabled a clear comparison of the variation and typical richness values for sites situated inside versus outside enclosures.

3.9.6. Multivariate Analysis

To reduce dataset dimensionality and identify salient gradients in the habitat variables, Principal Component Analysis (PCA) was performed on the standardized dataset of 22 variables. For the inside-enclosure subset, the first two principal components (PC1 and PC2, together explaining >99% of the variance) were used to identify the six variables with the greatest positive/negative loadings (Barren, Grassland, Scrubland, Soil, GHC3, Area) and include them as focal predictors (Jolliffe, 2002). For the combined inside–outside analysis, the first five PCs were retained (cumulative variance $\approx 70\%$), capturing dominant environmental gradients. The ten most informative variables from these axes, outside enclosure, inside

enclosure, Agriculture, Barren, Grassland, Scrubland, and GHC 0, 5, 7, and 8, were used in subsequent modeling. This approach ensured that only ecologically meaningful and statistically independent factors were retained for analysis, enhancing interpretability and reducing the risk of overfitting (Manly, 2005).

3.10. Reference

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CHAPTER 4

RESULTS



The survey in Desert National Park Wildlife Sanctuary documented a rich and diverse assemblage of spiders, including several species reported for the first time from India. In total, 29 families, 80 genera, and 114 species were recorded, of which more than 25 represent new species. Many of the recorded genera are endemic and have not been reported from any other state in India.

The study highlights the remarkable spider diversity of the Thar Desert, emphasizing its role as an important reservoir of arid-zone biodiversity. The documentation includes the first Indian records of the genus *Cebrennus* (Sparassidae), a dune-adapted spider, and *Irannatus* (Salticidae), whose female is described for the first time. The species *Olios kiranae* is resurrected and newly reported from Rajasthan, while *Stegodyphus pacificus* exhibits matriphagy for the first time in India.

Several additional records significantly extend known species ranges, including *Micaria ignea*, *Evippa fortis*, *Peucetia viridis*, and *Thanatus fabricii*. Multiple new taxa, such as *Stegodyphus thar*, *Palpimanus godawan*, *Mogrus harappan*, *Latrodectus indicus*, and more, further expand the country's described spider fauna.

A concise summary of these findings, including new records, rediscoveries, and notable observations, is presented in **Table 4.1**. This checklist serves as a baseline reference for future taxonomic, ecological, and conservation work on desert-dwelling spiders of India.

A detailed catalogue of families, genera, and species, along with distributional notes, abundance data, and live images, is provided in **Section 4.1**.

4.1. Catalogue and Taxonomic Notes on the Spiders of Desert National Park

FAMILY AGELENIDAE C. L. Koch, 1837

Funnel-web spiders

Agelenidae is a large, diverse spider family comprising 1,456 species across 98 genera worldwide (WSC, 2025). These spiders are renowned for their distinctive web structure, which is a flat, slightly concave sheet web with a funnel-shaped retreat. The family is particularly well-studied in the Palaearctic region, but its diversity in other parts of the world remains relatively underexplored. In India, only 14 species of Agelenidae have been documented, many of which require taxonomic revision due to old descriptions and the lack of detailed diagnostic images.

Type genus. *Agelena*, Walckenaer, 1805.

***BENOITIA* Lehtinen, 1967**

Benoitia species are distinct among agelenids due to the unique male palpal structure, featuring a turbinate conductor and an apical membranous lamella, as well as the paired openings of the females' epigyna. The genus, comprising ten species globally, is newly recorded from India.

Type species. *Agelena bornemiszai* Caporiacco, 1947.

***Benoitia* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. *Benoitia* is found on shrubs and low plants on gravel plains and stony deserts but not on dunes. Not much is known, as it has only been seen a few times.

Remark. This study marks the first record of the genus in India.

FAMILY ARANEIDAE Clerck, 1757

Orb-web spiders

Araneidae, commonly known as orb-weaver spiders, are small to medium-sized arachnids characterized by a generally flat carapace and eight eyes arranged in two rows, with widely spaced lateral eyes. Many genera exhibit sexual dimorphism, with males being significantly smaller than females. Their colouration varies widely: diurnal species are often brightly coloured, while nocturnal ones tend to be in shades of grayish-brown to brown. The defining feature of this family is their intricate orb-shaped web, constructed with concentric circles and radial spokes. Certain species, such as *Argiope*, often include a stabilimentum an enigmatic zigzag silk pattern.

Type genus. *Araneus* Clerck, 1757.

***ARGIOPE* Audouin, 1826**

Argiope are large, conspicuously coloured, diurnal spiders that usually hang upside down in the center of a nearly vertical web. Many have striking yellow and deep-brown markings or shiny silvery colours reflecting the sunlight. The large orb web, built in tall grass or suspended among shrubs in the open, may be crossed by a zig-zag of broad silken ribbons, known as stabilimentum. *Argiope* females are the largest orb-weavers in the entire region of the Thar desert. The genus is represented by 89 species globally and 10 species currently known from India.

Type species. *Argiope lobata* (Pallas, 1772).

Argiope lobata (Pallas, 1772)

Aranea lobata Pallas, 1772: 46, plate III, figs 14–15 (♀).

Aranea lobata Fabricius, 1781: 536.

Aranea argentea Gmelin, 1789: 2954.

(For the complete list of references, see WSC, 2025).

Distribution. Southern Europe to Central Asia and China, northern Africa, Tanzania, South Africa, Israel, Pakistan, India, from Myanmar to New Caledonia and northern Australia (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. During the monsoon, they are commonly seen building webs between grass twigs. Their primary prey includes bees, odonates, and grasshoppers, which are tightly wrapped in thick bands of silk, turned over and over by their long legs, bitten, and wrapped again. The prey is then seized and transported to the web's hub for feeding. Occasionally, multiple insects may become ensnared simultaneously, prompting the spider to dart between them, wrapping each one. These may be left at the capture site and later pulled to the center. Feeding occurs both day and night, with dry carcasses often dropped below, sometimes still covered in remnants of silk wrappings. Females consuming substantial prey develop visibly distended opisthosomas. During mating, several males gather around the web. Despite their considerable size, *Argiope* species are annual, with adult females living for only a few months.

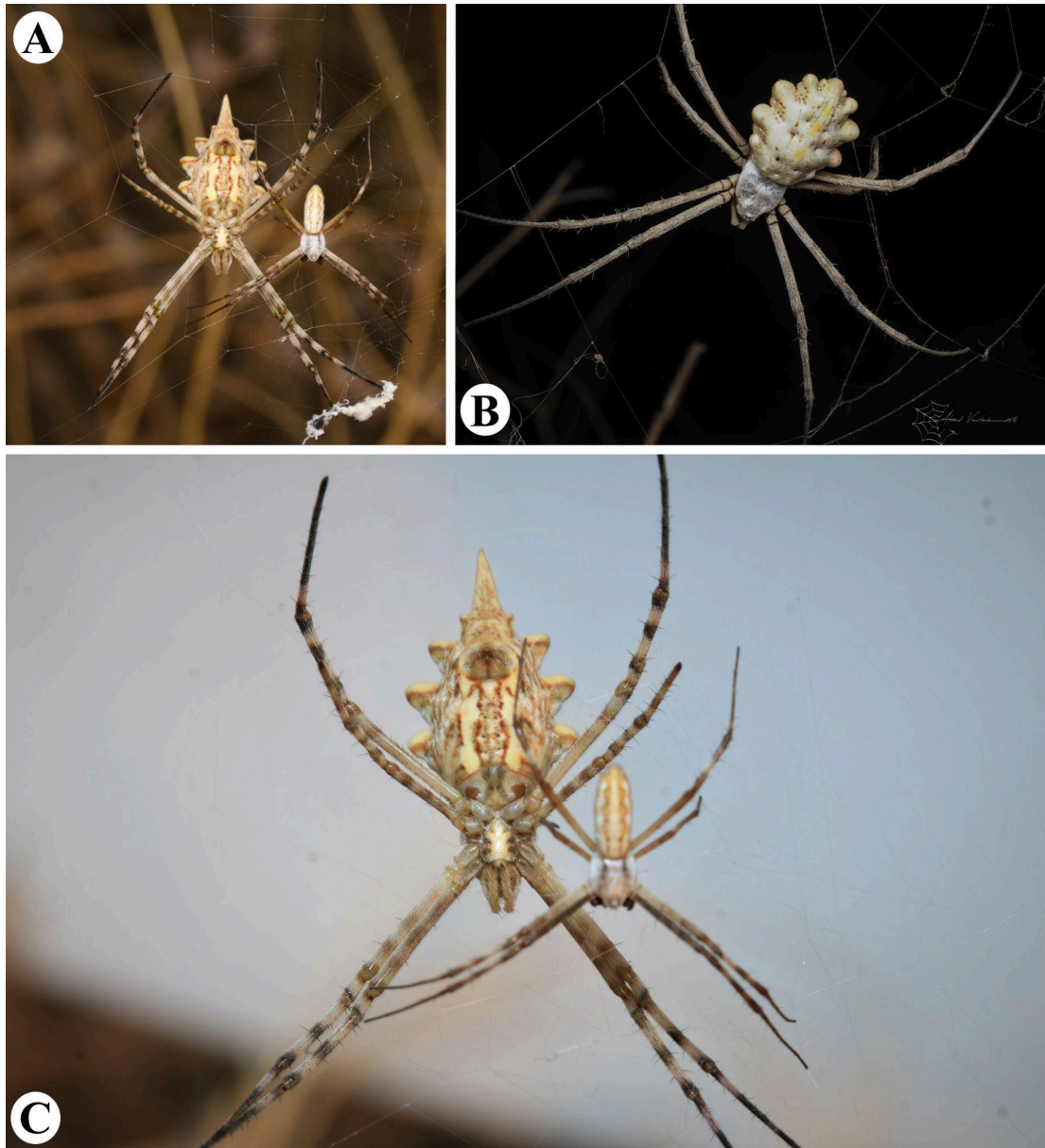


Figure 4.1: Live images of *Argiope lobata* (Pallas, 1772). **A & C.** Male, dorsal view & female, ventral view. **B.** Female, ventral view.

Argiope trifasciata (Forsskål, 1775)

Aranea trifasciata Forsskål, 1775: 86.

Aranea trifasciata Forsskål, 1776: 7, plate XXIV, fig. E (♀).

Aranea fastuosa Olivier, 1789: 202.

(For the complete list of references, see WSC, 2025).

Distribution. Africa. Introduced to both North and South America, Middle East, Pakistan, India, China, Japan, Thailand, Malaysia, Papua New Guinea, Australia and Hawaii (WSC, 2025).

Abundance: Common / Uncommon / **Rare**

Natural history. *Argiope trifasciata* was infrequently observed, appearing only during the monsoon near water pools on small shrubs. This suggests that they may visit the desert exclusively during the monsoon when conditions such as climate and food availability are optimal.

***CYCLOSA* Menge, 1866**

Cyclosa are widely distributed across various habitats and are known for their distinctive webs, which often feature a unique stabilimentum—a structure made of silk or debris—that runs through the center of the web. This stabilimentum is thought to camouflage the spider or attract prey. *Cyclosa* species are typically small and cryptic, blending seamlessly into their webs. The genus is represented by 180 nominal species globally, and 20 are currently known from India (WSC, 2025).

Type species. *Aranea conica* Pallas, 1772.

***Cyclosa* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. *Cyclosa* are rare in the Thar Desert and have only been observed a few times, primarily during the monsoon season and mostly in areas close to human settlements.

***LARINIA* Simon, 1874**

Medium-sized araneids with a narrow, elongated body. Carapace with a short, grooved longitudinal fovea. Anterior median eyes largest; the median ocular quadrangle is appreciably wider in front than behind. The genus is represented by 62 nominal species globally, and only 9 species are currently known from India.

Type species. *Larinia lineata* (Lucas, 1846).

***Larinia* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. Juveniles and subadults are observed throughout the year, while mature individuals are typically seen during the monsoon. They build their webs at night, although sometimes during the day; they reside beneath grass blades and camouflage effectively due to their brown colour and elongated body shape.

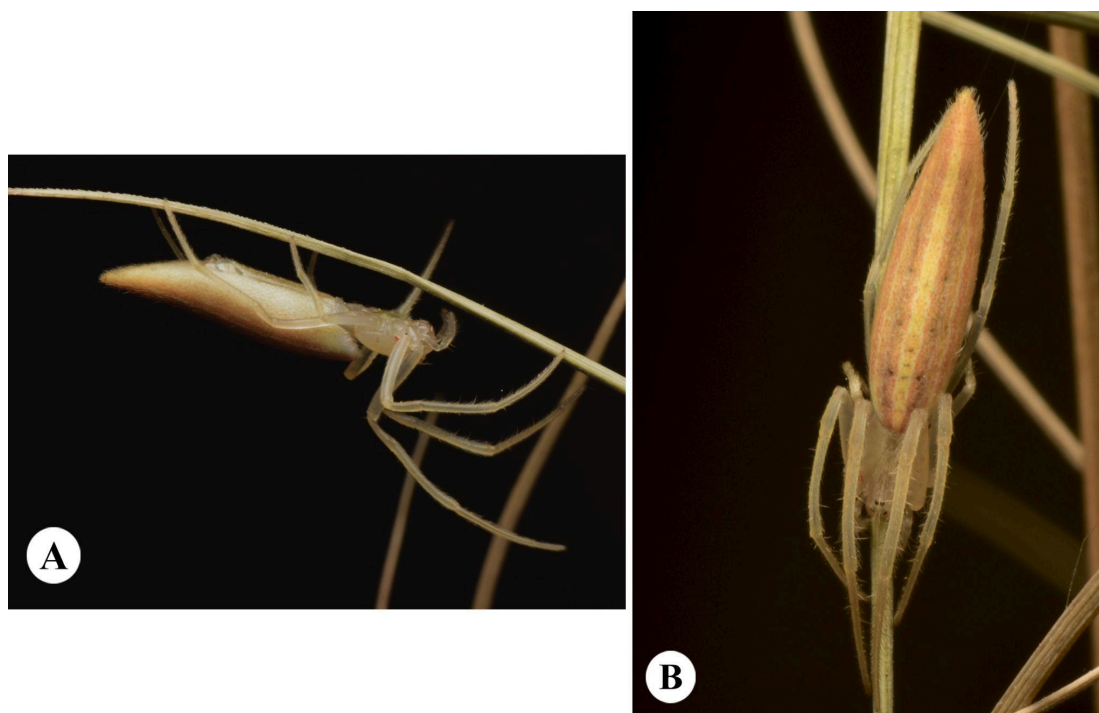


Figure 4.2: Live images of *Larinia*. **A.** Female, lateral view. **B.** same, dorsal view.

***NEOSCONA* Simon, 1864**

Neoscona widespread genus of orb-weaving spider. The opisthosoma exhibits significant variation in both shape and colouration, typically ranging from brown to black with different patterns. Additionally, *Neoscona* spiders have a longitudinal groove on the carapace. The genus is represented by 123 nominal species globally, and 29 of them are currently known from India (WSC, 2025).

Type species. *Neoscona arabesca* (Walckenaer, 1841).

***Neoscona bihumpi* Patel, 1988**

Neoscona bihumpi Patel, 1988: 1029, figs 1a–f (♂♀).

Distribution. India (WSC, 2025).

Abundance: Common / **Uncommon** / Rare

Natural history. *Neoscona bihumpi* spiders are primarily found on trees. There is significant variation in the colour pattern of the opisthosoma and in the size of the humps within populations from the same locality. These spiders are nocturnal, beginning to build their webs after dusk. They hunt throughout the night and spend the day hiding under leaves or on bark and twigs.

***Neoscona nautica* (L. Koch, 1875)**

Epeira tristis Taczanowski, 1873: 131 (♀; preoccupied by Blackwall, 1862).

Epeira nautica L. Koch, 1875: 17, plate II, fig. 2 (♂♀).

Epeira pullata Thorell, 1877: 385 (♀).

(For the complete list of references, see WSC, 2025).

Distribution. Asia and Pacific Islands, introduced to the Americas and Africa (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. Similar to *Neoscona bihumpi* Patel, 1988.

Neoscona theisi (Walckenaer, 1841)

Epeira theis Walckenaer, 1841: 53, plate XVIII, fig. 4 (♀).

Epeira mangareva Walckenaer, 1847: 469 (♀).

Epeira assidua Vinson, 1863: 180, 310 (♀).

(For the complete list of references, see WSC, 2025).

Distribution. Cyprus, Israel, Caucasus (Georgia, Russia), Iran, Pakistan, India, Nepal, Philippines, China to Indonesia, Japan, and Australia. Introduced to Seychelles, Pacific Islands (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Neoscona theisi* is the most abundant orb-weaver spider in desert habitats, especially during the monsoon season when their numbers significantly increase. They construct webs on various substrates, ranging from grass to trees, and are both diurnally and nocturnally active. In years with good rainfall, they can be found throughout the desert, thriving in the favorable conditions brought by the monsoon.

Neoscona sp. 1

Neoscona sp. 2

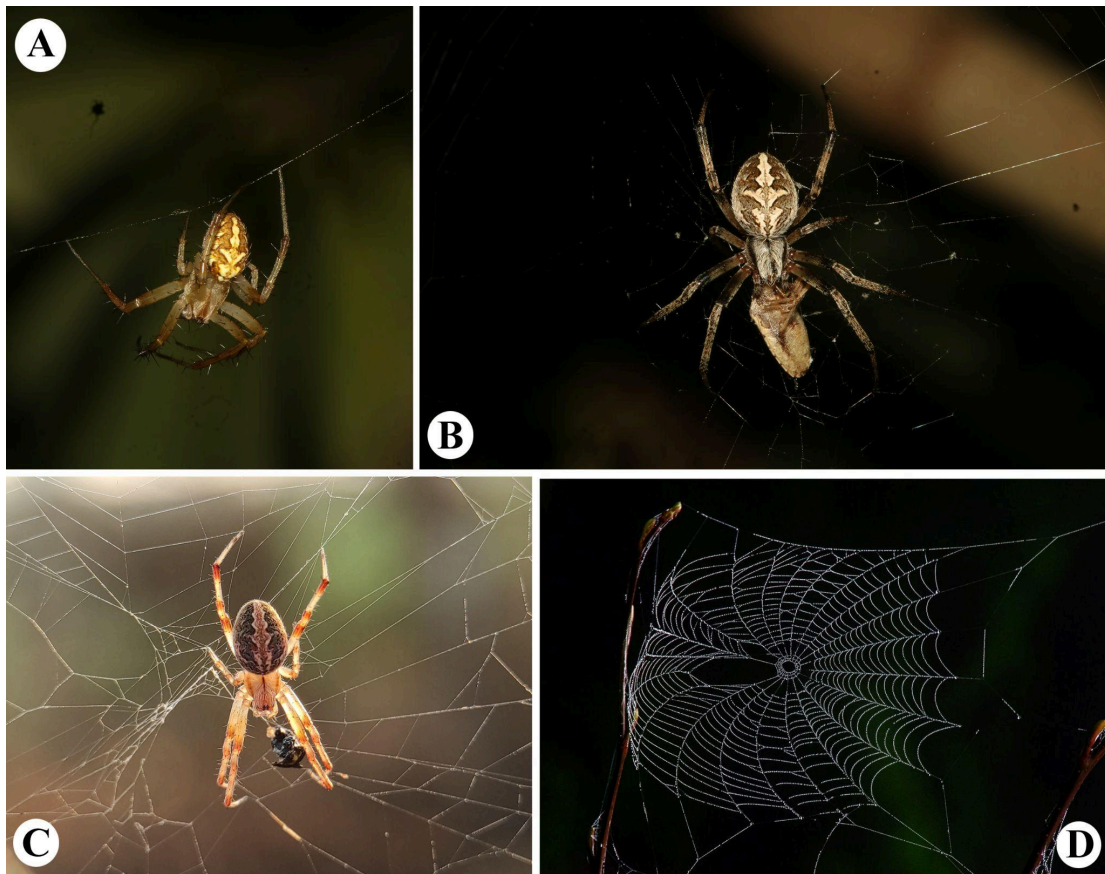


Figure 4.3: Live images of *Neoscona theisi* (Walckenaer, 1841). **A.** Male, dorsal view. **B–C.** Female, dorsal view. **D.** Web structure.

FAMILY CHEIRACANTHIIDAE Wagner, 1887

Yellow Sac spiders

Cheiracanthiids are medium-sized, agile hunters. Generally, they make a retreat in live leaves. They are characterized by their slender, elongated legs and an oval-shaped abdomen. Members of this family are nocturnal predators. Their colouration typically ranges from pale yellow to greenish or brown, often with darker markings. Globally distributed, with many species recorded in tropical and subtropical regions, notable genera include *Cheiracanthium*.

Type genus. *Cheiracanthium* C. L. Koch, 1839.

CHEIRACANTHIUM C. L. Koch, 1839

Cheiracanthium is a widely distributed genus characterized by eight eyes arranged in two rows and long legs, with an elongated carapace. It is closely related to the genus *Clubiona* from the family Clubionidae but differs by lacking a prominent dorsal groove along the midline of the carapace and a cluster of long, curved, erect setae at the anterior end of the abdomen. Additionally, the first pair of legs is the longest. The genus includes 231 nominal species worldwide, with 30 species currently known from India.

Type species. *Cheiracanthium punctorium* (Villers, 1789).

Cheiracanthium melanostomum (Thorell, 1895)

Eutittha melanostoma Thorell, 1895: 44 (♂♀).

Chiracanthium melanostomum Simon, 1901: 67.

Chiracanthium melanostomum Gravely, 1931: 264, figs 17 C–D (♂♀).

(For the complete list of references, see WSC, 2025).

Distribution. India, Bangladesh, Myanmar (WSC, 2025).

Abundance: Common / Uncommon / Rare



Figure 4.4: Live images of *Cheiracanthium melanostomum* (Thorell, 1895). **A.** Female, frontal view. **B.** same, dorsal view.

Natural history. *Cheiracanthium melanostomum* is widely distributed across various habitats, exhibiting diverse feeding and living habits. However, in desert regions, they were primarily observed during the monsoon season, when they take shelter in retreats constructed from clusters of grass twigs bound with silk. While they are typically found in open grasslands, similar silk retreats are also made by *Olios kiranae*.

CITHAERONIDAE Simon, 1893

Curly-legged spider

Cithaeronidae is a small family of spiders represented by two genera, *Cithaeron* and *Inthaeron*. Members are small to medium to large-sized spiders with a rounded carapace in dorsal view and a pale yellow abdomen with or without dark markings. Eye rows are slightly procurved, PME's the largest, flattened, irregular in shape and pale. The pseudosegmented tarsi are long, tend to curled up in preserved specimens. The family currently comprises only 2 genera and 10 recognized species.

Type genus. *Cithaeron* O. Pickard-Cambridge, 1872.

CITHAERON O. Pickard-Cambridge, 1872

The genus *Cithaeron* is represented by seven species, of which two are known from India (WSC, 2025).

Type species. *Cithaeron praedonius* O. Pickard-Cambridge, 1872.

Cithaeron praedonius O. Pickard-Cambridge, 1872

Cithaeron praedonius O. Pickard-Cambridge, 1872: 273 (♀)

Tephlea agelenoides Simon, 1878: 207 (♀)

Tephlea limbata Simon, 1885: 36 (♂♀)

(For the complete list of references, see WSC, 2025).

Distribution. North Africa, Greece, Cyprus, Turkey, Middle East to India, Malaysia. Introduced to USA, Mexico, Honduras, Panama, Cuba, Brazil, Australia (WSC, 2025).

Abundance: Common / Uncommon / **Rare**

Natural history. *Cithaeron praedonius* are extremely fast-moving ground-dwelling spiders, found in silk retreats under stones during the day.

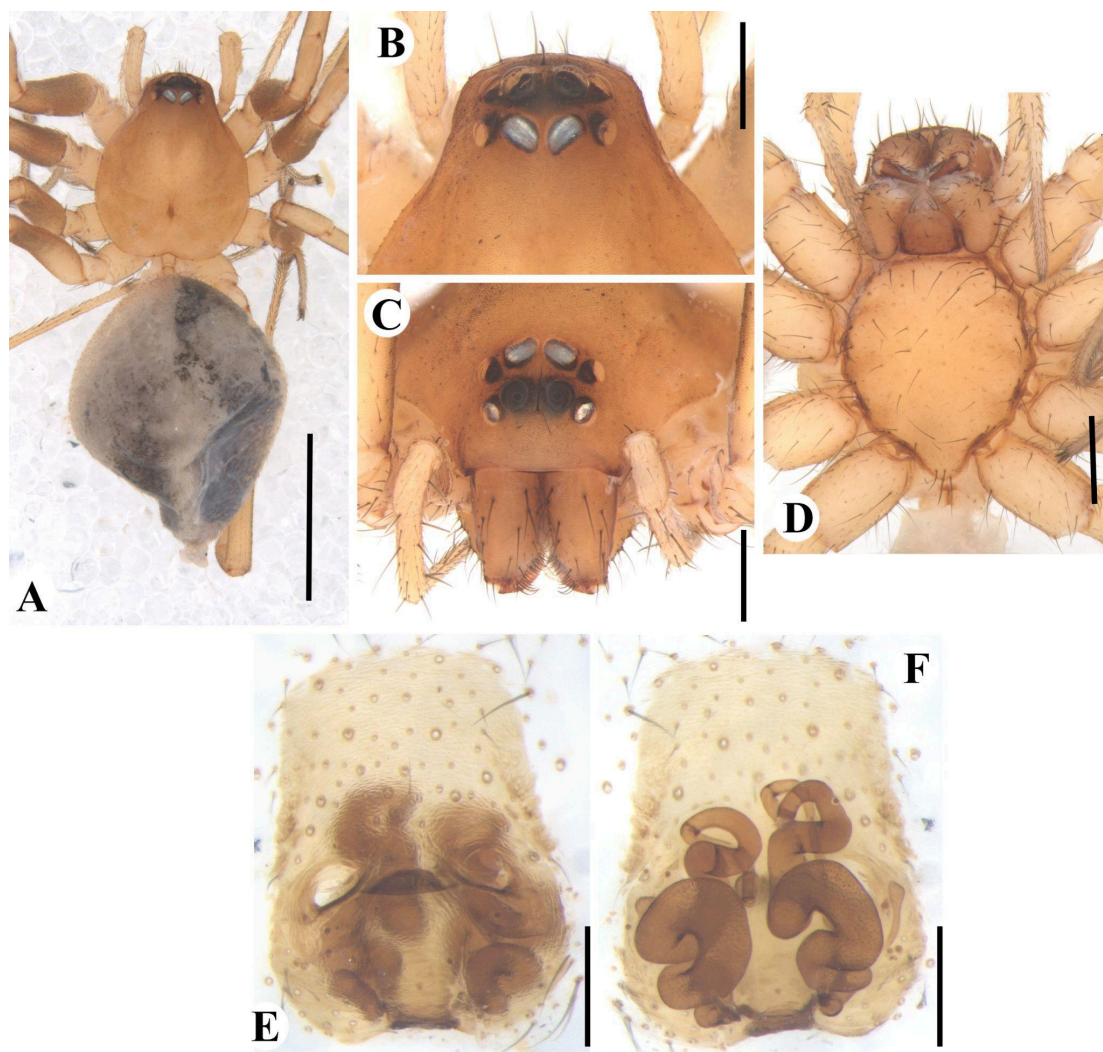


Figure 4.5: Microscopic images of *Cithaeron praedonius* O. Pickard-Cambridge, 1872. **A.** Female, dorsal view. **B.** same, Eye close-up. **C.** same, frontal view. **D.** Sternum, ventral view. **E.** Epigyne, ventral view. **F.** Vulva, dorsal view. Scale bars: A 2 mm; B–D 0.5 mm; E–F 0.2 mm.

FAMILY CORINNIDAE Karsch, 1880

Dark sac spiders/ Ant-like sac spiders

Corinnidae are free-living ground spiders and are known for their remarkable mimicry of ants or wasps in many species. Their carapace is typically ovoid in shape, though it may appear elongated in ant-mimicking species. Their colouration ranges from dark to yellowish, aiding in camouflage on the ground or enhancing their mimicry. Currently, 18 species from this family are recorded in India, including a newly documented genus, *Medmassa* from Southern India.

Type genus. *Corinna* C. L. Koch, 1841.

***CASTIANEIRA* Keyserling, 1879**

Species of *Castianeira* possess 8 eyes arranged in 2 slightly procurved rows. The posterior eye row is slightly wider than the anterior row, with all four eyes about the same size. The anterior median eyes can be slightly smaller to much larger than the other two in the row. Leg proportions are characteristics, with the fourth pair the longest, followed by the first pair, and the abdomen is often decorated with bands of white scale-like setae. The genus is represented by 123 nominal species globally and only 3 species are currently known from India.

Type species. *Castianeira rubicunda* Keyserling, 1879.

***Castianeira zetes* Simon, 1897**

Castaneira zetes Simon, 1897: 294 (♀).

Castaneira zetes Gravely, 1931: 273, figs 20A–B (♂♀).

Castianeira zetes Tikader & Biswas, 1981: 73, figs 129–130 (♀).

(For the complete list of references, see WSC, 2025).

Distribution. Pakistan, India, Bangladesh (WSC, 2025).

Abundance: Common / **Uncommon** / Rare

Natural history. *Castianeira zetes* are typically observed in habitats near water, often found in agricultural areas where the soil remains relatively moist. This suggests that they are not true desert species but are likely associated with human-altered habitats. Additionally, they are not particularly common in desert environments.

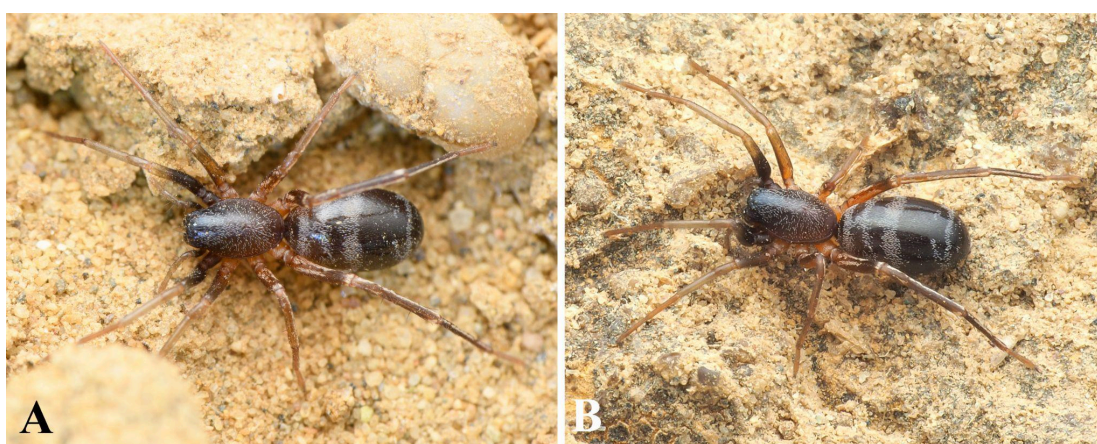


Figure 4.6: Live images of *Castianeira zetes* Simon, 1897. **A–B.** Female, dorsal view.

FAMILY DICTYNIDAE O. Pickard-Cambridge, 1871

Mesh web spiders

Dictynidae are small araneomorph spiders characterized by three tarsal claws and either a cribellum or a reduced cribellum. They possess six or eight eyes, converging endites, and branched tracheae. These spiders typically construct irregular, tangled webs at the tops of plants or across leaf surfaces.

Type genus. *Dictyna* Sundevall, 1833.

***EMBLYNA*, Chamberlain, 1948**

Emblyna are small cribellate spiders, recognized by their woolly silk webs and the presence of a cribellum and calamistrum. They inhabit low vegetation and leaf litter, building irregular mesh webs. The genus has a Holarctic distribution with over 66 described species worldwide (WSC, 2025).

Type species. *Emblyna completa* (Chamberlin & Gertsch, 1929)

***Emblyna* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. *Emblyna*, a rarely encountered spider in the Thar Desert, is likely a visitor species, with genus confirmation pending discovery of a male specimen.

Remark. This study marks the first record of the genus in India.

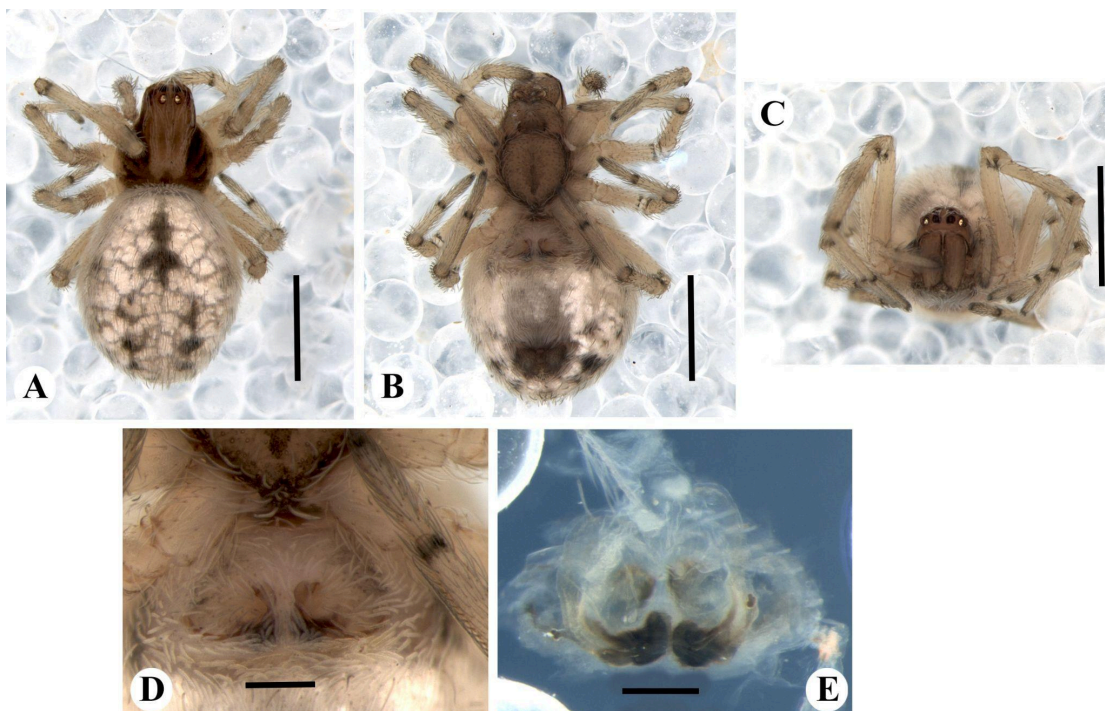


Figure 4.7: Microscopic images of *Emblyna* sp.1. **A.** Female, dorsal view. **B.** same, ventral view. **C.** same, frontal view. **D.** Epigyne intact, ventral view. **E.** Same, after clearing in KOH, dorsal view. Scale bars: A–C 0.5 mm; D–E 0.2 mm.

FAMILY ERESIDAE C. L. Koch, 1845

Velvet spiders

Family Eresidae includes medium-sized, robust spiders known for their vibrant colours and velvety texture. These are cribellate spiders, equipped with a cribellum and calamistrum for producing fine, woolly silk. Velvet spiders are unique in their social behaviour; some species exhibit subsocial or cooperative traits, including maternal care and matriphagy, where the mother sacrifices herself to feed her offspring which is reported for the first time in *Stegodyphus pacificus* during this study. Eresidae have six or eight eyes, robust chelicerae, and strong legs, making them efficient ambush predators. These spiders are an interesting focus for studies on sociality and reproductive strategies in arachnids. The family currently comprises 9 genera and 117 recognized species.

Type genus. *Eresus* Walckenaer, 1805.

***STEGODYPHUS* Simon, 1873**

Genus *Stegodyphus* is relatively species-poor, with a distribution spanning the Oriental, Ethiopian, Palearctic, and Neotropical regions. The genus includes 19 recognized species globally, of which 4 are currently recorded from India (WSC, 2025).

Type species. *Stegodyphus lineatus* (Latreille, 1817).

***Stegodyphus pacificus* Pocock, 1900**

Stegodyphus pacificus Pocock, 1900: 209 (♂♀).

Stegodyphus pacificus Dyal, 1935: 131, plate XI, fig. 2.

(For the complete list of references, see WSC, 2025).

Distribution. Jordan, Iran, Pakistan, and India (WSC, 2025).

Abundance: Common / Uncommon / Rare

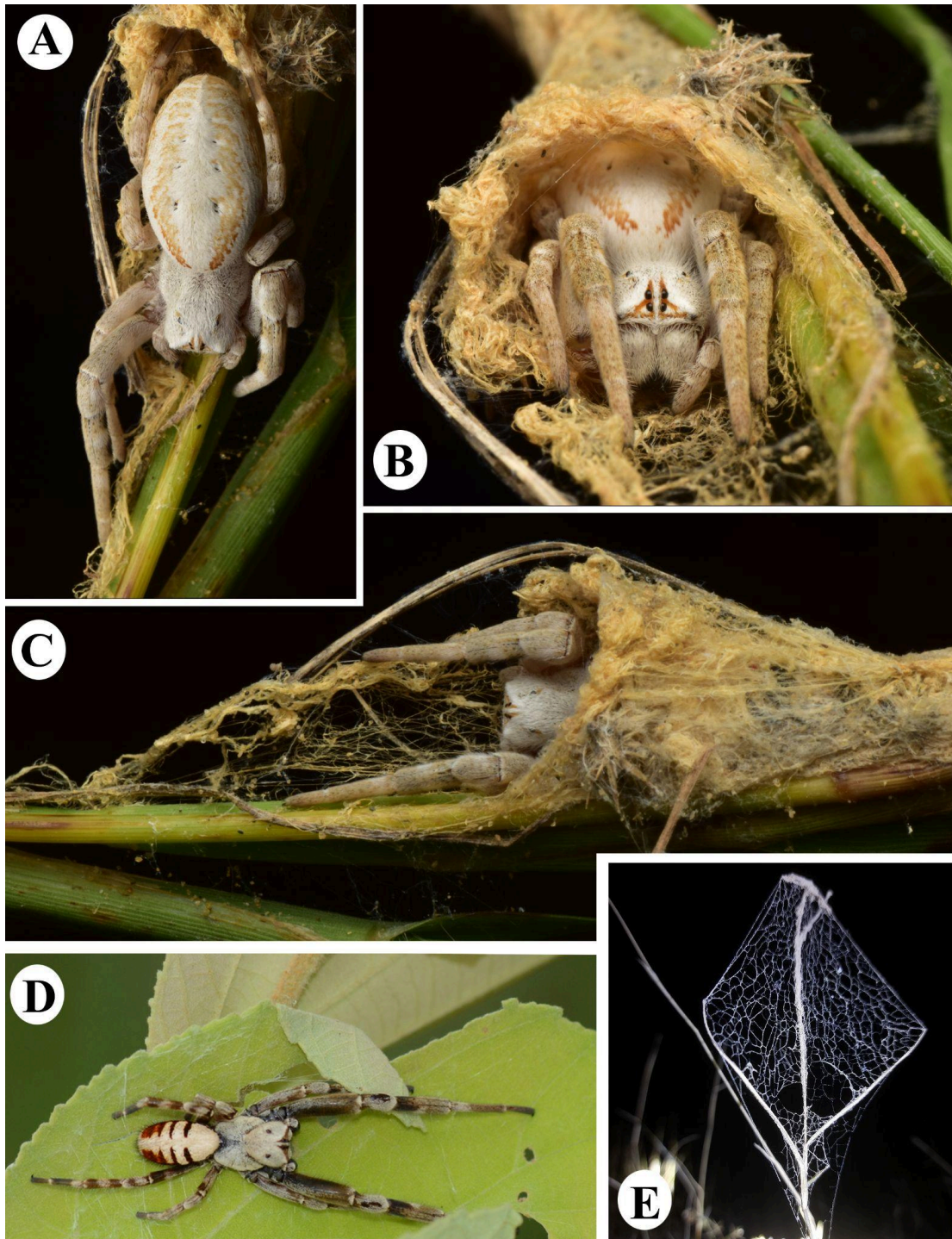


Figure 4.8: Live images of *Stegodyphus pacificus* Pocock, 1900. **A.** Female, dorsal view. **B.** same, frontal view. **C.** same, dorsal view. **D.** Male, dorsal view. **E.** Web structure.

Natural history. *S. pacificus* is a relatively common species in the Thar Desert, frequently encountered on *Ziziphus* trees. It builds dense, irregular silk webs among

shrubs or low vegetation and exhibits subsocial behavior, with juveniles remaining in the maternal web for an extended period and cooperating in prey capture and web maintenance. A remarkable aspect of its biology is matrophagy where spiderlings consume their mother's body as a nutrient source, ensuring survival in resource-limited desert conditions. This extreme form of parental care reflects a striking adaptation to the harsh arid environment (Tripathi et al., 2020).

Stegodyphus thar sp. nov.

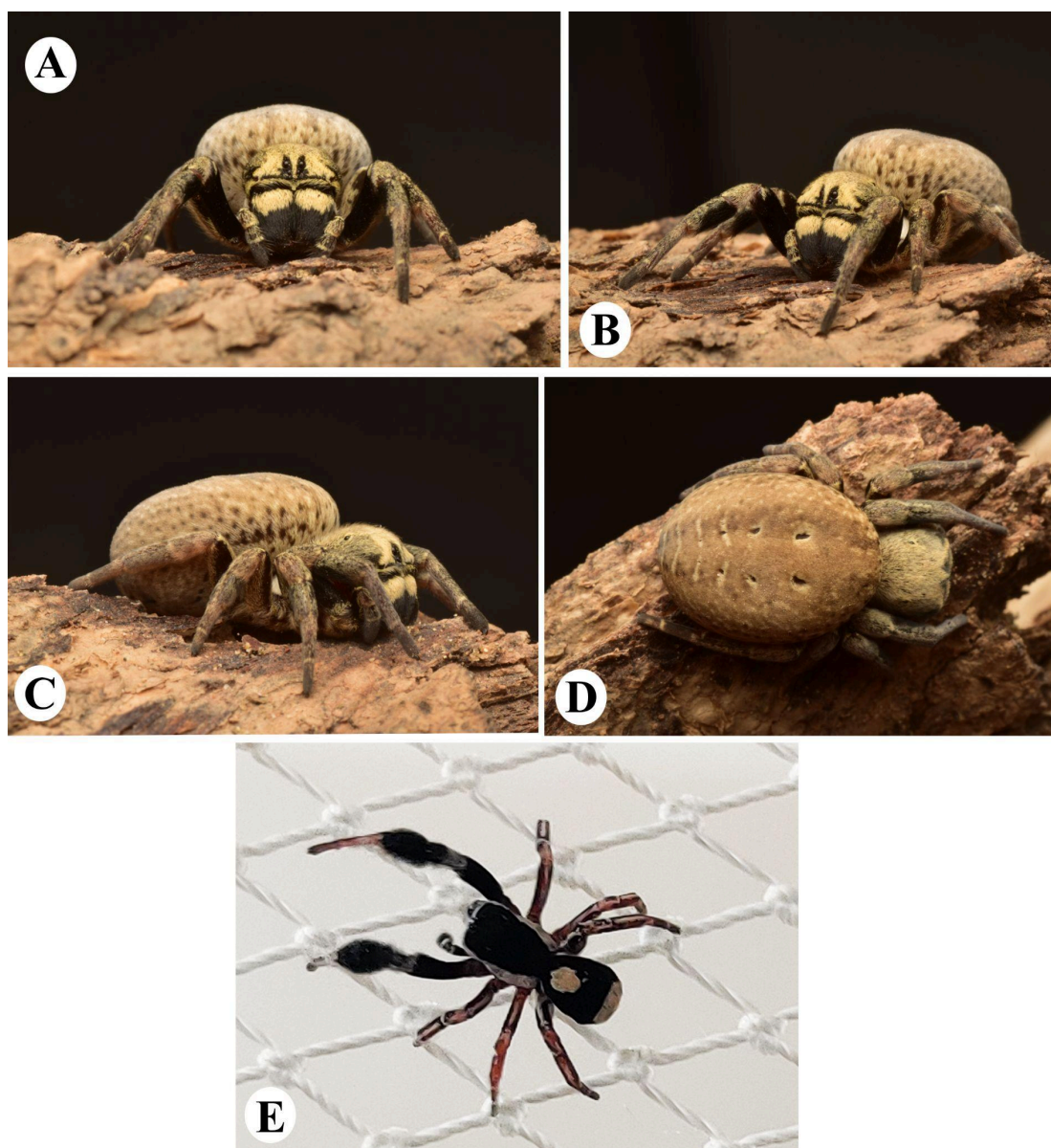


Figure 4.9: Live images of *Stegodyphus thar* sp. nov. **A–B.** Female, frontal view. **C.** same, lateral view. **D.** same, dorsal view. **E.** Male, dorsal view.

Abundance: Common / Uncommon / **Rare**

Natural history. *Stegodyphus thar* is a rare spider species endemic to the Thar Desert, with limited information available about its biology and behaviour. Mature individuals are observed primarily during the monsoon months of August and September. Unlike most *Stegodyphus* species, which are arboreal, this species exhibits a unique behaviour of dwelling beneath rocks. Females have been repeatedly found under the same rock, suggesting site fidelity, while only a single male was observed wandering during the monsoon. A detailed study is essential to uncover more about the ecology and life history of this elusive species. The closest morpho species is known from southern India, *S. tibialis*.

FAMILY FILISTATIDAE Ausserer, 1867

Crevice weavers

Filistatidae consists of small to medium-sized araneomorph spiders characterized by three tarsal claws, a cribellate silk-producing system, and a haplogyne genital structure. They have eight eyes, with a labium fused to the sternum and chelicerae that are basally fused with laminae. The cribellum is divided and bears claviform cribellate spigots, enabling the production of fine silk for their webs. The family currently comprises 18 genera and 192 recognized species.

Type genus. *Filistata* Latreille, 1810.

***SAHASTATA* Benoit, 1968**

Sahastata comprises robust, velvety spiders with long legs and cylindrical posterior spinnerets, adapted to arid and semi-arid habitats across the Middle East, Africa, and South Asia. They build funnel-shaped webs in crevices, under rocks, or in man-made

structures. The genus currently includes ten recognized species worldwide, with two recorded from India (WSC, 2025).

Type species. *Sahastata nigra* (Simon, 1897).

Sahastata ashapuriae Patel, 1978

Sahastata ashapuriae Patel, 1978: 186, figs 2a–e (♂♀).

Distribution. India (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Sahastata* was primarily found on the bark, while a smaller individual was also observed nestled within the rock crevices of a rock wall.

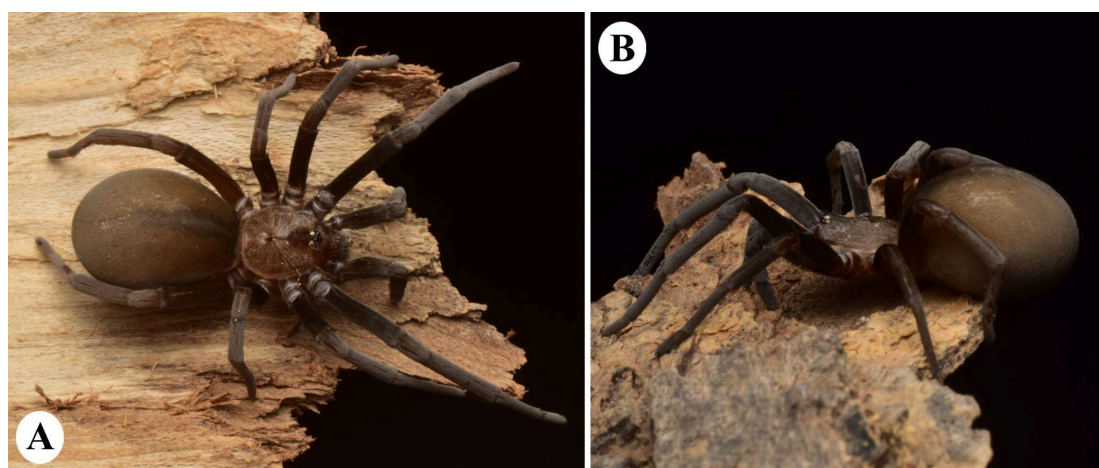


Figure 4.10: Live images of *Sahastata ashapuriae* Patel, 1978. **A.** Female, dorsal view. **B.** same, lateral view.

FAMILY GNAPHOSIDAE Banks, 1892

Flat-bellied ground spiders

Gnaphosids are a diverse family of nocturnal, ground-dwelling spiders, typically small to medium-sized with elongated bodies and cylindrical spinnerets. Their brown to gray coloration provides effective camouflage against soil and leaf litter. Active

hunters, they are commonly found under substrates or within crevices and show greater diversity in arid to semi-arid habitats than in forests. The family currently comprises 140 species reported from India, though several have been synonymized, and many await taxonomic revision.

Type genus. *Gnaphosa* Latreille, 1804.

***ANAGRAPHIS* Simon, 1893**

Anagraphis are medium-sized spiders that possess a very narrow but clearly defined annular crescent distally on the expanded anterior lateral spinnerets, from which emerges a fringe of uniformly closely spaced, thin setae. This character is not possessed by any other gnaphosid group (Murphy, 2007). This small genus is represented by only nine known species distributed in the Palearctic and Afrotropical regions of the world (WSC, 2025), this study marks the first record of species from India.

Type species. *Anagraphis pallens* Simon, 1893.

***Anagraphis* sp. nov.**

Abundance: Common / Uncommon / **Rare**

Natural history. They were among the rare species with limited records, and their lifestyle remained largely unknown.

Remark. This study marks the first record of the genus in India and a new species.

BERLANDINA Dalmas, 1922

Berlandina is a relatively large genus comprising 40 species distributed across the Palaearctic and the northern regions of the Afrotropical realm. This study represents the first confirmed report of the genus from India.

Type species. *Gnaphosa plumalis* O. Pickard-Cambridge, 1872.

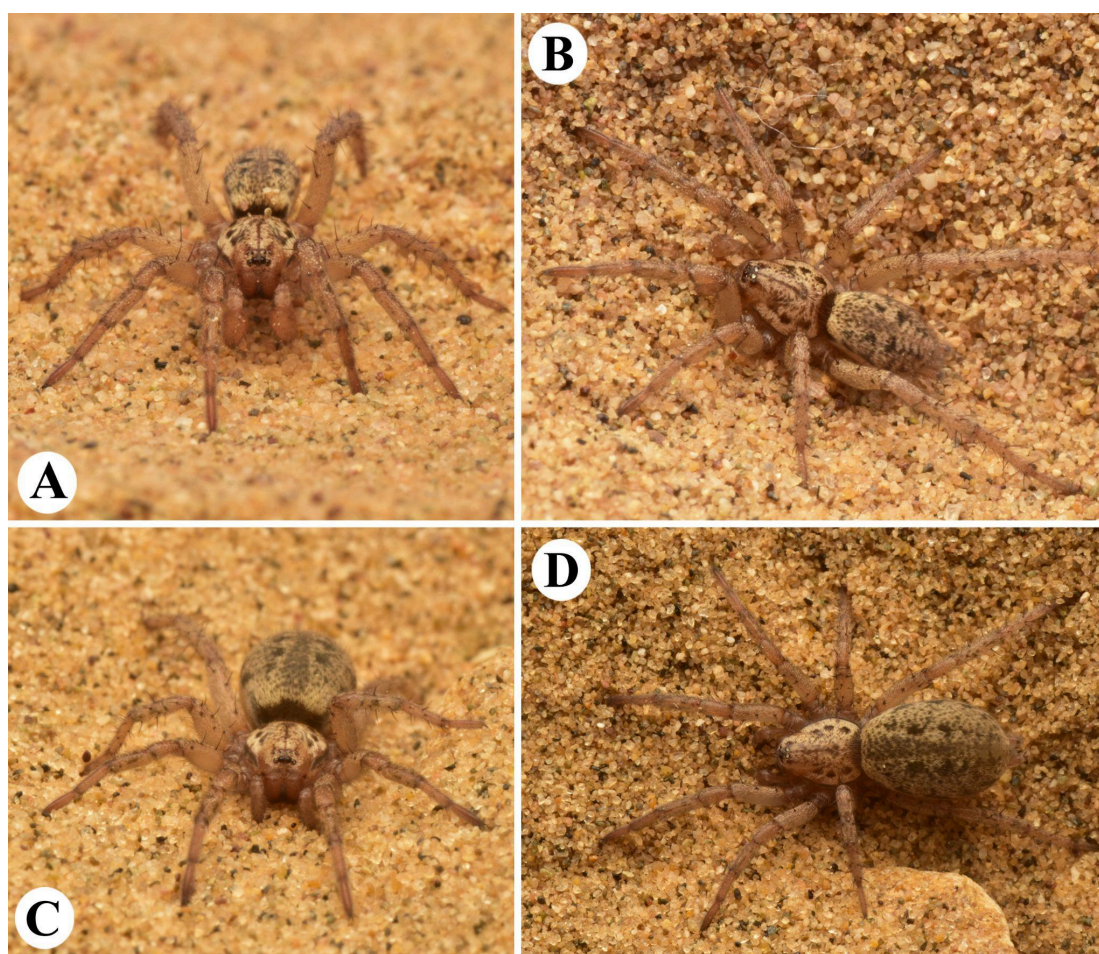
Berlandina bishnoi sp. nov.

Figure 4.11: Live images of *Berlandina bishnoi* sp. nov. **A.** Male, frontal view. **B.** same, dorsal view. **C.** Female, frontal view. **D.** same, dorsal view.

Abundance: Common / Uncommon / Rare

Natural history. *Berlandina bishnoi* is a common spider found throughout the year, often near human habitation. They were observed under rocks, cattle dung, and other

substrates, exhibiting nocturnal activity. Occasionally, they were seen being preyed upon by scorpions.

Remark. This study marks the first record of the genus in India and describe a new species.

***CRYPTODRASSUS* Miller, 1943**

Cryptodrassus are small, pale spiders distinguished by a few small, distinct teeth on both margins of their chelicerae (typically 2–4 on the promargin and 2–3 on the retromargin), males with a dorsal scutum, and anterior median eyes (AME) with black surrounds that appear smaller than the other eyes when viewed from the front. Additionally, the posterior median eyes (PME) are larger than the AME when observed from above (Murphy, 2007). The genus comprises 12 recognized species globally, with four currently recorded from India (WSC, 2025).

Type species. *Cryptodrassus pulchellus* Miller, 1943.

***Cryptodrassus ovalus* sp. nov.**

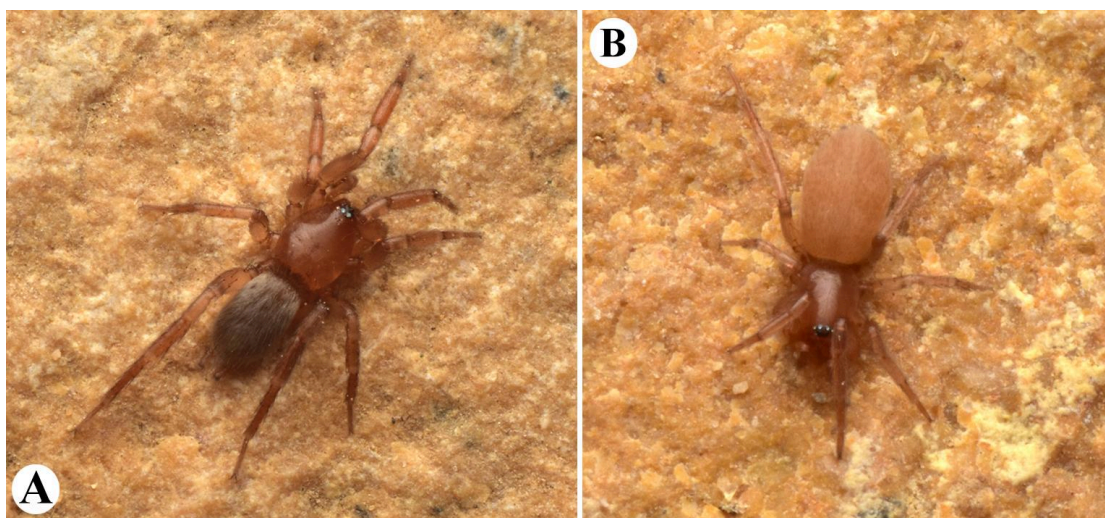


Figure 4.12: Live images of *Cryptodrassus ovalus* sp. nov. **A.** Male, dorsal view. **B.** Female, dorsal view.

Abundance: Common / **Uncommon** / Rare

Natural history. Their numbers were observed to increase during the monsoon, while others appeared in fewer numbers. Males were less abundant compared to females.

Remark. This species is newly described in this study.

Cryptodrassus pallidus sp. nov.

Abundance: Common / **Uncommon** / Rare

Natural history. Similar to *C. ovalus*.

Remark. This species is newly described in this study.

DRASSODES Westring, 1851

Drassodes are medium to large-sized spiders distinguished by their plain tawny to light grayish abdomens, sometimes bearing faint patterns, and by distinct trochanteral notches rather than smooth indentations. Males notably lack a dorsal scutum, a unique combination of features among gnaphosids (Murphy, 2007). The genus is globally distributed, comprising 134 recognized species, including 28 reported from India, many of which require detailed taxonomic revision (WSC, 2025).

Type species. *Aranea lapidosa* Walckenaer, 1802.

Drassodes sp. 1

Drassodes sp. 2

Abundance: **Common** / Uncommon / Rare

Natural history. Both the species are commonly encountered and are frequently mistaken for *Megamyrmaekion caudatum* due to similar morphological features. Like other gnaphosids, they are typically found beneath substrates.

***HITOBIA* Kamura, 1992**

Hitobia closely resembles *Litopyllus* (Chamberlin, 1922) in the structure of the female median spinnerets and the male palpal morphology. However, it can be distinguished by the slightly recurved posterior eye row, compared to the procurved row in *Litopyllus* (Kamura, 1992). This genus is primarily distributed in East Asia and includes 25 species described to date, many of which are known only from males or females (WSC, 2025; Wang & Peng, 2014; Kamura, 2011). Currently, the genus is represented by 8 species from India (WSC, 2025).

Type species. *Micaria unifascigera* Bösenberg & Strand, 1906.

***Hitobia* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. *Hitobia* closely resembles *Micaria*, which can often lead to confusion in the field. However, *Micaria* is more common and has a thinner, weaker appearance compared to *Hitobia*.

***MARINAROELOTES* Ponomarev, 2020**

Marinarozelotes is distinguished within the subfamily Zelotinae by the unique morphology of its copulatory organs. Males possess a large, distally rounded embolus base, an obliquely oriented or rounded terminal apophysis, and a looped embolus, while females feature an epigyne with an M-shaped median ridge. The basal segments

of the chelicerae are externally covered with dense, stiff bristles. The genus comprises 23 recognized species worldwide, with one species currently recorded from India (WSC, 2025).

Type species. *Marinarozelotes barbatus* (L. Koch, 1866).

***Marinarozelotes jaxartensis* (Kroneberg, 1875)**

Melanophora jaxartensis Kroneberg, 1875: 23, plate II, fig. 1 (♀).

Prothesima semibadia L. Koch, 1878: 42, plate. I, fig. 3 (♀).

(For the complete list of references see WSC, 2025).

Distribution. Northern Africa to Caucasus, Russia (Europe) to Central Asia, Iran. Introduced to Hawaii, USA, Mexico, South Africa, India, China, Japan (WSC, 2025).

Abundance: Common / Uncommon / **Rare**

Natural history. *Marinarozelotes jaxartensis* constructs silk-lined retreats under rocks, within leaf litter, or inside crevices during the day. These retreats offer shelter from predators and harsh environmental conditions. They emerge to actively hunt prey at night, showcasing their nocturnal and ground-dwelling lifestyle.

***MEGAMYRMAEKION* Reuss, 1834**

Megamyрмаekion is notable for its slender body, elongated legs, and active hunting behaviour. They currently include 12 nominal species, out of which three species are known from India (Caleb & Sankaran, 2025; WSC, 2025).

Type species. *Megamyрмаekion caudatum* Reuss, 1834.

***Megamyрмаekion caudatum* Reuss, 1834**

Megamyрмаekion caudatum Reuss, 1834: 217, plate XVIII, fig. 12 (juv.).

Dyction reussi Walckenaer, 1837: 380 (♀).

Drassus tarrhunensis Karsch, 1881: 12, plate I, fig. 11 (♀).

(For the complete list of references see WSC, 2025).

Distribution. Algeria, Tunisia, Libya, Egypt, Israel, Iran, India (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. Among the most common gnaphosid species in the Thar Desert, they inhabit a wide range of habitats. Their long legs make them swift and agile runners, enabling them to actively hunt prey on the ground, often at night. These spiders rely on their excellent vision and rapid bursts of speed to capture insects, and during the day they usually shelter under stones, leaf litter, or in silk-lined retreats to avoid the harsh desert heat.

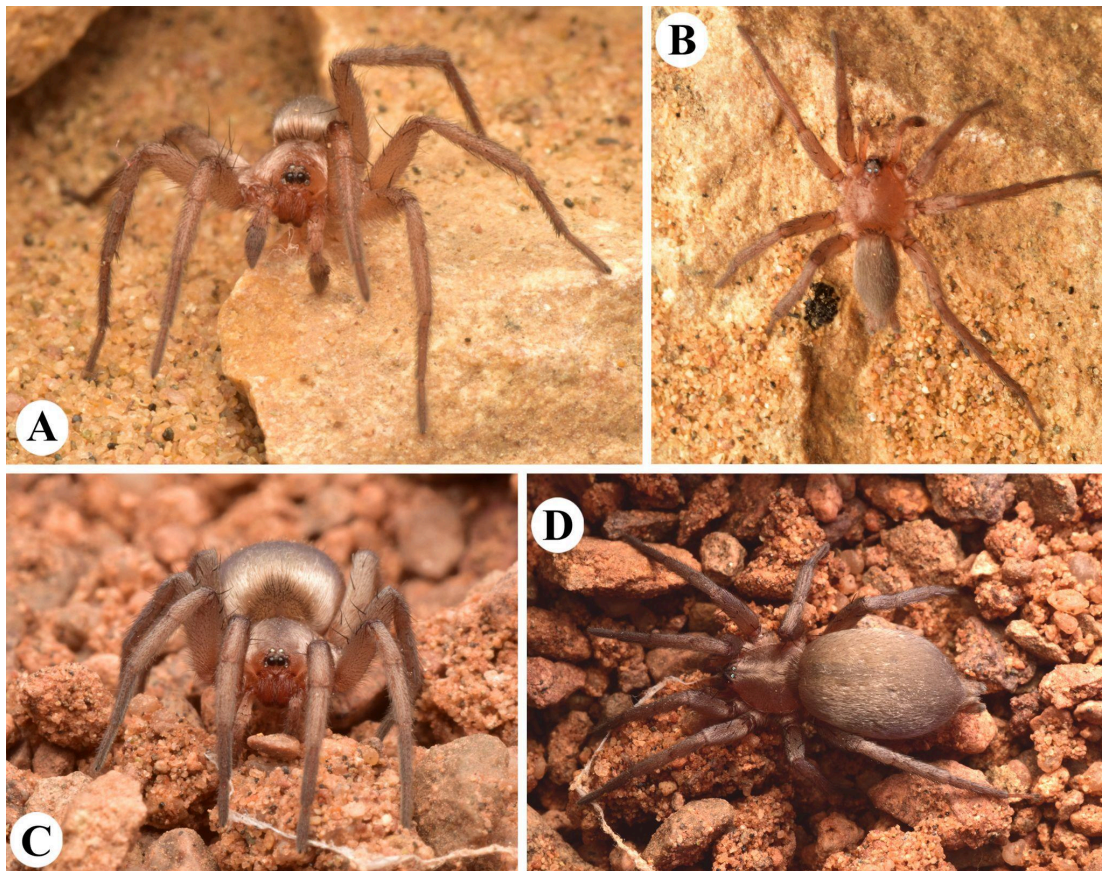


Figure 4.13: Live images of *Megamyрмаekion caudatum* Reuss, 1834. **A.** Male, frontal view. **B.** same, dorsal view. **C.** Female, frontal view. **D.** same, dorsal view.

MICARIA Westring, 1851

Micaria are commonly referred to as ant-mimicking spiders due to their striking resemblance to ants. This mimicry is an evolutionary adaptation that provides protection against predators and aids in hunting by allowing the spiders to blend into environments dominated by ants. Small, active hunters, *Micaria* spiders are often found in hot, dry habitats, frequently in full sunlight. They typically possess slender bodies and thin transverse bands of contrasting setae that mimic the segmented appearance of ants, along with a shine produced by flattened, scale-like iridescent setae. Additionally, these spiders often hold their front legs forward like antennae, and their nervous, erratic walk closely resembles the behaviour of ants. The genus includes 124 recognized species globally, of which four are currently recorded from India (WSC, 2025).

Type species. *Micaria fulgens* (Walckenaer, 1802).

Micaria ignea O. Pickard-Cambridge, 1872

Drassus fastuosus Lucas, 1846: 221, plate XIII, fig. 10 (♀)

Pythonissa fastuosa Simon, 1864: 121.

Micaria ignea O. Pickard-Cambridge, 1872: 248, plate XVI, fig. 30 (♀).

(For the complete list of references see WSC, 2025).

Distribution. Canary Islands, Algeria, Spain, Greece, Cyprus, Egypt, Yemen, Israel, Syria, Iran, Central Asia (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Micaria ignea* was predominantly observed active during the daytime, often in the company of ants, which it closely mimics in size, colouration, and walking patterns, making differentiation challenging.

Remark. This study marks the first record of the species in India.

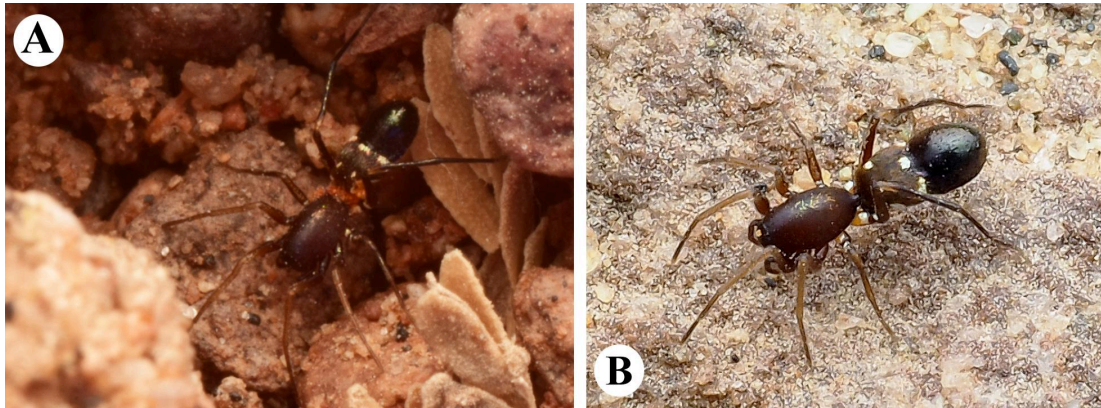


Figure 4.14: Live images of *Micaria ignea* O. Pickard-Cambridge, 1872. **A–B.** Female, dorsal view.

***MINOSIELLA* Dalmas, 1921**

Minosiella Dalmas, 1921, is a small genus, consisting of seven species distributed across the western Palaearctic, from Algeria to Afghanistan (Platnick, 2009). Males of this genus are distinctly identifiable by their strong cymbial spines. This study marks the first report of the genus.

Type species. *Minosiella mediocris* Dalmas, 1921.

***Minosiella intermedia* Denis, 1958**

Minosiella intermedia Denis, 1958: 94, fig. 16 (♀).

Minosiella intermedia Marusik & Kovblyuk, 2009: 65, figs 1-15 (♂♀).

Minosiella intermedia El-Gendy, 2022: 4, figs 1, 2a–d, 3a–b (♂).

(For the complete list of references see WSC, 2025).

Distribution. Egypt, Iraq, Iran, Central Asia, Afghanistan (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Minosiella intermedia* has a wide distribution and has also been observed in the Jodhpur district of Rajasthan. During summer, it is commonly found hiding among grass clumps, beneath rocks, under cattle dung, and within leaf litter. It is nocturnal and has also been observed falling prey to scorpions.

Remark. Based on the illustrations provided by Tikader & Gajbe (1977: 47, Figs. 3A–E) for a female specimen of *Callilepis rajasthanicus*, there is a possibility that it is a junior synonym of *M. intermedia*. This study marks the first report of genus *Minosiella* from India.

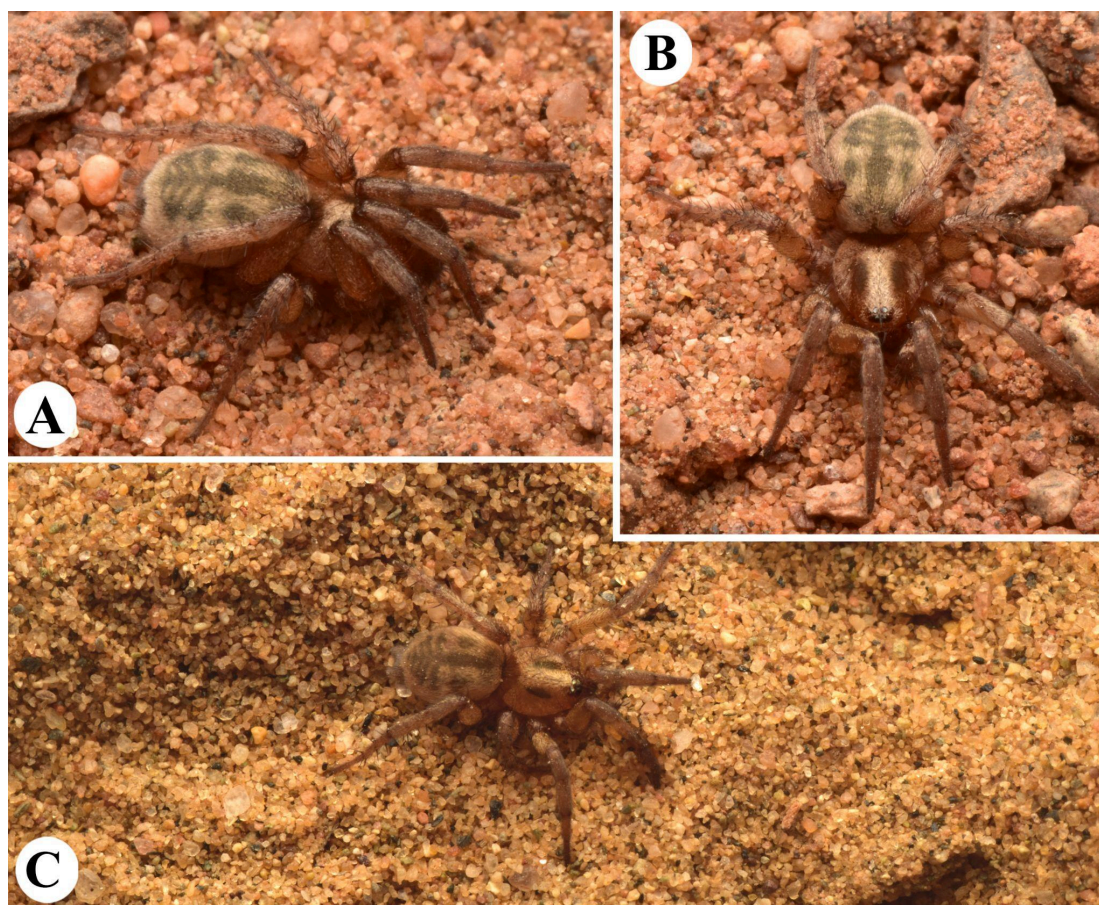


Figure 4.15: Live images of *Minosiella intermedia* Denis, 1958. A–C. Female, dorsal view.

***ODONTODRASSUS* Jézéquel, 1965**

Odontodrassus comprises small to medium-sized gnaphosids, typically yellowish to deep brown, with the opisthosoma sometimes showing wavy transverse bands. Males may or may not bear a dorsal scutum. The chelicerae bear three or more promarginal and one to three retromarginal teeth. Males are easily recognized by a retrolaterally directed embolus and a greatly enlarged, grooved conductor (Levy, 1999). This small genus includes eight known species, mainly from East Asia (WSC, 2025); the present study represents the first record of the genus from India.

Type species. *Odontodrassus nigriritibialis* Jézéquel, 1965.

***Odontodrassus sutirthai* sp. nov.**

Abundance: Common / **Uncommon** / Rare

Natural history. Little is known about the natural history of *Odontodrassus sutirthai*, as they have rarely been observed. They are typically found beneath rocks or other substrates.

Remark. This study marks the first record of the genus in India with the description of a new species.

***PTEROTRICA* Kulczyński, 1903**

Pterotricha are medium-sized spiders, carapace and dorsal surface of the opisthosoma are often striped or mottled with dots. Males of some species possess a dorsal scutum on the opisthosoma near the pedicel. Eyes are relatively large, arranged in two nearly straight rows in dorsal view, with lateral eyes typically touching the medians. The AME are always the smallest, even when appearing similar in size to the ALE. Legs are relatively long, with the fourth pair being the longest, followed by the first or third

pair. The genus comprises 40 recognized species globally, with only one currently recorded from India (WSC, 2025). This study reports one new species from the Thar Desert.

Type species. *Aranea lentiginosa* C. L. Koch, 1837.

***Pterotricha marusthala* sp. nov.**

Abundance: Common / Uncommon / Rare

Natural history. *Pterotricha marusthala* is a nocturnal species that builds tubular retreats on firm sandy flats, generally on the edge of the gravel plains towards the vegetation and in dunes.

Remark. This species is newly described in this study.

***SETAPHIS* Simon, 1893**

Setaphis is distinguished by specific morphological traits, including a metatarsal preening comb that is typical of zelotine spiders. Males feature a uniquely coiled embolus, whereas females have coiled epigynal ducts, allowing for straightforward identification of specimens within this genus. The genus includes 23 recognized species globally, of which four are currently recorded from India (WSC, 2025).

Type species. *Drassus parvulus* Lucas, 1846.

***Setaphis latus* sp. nov.**

Abundance: Common / Uncommon / Rare

Natural history. *Setaphis latus* are typically found beneath the substrate, like other gnaphosids, and are easily identifiable by their unique abdominal pattern featuring a

prominent scutum. These spiders are small in size and exhibit a distinctive olive-black colouration.

Remark. This species is newly described in this study.

***TRICHOTHYSE* Tucker, 1923**

Trichothyse is native to Africa, southern Europe, and Asia, distinguished by robust bodies, large anterior median eyes, and unique copulatory structures such as a bifurcated retrolateral tibial apophysis in males and characteristic spermathecae in females; species are typically found in arid or semi-arid habitats, often sheltering under stones or debris, and are poorly known in terms of natural history.

Type species. *Trichothyse hortensis* Tucker, 1923.

***Trichothyse jodhpurensis* (Gajbe, 1993)**

Megamyrmecon jodhpurensis Gajbe, 1993: 231, fig 1–5 (♀).

Poecilochroa jodhpurens Sankaran & Caleb, 2021: 548, figs 44–46, 49–51 (♀, transfer from *Megamyrmaekion*).

Trichothyse jodhpurens Sankaran, Haddad & Tripathi, 2025: 60, figs 90–119 (♂♀, transfer from *Poecilochroa*).

Distribution. Africa, Europe and Asia (Sankaran, P. M., Haddad, C. R. & Tripathi, R., 2025, World Spider Catalog 2025; present data)

Abundance: Common / Uncommon / Rare

Natural history. *Trichothyse jodhpurensis* is a common species often found under substrates with fine silk retreats. It can be easily identified by its dark colouration and a distinctive longitudinal stripe on the abdomen



Figure 4.16: Live images of *Trichothyse jodhpurensis* (Gajbe, 1993). A–C. Female, dorsal view.

Remark. In this study, we transferred the genus from *Poecilochroa* to *Trichothyse* and described male for the first time.

***XEROPHAEUS* Purcell, 1907**

Xerophaeus species are typically found in dry, arid ecosystems where they have adapted to the challenges of low humidity and sparse vegetation. They can be identified by carapace which is moderately convex and tapers at the front, featuring a thoracic stria. The sternum resembles that of *Drassodes*, being rather broad in the front and not strongly attenuated. The legs are typically short and robust, with spines on the metatarsi and tibiae of the anterior pairs. The genus includes 42 recognized species globally, and with first record of genus from India (WSC, 2025).

Type species. *Xerophaeus capensis* Purcell, 1907.

Xerophaeus aridocampus sp. nov.

Abundance: Common / Uncommon / Rare

Natural history. The name *Xerophaeus* comes from 'Xero,' meaning dry, and 'phaeus,' referring to the colour of twilight. This gives rise to the idea that they could be called 'dusky arid ground spiders,' as their colour allows them to blend seamlessly with the desert ground. *Xerophaeus aridocampus*, in particular, has been observed only a few times, and much remains unknown about this elusive species.

Remark. This study marks the first record of the genus in India with the description of a new species.

***ZELOTES* Gistel, 1848**

Zelotes are small to medium-sized ground spiders, known for their nocturnal, predatory behaviour. These dark-coloured spiders, often black or brown, are found in diverse habitats, including forests, grasslands, deserts, and urban areas, where they hide under rocks, logs, or leaf litter. The genus includes 404 recognized species globally, of which 29 are currently recorded from India (WSC, 2025).

Type species. *Melanophora subterranea* C. L. Koch, 1833.

Natural history. *Zelotes* are the most commonly encountered spiders in the Thar Desert, often thriving in diverse open habitats and adapting well to arid environments. These spiders are typically found beneath substrates such as rocks, cattle dung, and debris, where they shelter during the daytime to avoid high temperatures. Dark and robust, built for rapid movement, *Zelotes* are active nocturnal predators.

Zelotes sp. 1–6

FAMILY HERSILIIDAE Thorell, 1870

Two-tailed spiders

Hersiliidae are small to medium-sized arachnids known for their elongated spinnerets, which extend beyond their abdomen, giving them their distinctive name. Found in tropical and subtropical regions, they typically inhabit tree trunks, rocks, and flat surfaces, where their cryptic colouration provides excellent camouflage. The family currently includes 187 species in 16 genera globally, and 12 of them are presently known from India (Caleb & Sankaran, 2025; WSC, 2025).

Type genus. *Hersilia* Audouin, 1826.

***HERSILIA* Audouin, 1826**

Hersilia is a moderately diverse group of spiders with a widespread distribution across the Old World, comprising 80 recognized species worldwide, including seven documented from India (WSC, 2025). These spiders are easily identified by their exceptionally long posterior lateral spinnerets (Foord & Dippenaar-Schoeman, 2006). We describe a new species of *Hersilia* from the Thar Desert, naming it *sukshma* in reference to its diminutive size. Notably, no other members of the family Hersiliidae were encountered during the survey.

Type species. *Hersilia caudata* Audouin, 1826.

***Hersilia sukshma* sp. nov.**

Distribution. India (present study).

Abundance: Common / **Uncommon** / Rare

Natural history. *Hersilia sukshma* is found on tree trunks and is smaller than other species of *Hersilia* in India, with its name "sukshma" meaning "small." Its colouration

blends with the tree bark, providing effective camouflage. Mature individuals are typically observed only during the monsoon season.

Remark. This species is newly described in this study.

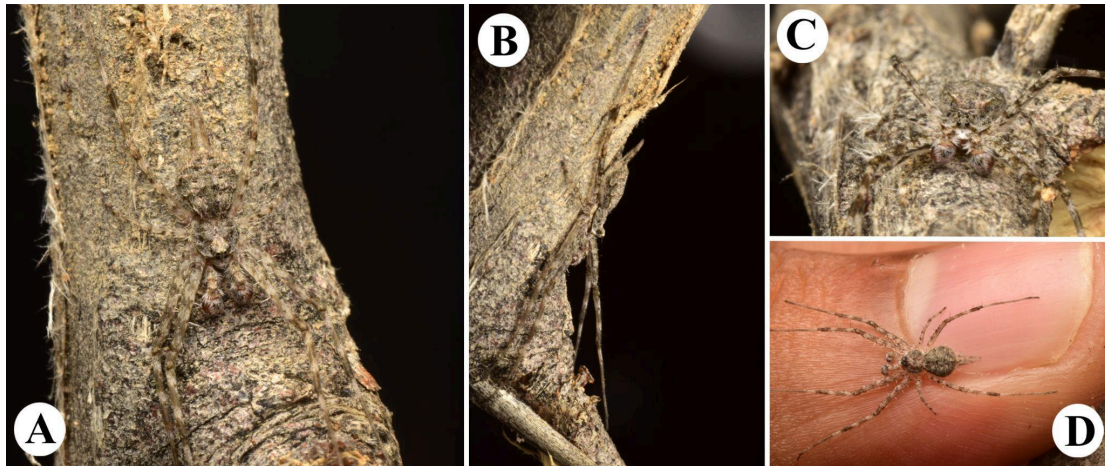


Figure 4.17: Live images of *Hersilia sukshma* sp. nov. **A & D.** Male, dorsal view. **B.** same, lateral view. **C.** same, frontal view.

FAMILY LYCOSIDAE Sundevall, 1833

Wolf spiders

Lycosids are a family of agile and visually adept ground-dwelling spiders found worldwide in diverse habitats, including forests, grasslands, deserts, and wetlands. Known for their keen eyesight, they have a distinctive eye arrangement. Wolf spiders are active hunters that do not rely on webs, instead using speed and stealth to ambush prey. Females are notable for their maternal care, carrying their egg sacs attached to their spinnerets and later transporting spiderlings on their abdomen. The family currently comprises 2,491 species in 135 genera globally, with 120 species recorded from India (Caleb & Sankaran, 2025; WSC, 2025).

Type genus. *Lycosa* Latreille, 1804.

***DRAPOSA* Kronestedt, 2010**

Draposa is a recent addition to the wolf spider genera, currently consisting of 12 species, nine of which have been documented in India. They are characterized by the presence of a subpaleal sclerite with two processes, partially concealed by the palea in the terminal section of the bulbus. Females can be distinguished by their epigyneal cavity, which is partially divided by a tongue-like septum.

Type species. *Lycosa nicobarica* Thorell, 1891.

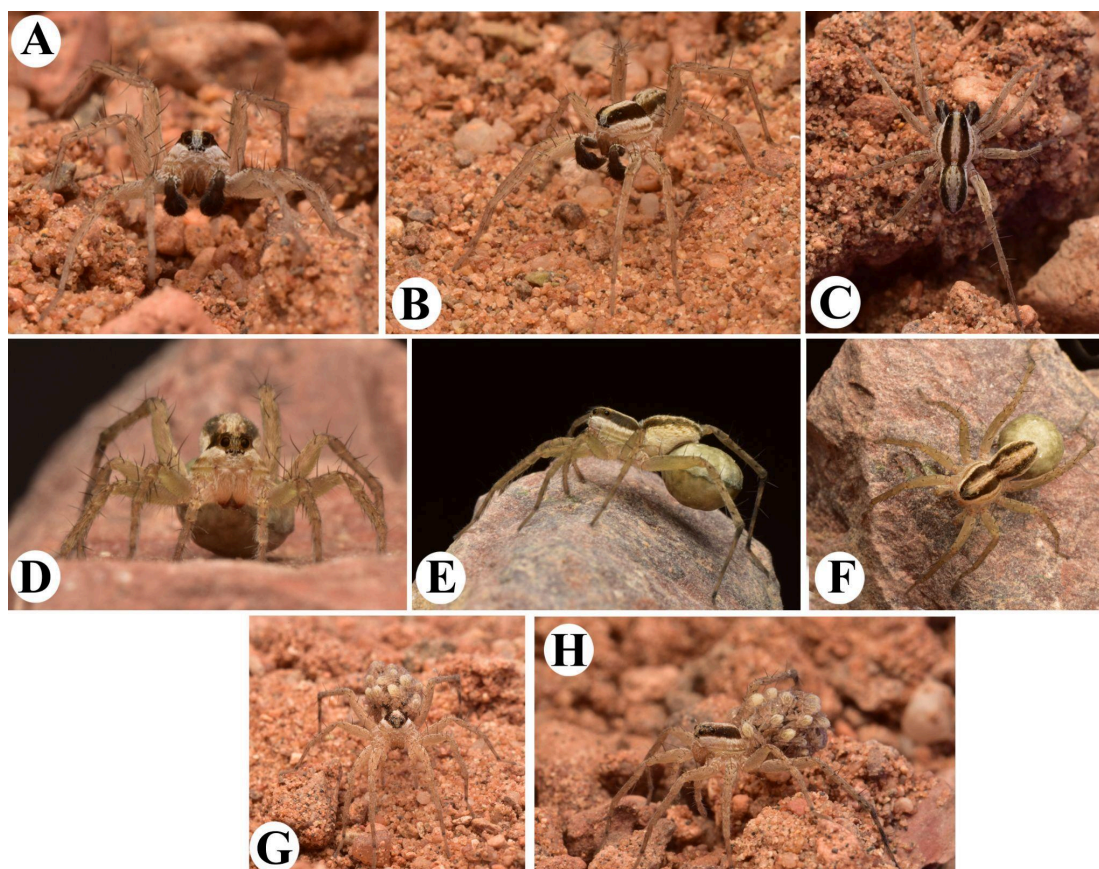
***Draposa* sp. 1**

Figure 4.18: Live images of *Draposa* sp. 1. A–B. Male, frontal view. C. same, dorsal view. D & G. Female, frontal view. E & H. same, lateral view. F. same, dorsal view.

Abundance: Common / Uncommon / Rare

Natural history. *Draposa* are primarily observed during the monsoon season when the climate is moist and the grass is lush and green, with a significant presence in Ramdeora but very few or none in Sam. They tend to occur in high numbers where they are present but are entirely absent in other areas. In the same location, all life stages can be found, from juveniles to adults, including females carrying egg sacs attached to their abdomen or spiderlings on their abdomen.

***EVIPPA* Simon, 1882**

Evippa are small to medium-sized wolf spiders with relatively long legs, distinguished by six pairs of long spines on legs I-II. Carapace features a transverse depression behind the ocular area. Cephalothorax with a prominent pale median band and lateral bands on the carapace that may appear as continuous lines or broken into pale spots. Abdomen displays a well-developed pattern of white patches on a speckled brown or sandy-yellow background. The legs are relatively long, equipped with elongated tarsal claws featuring numerous teeth. Notably, some species tarsi feature a pseudo-articulation a transverse groove aiding in sandy terrain navigation by providing extra support for movement (Alderweireldt, 1991). Genus includes 38 recognized species globally, of which nine are currently recorded from India (WSC, 2025).

Type species. *Lycosa arenaria* Audouin, 1826.

***Evippa fortis* Roewer, 1955**

Evippa fortis Roewer, 1955: 758, fig. 4 (♂).

Evippa sector Alderweireldt & Jocqué, 2017: 13, plate IX–XI, XIV, figs 10–11, 14, 17 (♂♀).

Evippa fortis Zamani et al., 2017: 69, figs 7A–C (♂, synonym of *Evippa sector*).

Abundance: Common / **Uncommon** / Rare

Distribution. Iran, United Arab Emirates, India (WSC, 2025; present study).

Natural history. Similar to *E. rajasthanica* but less common.

Remark. This study marks the first record of the species in India.

Evippa rajasthanica Tikader & Malhotra, 1980

Evippa rajasthanica Tikader & Malhotra, 1980: 306, figs 126–130 (♂♀).

Evippa rajasthanica Sankaran, Caleb & Sebastian, 2021: 160, figs 2A–C, 3A–F (♂♀).

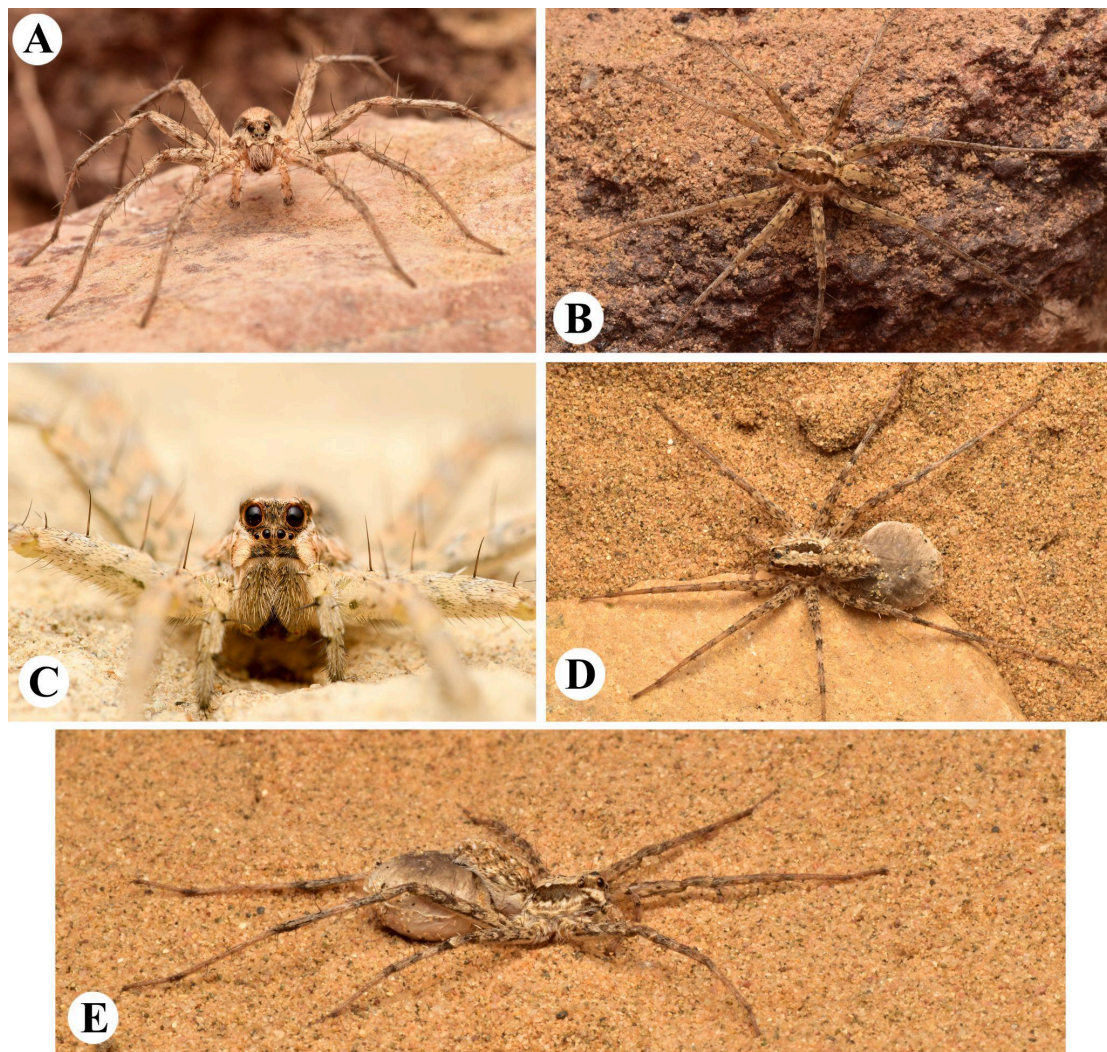


Figure 4.19: Live images of *Evippa rajasthanica* Tikader & Malhotra, 1980. **A.** Male, frontal view. **B.** same, dorsal view. **C.** Female, frontal view. **D.** same, dorsal view. **E.** same, lateral view.

Abundance: Common / Uncommon / Rare

Distribution. India (WSC, 2025).

Natural history. *Evippa rajasthanica* is most common lycosid species in the Thar Desert, observed throughout all seasons. Females are more abundant than males, and they are predominantly active during the day.

***HIPPASA* Simon, 1885**

Hippasa species are web-building spiders that construct funnel-like webs resembling those of the family Agelenidae. However, they are set apart by their distinct eye arrangement, also unlike most Lycosidae, which are primarily cursorial hunters. They are distinguishable by their slender body, distinct chevron-like yellow and white markings on the dorsum of the opisthosoma, and two-segmented posterior spinnerets with elongated basal segments. A mid-longitudinal black band on the sternum further aids identification. Currently, the genus includes 26 species restricted to the Old World, ranging from the African continent and Arabian Peninsula to Central and Eastern Asia, with 11 notable representations in India.

Type species. *Pirata agelenoides* Simon, 1884.

***Hippasa agelenoides* (Simon, 1884)**

Pirata agelenoides Simon, 1884: 334 (♀).

Hippasa agelenoides Simon, 1885: 31.

Diapontia agelenoides Thorell, 1887: 300 (♂).

(For the complete list of references see WSC, 2025).

Abundance: Common / Uncommon / Rare

Distribution. Pakistan, India, Myanmar (WSC, 2025).

Natural history. *Hippasa agelenoides* constructs distinctive funnel-shaped webs in loose soil, grass litter, or low vegetation. These webs serve as both hunting platforms and retreats, where the spiders ambush prey that lands on the web, alerted by vibrations. These spiders were observed in greater numbers at Ramdeora compared to the Sam area.

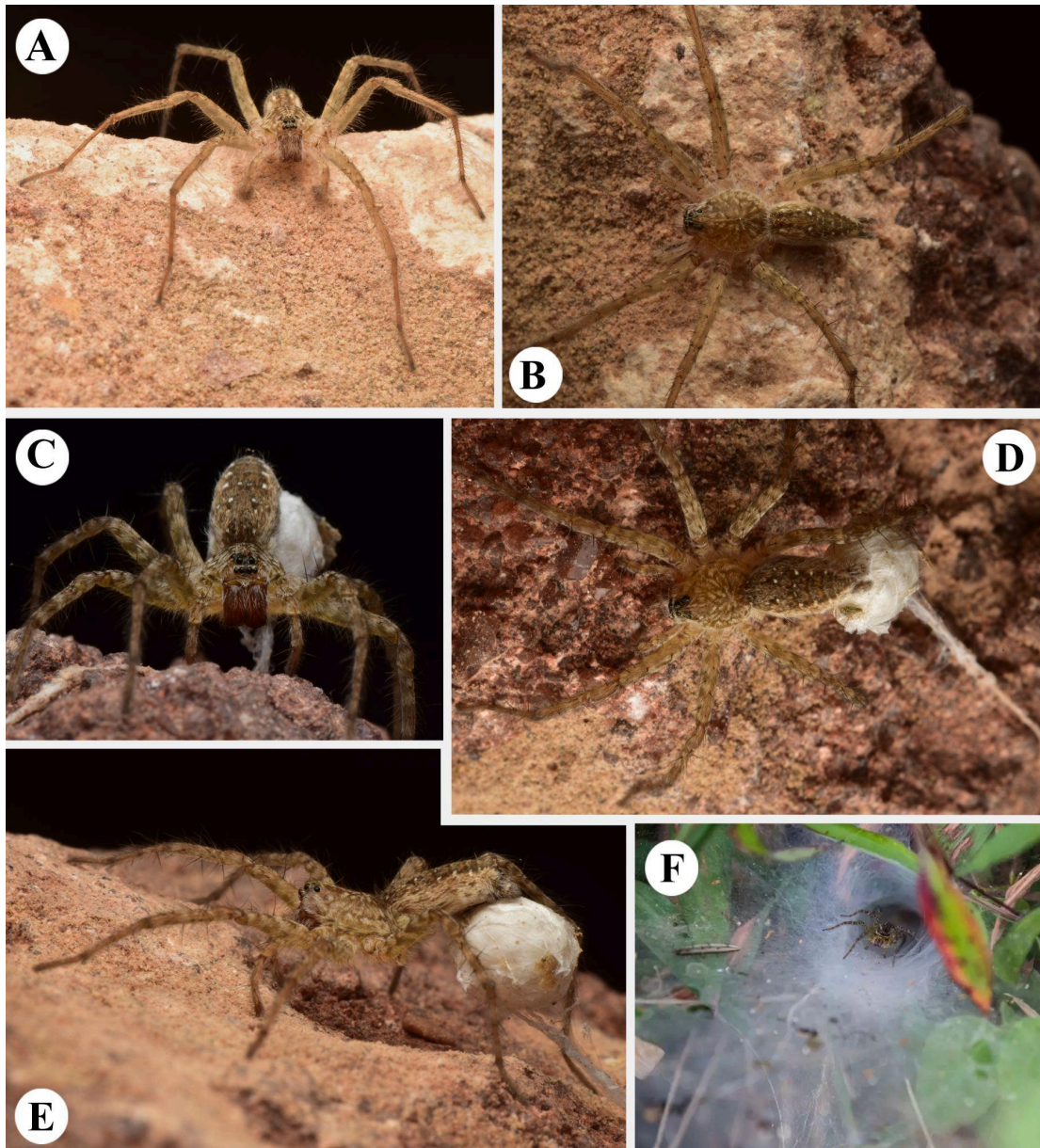


Figure 4.20: Live images of *Hippasa agelenoides* (Simon, 1884). **A.** Male, frontal view. **B.** same, dorsal view. **C.** Female, frontal view. **D.** same, dorsal view. **E.** same, lateral view. **F.** Web structure.

HOGNA Simon, 1885

Hogna comprises medium to large wolf spiders found worldwide except Antarctica. These robust ground-dwelling spiders are known for their agile hunting behavior, often living in self-made burrows or under debris rather than spinning webs.

Type species. *Lycosa radiata* Latreille, 1817.

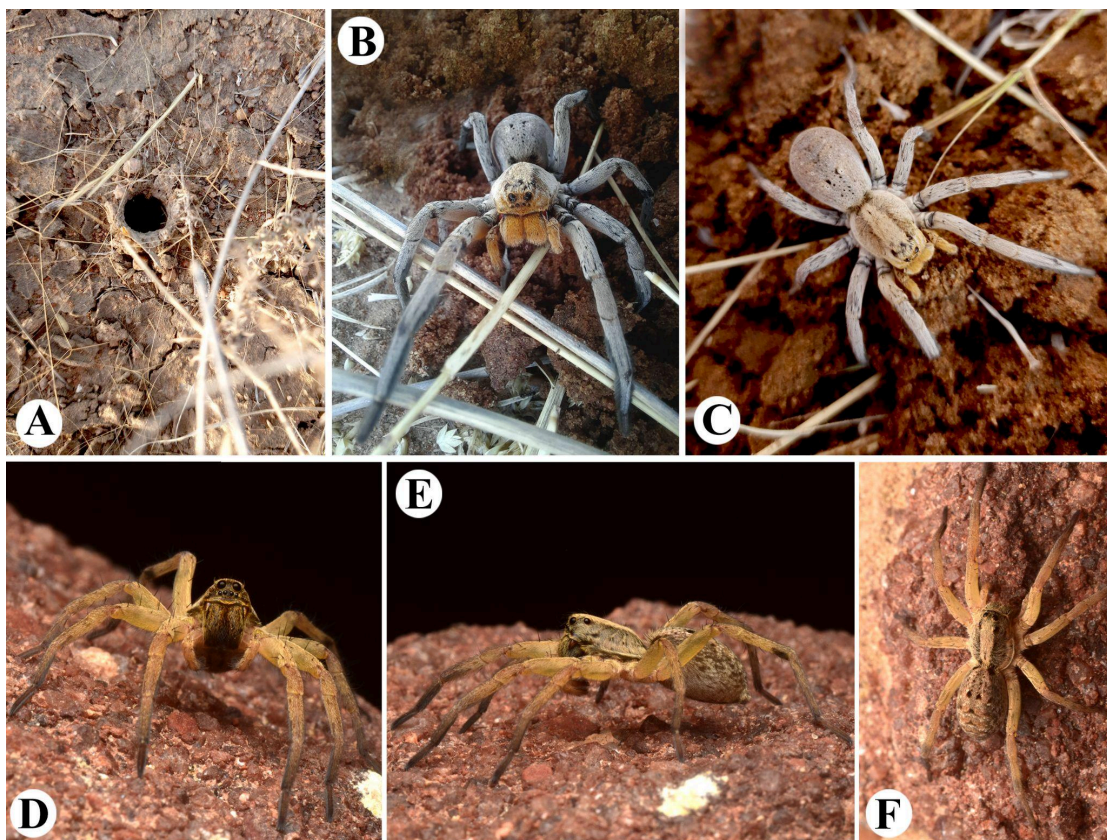
***Hogna* sp. 1**

Figure 4.21: Live images of *Hogna*. **A.** Ground burrow. **B.** Female, frontal view. **C.** same, dorsal view. **D.** Subadult female, frontal view. **E.** same, lateral view. **F.** same, dorsal view.

Abundance: Common / **Uncommon** / Rare

Natural history. *Hogna* sp. was more abundant at Ramdeora than at Sam. These primarily nocturnal spiders shelter in vertical burrows in grasslands during the day and emerge at night near light sources, exploiting the attracted insects as prey.

WADICOSA Zyuzin, 1985

Wadicosa is characterized by medium-sized wolf spiders with robust bodies adapted to semi-aquatic and terrestrial habitats. Species are typically distinguished by their well-developed leg spination, unique genital morphology, and often striking dorsal patterns, which aid in camouflage. These spiders are active hunters, relying on speed and agility rather than webs to capture prey. Distributed primarily across Africa, Asia, and the southern Palearctic region, they are frequently found near water bodies or moist habitats (WSC, 2025).

Type species. *Lycosa fidelis* O. Pickard-Cambridge, 1872.

***Wadicosa fidelis* (O. Pickard-Cambridge, 1872)**

Lycosa fidelis O. Pickard-Cambridge, 1872: 319 (♂).

Lycosa galerita L. Koch, 1875: 69, plate VII, fig 1 (♂).

Lycosa galerita Simon, 1876: 269 (♀).

(For the complete list of references see WSC, 2025).

Abundance: Common / Uncommon / Rare

Distribution. Macaronesia, North Africa, Southern Europe, Caucasus, Middle East, Central Asia, China, Japan, Pakistan, India, Bhutan, Bangladesh, Philippines, Indonesia (Sumatra) (WSC, 2025).

Natural history. *Wadicosa fidelis* is predominantly observed near water bodies, with their populations experiencing a noticeable surge following the monsoon season. Their numbers are particularly high around temporary pools formed during this period, which persist for a few months.

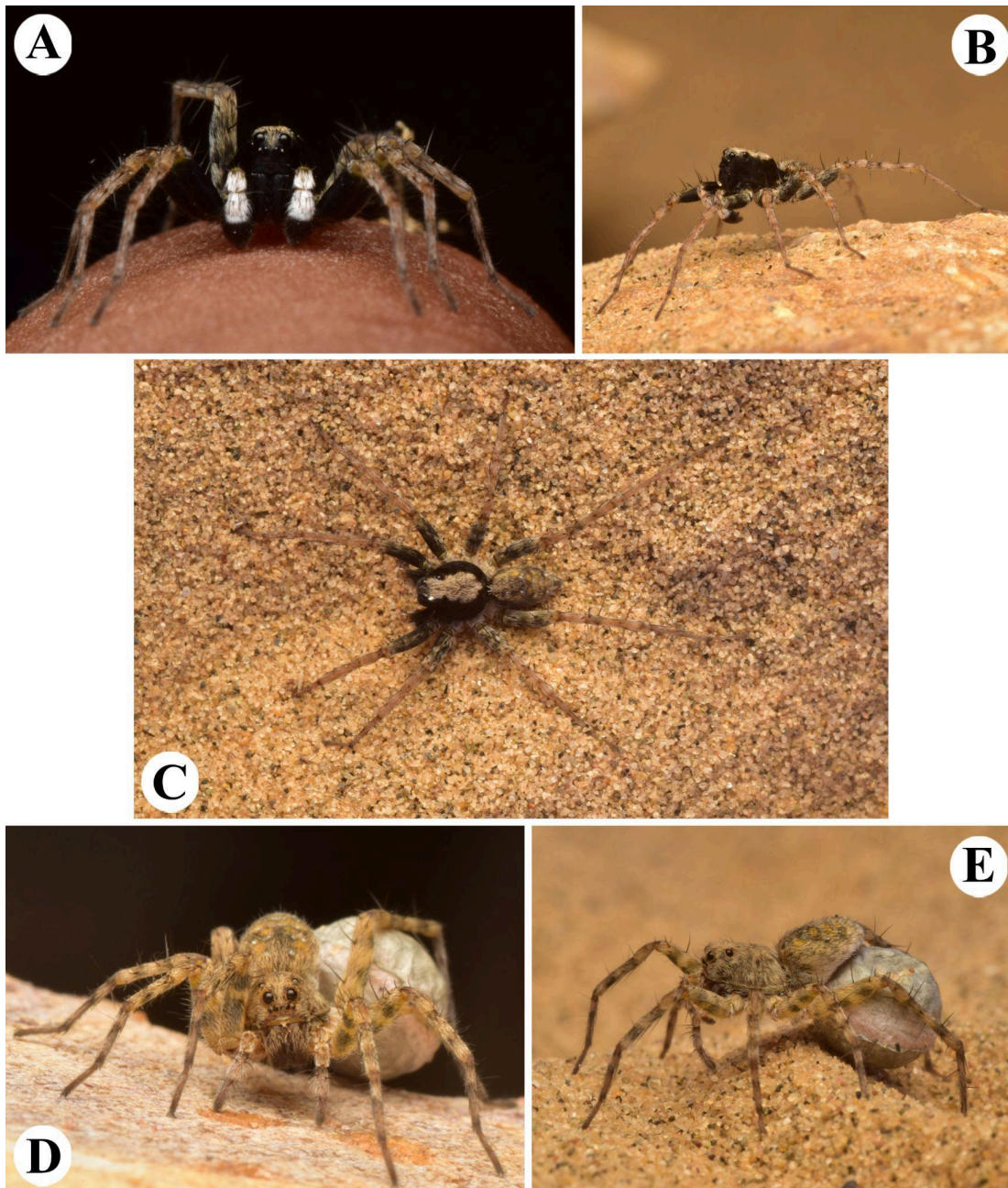


Figure 4.22: Live images of *Wadicosa fidelis* (O. Pickard-Cambridge, 1872). **A.** Male, frontal view. **B.** same, lateral view. **C.** same, dorsal view. **D.** Female, frontal view. **E.** same, lateral view.

FAMILY MIMETIDAE Simon, 1881

Pirate spiders

Mimetidae, or pirate spiders, are known for its unique predatory behaviour, often preying on other spiders. These small to medium-sized spiders have slender bodies, long spiny legs, and a globular abdomen. Instead of building their own webs, they

invade the webs of other spiders, mimicking prey vibrations to lure and attack the host. Found worldwide, especially in tropical and subtropical regions, mimetids play a vital ecological role by regulating spider populations through their specialized hunting strategies. The family currently has 164 species in 8 genera globally (WSC, 2025).

Type genus. *Mimetus* Hentz, 1832.

ERO C. L. Koch, 1836

Ero are known for their unique araneophagic behavior, specializing in preying on web-building spiders, particularly theridiids and linyphiids. They skillfully invade the webs of other spiders, moving freely within them to capture and feed on the web owners. Currently, the genus comprises 43 species, and this study represents the first record of the genus from India.

Type species. *Aranea tuberculata* De Geer, 1778.

Ero sp. 1

Abundance: Common / **Uncommon** / Rare

Natural history. *Ero* sp. are nocturnal pirate spiders often found in close association with *Neoscona* sp. In the Thar Desert region, they are frequently found on trees such as *Prosopis cineraria* (khejri), *Ziziphus* (ber), and *Vachellia tortilis*, with notable populations recorded near the Indira Gandhi Canal. Their presence near orb-weaver webs highlights their ecological role as specialized spider predators and occasional scavengers in these habitats.

Remark. First record of genus from India with a new species

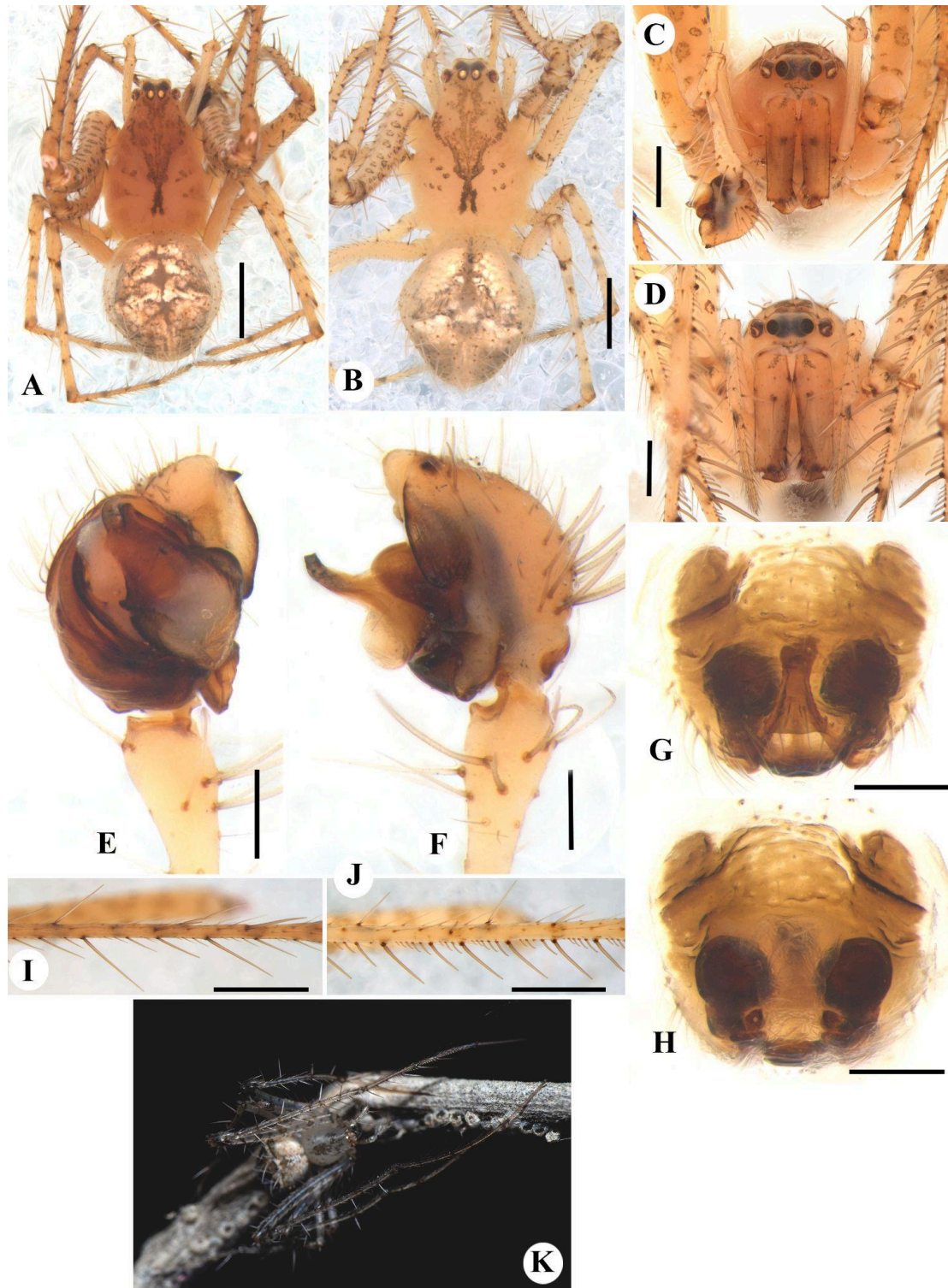


Figure 4.23: Microscopic and live images of *Ero* sp. 1. **A.** Male, dorsal view. **B.** Female, dorsal view. **C.** Male, frontal view. **D.** Female, frontal view. **E.** Left palp, ventral view. **F.** same, retrolateral view. **G.** Epigyne, ventral view. **H.** same, dorsal view. **I.** Male, leg I metatarsus. **J.** Female, leg I metatarsus. **K.** Live, dorsal view. Scale bars: A–B 1mm; C–D 0.5 mm; E–H 0.2 mm; I–J 1 mm.

FAMILY OECOBIIDAE Blackwall, 1862

Disc web spiders

Oecobiidae, or Disc web spiders, comprise small to medium-sized spiders recognized for their flattened bodies and distinctive circular webs. These spiders are often found in warm climates on walls, under rocks, or in crevices. They are characterized by their short legs, which are well-suited for navigating flat surfaces, and a unique arrangement of their spinnerets, with an enlarged cribellum used to produce fine, wool-like silk for their webs. Oecobiid spiders are active hunters, feeding on small arthropods, including ants, which they immobilize with rapid silk spinning. The family has 129 species in 7 genera globally (WSC, 2025).

Type genus. *Oecobius* Lucas, 1846.

***OECOBIUS* Lucas, 1846**

Oecobius are small, and flattened, these spiders are easily recognized by their compact bodies, and short legs. *Oecobius* are often found on walls, ceilings, under rocks, and in crevices, they have a unique arrangement of spinnerets with an enlarged cribellum and calamistrum, distinguishing them from *Uroctea* Dufour, 1820, which lack these structures. The genus is represented by 93 nominal species globally, four are currently known from India (WSC, 2025).

Type species. *Oecobius domesticus* Lucas, 1846.

***Oecobius thar* Tripathi, Sudhikumar & Sherwood, 2023**

Oecobius thar Tripathi, Sudhikumar & Sherwood, 2023: 485, fig. 1A–D, 2A–E, 3A–B, 4A–D (♂♀).

Abundance: Common / Uncommon / Rare

Distribution. India (present study; Tripathi, Sudhikumar & Sherwood, 2023).

Natural history. *Oecobius thar* are tiny spiders found on walls, rocks, and ceilings near human settlements. They are pale and flattened, allowing them to blend seamlessly with surfaces. Females lay eggs in silk-covered sacs near their webs and guard them until the spiderlings hatch and disperse. These spiders construct small, circular webs with a central retreat, where they ambush prey such as small insects.

Remark. *Oecobius thar* is the new species described in this study.

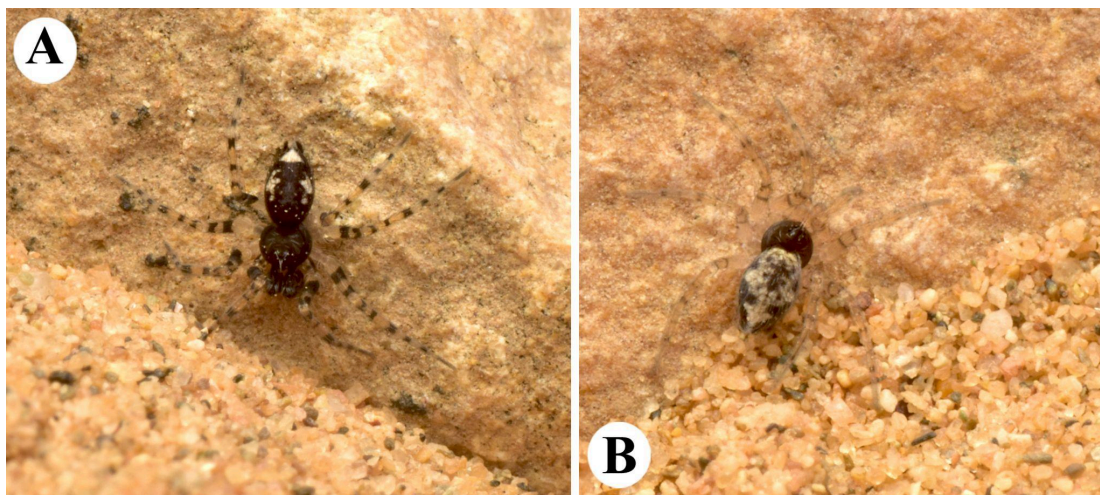


Figure 4.24: Live images of *Oecobius thar* Tripathi, Sudhikumar & Sherwood, 2023. **A.** Male, dorsal view. **B.** Female, dorsal view.

UROCTEA Dufour, 1820

Uroctea are typically found in dimly lit habitats such as walls, wood, or under stones, where they construct distinctive tent-like webs with radiating silk strands. Most of its known species occur in Africa and Asia, except the type species *Uroctea durandi* (Latreille, 1809), which is found in Mediterranean regions of Southern Europe (WSC, 2025). *Uroctea* shares a similar body shape with other oecobiids but can be distinguished by its larger body size (exceeding 5 mm) and the absence of a cribellum, which separates it from Oecobiinae genera like *Oecobius*, *Paroecobius*,

and *Platoecobius* (Le Peru, 2011). Ecologically, *Uroctea* thrives in concealed, low-light environments, using its unique web architecture for both shelter and prey capture. The genus includes 23 recognized species globally, of which three are currently recorded from India

Type species. *Clotho durandi* Latreille, 1809.

Uroctea thaleri Rheims, Santos & van Harten, 2007

Uroctea paivani Baum, 1972: 135, figs 45–49 (♂, misidentified).

Uroctea sp. Baum, 1972: 113, figs 11–13 (♀).

Uroctea indica Gajbe & Bhadra, 1978: 933, figs 1–5 (♀, misidentified).

(For the complete list of references see WSC, 2025).

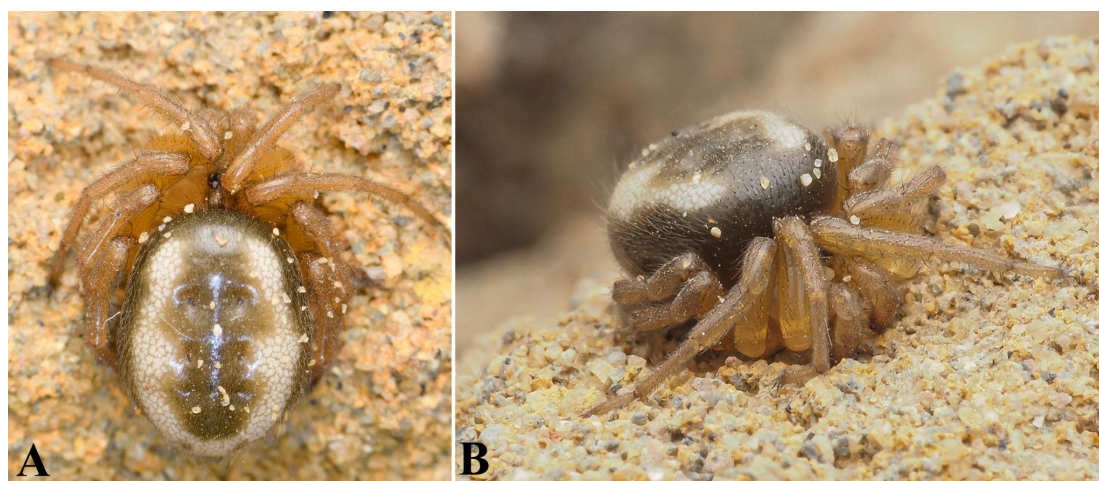


Figure 4.25: Live images of *Uroctea thaleri* Rheims, Santos & van Harten, 2007. **A.** Female, dorsal view. **B.** same, frontal view.

Abundance: Common / **Uncommon** / Rare

Distribution. Turkey, Israel, Yemen, Iraq, Iran, India (WSC, 2025).

Natural history. *Uroctea* spiders build dome-shaped webs with a central retreat for protection and prey capture; their flattened bodies help them blend into rocky surfaces, and females guard egg sacs. They are commonly found sheltering under rocks.

FAMILY OONOPIDAE Simon, 1890

Goblin spiders

Oonopidae is a family of tiny, six-eyed spiders found worldwide, especially in tropical and subtropical regions. They are often less than 2 mm in size, are with specialized adaptations, such as modified chelicerae or pedipalps, which are crucial for species identification. Typically nocturnal and predatory, they inhabit leaf litter, soil, caves, and bark, preying on small arthropods. With over 1,962 described species and many more awaiting discovery, Oonopidae represents a fascinating and diverse group within the spider world. India currently has 47 described species.

Type genus. *Oonops* Templeton, 1835.

***GAMASOMORPHA* Karsch, 1881**

Gamasomorpha is one of the largest genera in the family Oonopidae, with 48 species recorded worldwide (Platnick, 2008) and one only species from India.

Type species. *Gamasomorpha cataphracta* Karsch, 1881.

***Gamasomorpha* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. Their lifestyle remains largely unknown, as they have only been observed a few times.

FAMILY OXYOPIDAE Thorell, 1869

Lynx spiders

Oxyopidae consists of small to medium-sized spiders characterized by their spiny legs and fast, aggressive behaviour. Oxyopids are distinguished by their long, slender bodies, sharp spines on their legs, a carapace that is longer than wide, conspicuous

stripes and spots on the clypeus, eyes arranged in a hexagonal pattern on the carapace, and an abdomen tapering to a point at the posterior. The family currently represents 443 species in 9 genera globally, and 89 are known from India (Caleb & Sankaran, 2025; WSC, 2025). Many Indian species are known from the original description, which needs revision.

Type genus. *Oxyopes* Latreille, 1804.

HAMATALIWA Keyserling, 1887

Hamataliwa is a moderately diverse genus of lynx spiders with worldwide distribution, comprising 90 species globally, including 10 from India (WSC, 2025). Species are recognized by their distinct sexual characters: females possess an epigyne with a shallow median depression bordered by a semicircular or U-shaped sclerotized rim, short copulatory ducts, and round to oval spermathecae, while males show a palpal embolus with a basal twist or loop and a finger-like outgrowth at the base of the cymbium.

Type species. *Hamataliwa grisea* Keyserling, 1887.

Hamataliwa sp. 1

Abundance: Common / **Uncommon** / Rare

Natural history. *Hamataliwa* sp. 1 are arboreal predators found on tree branches. These spiders are highly camouflaged, blending seamlessly with bark or foliage, which aids in ambush predation. Juveniles are often seen before the monsoon season, sharing similar colouration, while adults become more prominent during monsoons, with some species showing sexual dimorphism.

***Hamataliwa* sp. 2**

Abundance: Common / Uncommon / **Rare**

Natural history. Similar to *Hamataliwa* sp. 1.

***OXYOPES* Latreille, 1804**

Oxyopes is a highly diverse genus of lynx spiders with worldwide distribution, comprising 284 recognized species, of which 56 are known from India (WSC, 2025). They are characterized by a high, rounded carapace with a vertical clypeus that remains flat for most of its length before sloping steeply at the thoracic part; eyes arranged in four rows with the posterior eye row strongly procurved and evenly spaced; a thin black line extending from each anterior median eye down the vertical face to the tip of the long pale chelicerae, and a slender abdomen that is broadest at the front and gradually tapers to the spinnerets.

Type species. *Aranea heterophthalma* Latreille, 1804.

***Oxyopes kusumae* Gajbe, 1999**

Oxyopes kusumae Gajbe, 1999: 58, figs 59–62 (♀).

Oxyopes kusumae Gajbe, 2008: 59, figs 122–125 (♀).

Distribution. India (WSC, 2025).

Abundance: Common / **Uncommon** / Rare

Natural history. *Oxyopes kusumae* is uncommon; typically we found them on shrubs, but their numbers significantly increase during the monsoon season.

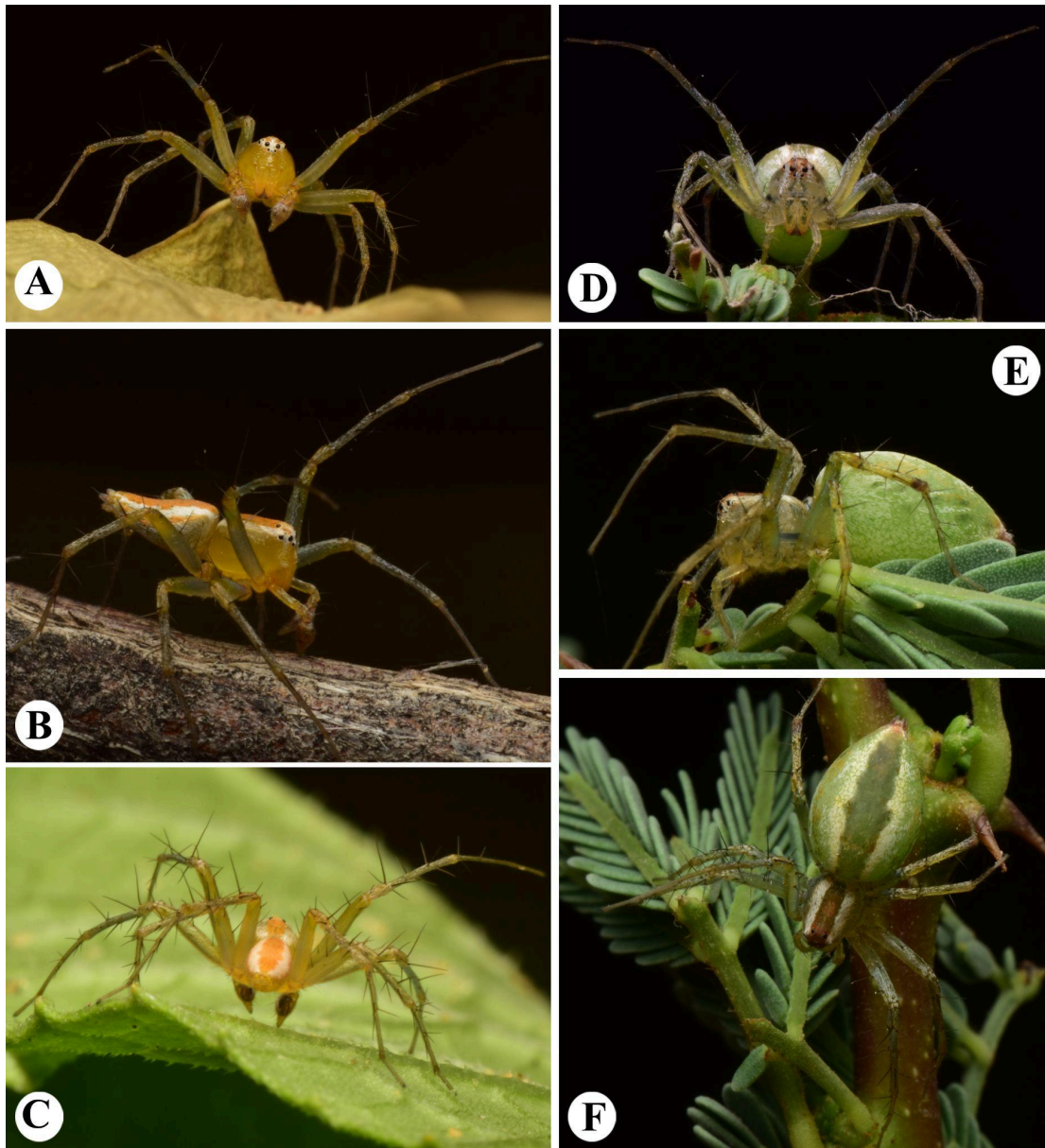
Oxyopes orange sp. nov.

Figure 4.26: Live images of *Oxyopes orange*. **A.** Male, frontal view. **B.** same, lateral view. **C.** same, rear view. **D.** Female, frontal view. **E.** same, lateral view. **F.** same, dorsal view.

Abundance: Common / **Uncommon** / Rare

Natural history. *Oxyopes orange* spiders are found on trees during the monsoon; juveniles are orange, males remain orange as adults, while females turn green.

Remark. This species is newly described in this study.

PEUCETIA Thorell, 1869

Peucetia is a moderately species-rich genus of lynx spiders with worldwide distribution, comprising 47 recognized species globally, including 21 reported from India (WSC, 2025). They differ from *Oxyopes* and *Hamataliwa* by the absence of cheliceral teeth and the presence of a paracymbium in the male palp, along with a long articulated median apophysis.

Type species. *Pasithea viridis* Blackwall, 1858.

Peucetia viridis (Blackwall, 1858)

Pasithea viridis Blackwall, 1858: 428 (♂).

Oxyopes littoralis Simon, 1866: 287, plate IV, figs 13–18 (♂♀).

Peucetia viridis Thorell, 1869: 37.

(For the complete list of references, see WSC, 2025).



Figure 4.27: Live images of *Peucetia viridis* (Blackwall, 1858). **A.** Male, frontal view. **B.** same, dorsal view.

Distribution. Spain, Greece, Africa, Middle East, India. Introduced to Caribbean Islands (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Peucetia viridis* is the most common species in the Thar Desert, frequently found on green shrubs and emitting a peculiar odor. They are abundant in

agricultural areas, and after harvest, they can be seen in large numbers on the remaining standing shrubs. It has been observed that their colour changes with the seasons: during the monsoon, when most plants are green, they adopt a green colouration; in summer and winter, when grasses and plants turn brown or pale, they blend in with those colours. In transitional periods, intermediate colours are also visible.

Remark. The study presents the first record of species from India.

FAMILY PALPIMANIDAE Thorell, 1869

Palp-footed spiders

Palpimanidae comprises a small group of spiders known for their robust, heavily sclerotized front legs, which they use to capture prey. They are nocturnal hunters, often residing under rocks, bark, or leaf litter. Characterized by cribellate, two to three-clawed, six or eight-eyed, distributed in the tropical and subtropical regions of the world except Australia. The family currently represents 176 species in 20 genera globally, and 8 of them are known from India (Caleb & Sankaran, 2025; WSC, 2025).

Type genus. *Palpimanus* Dufour, 1820.

***PALPIMANUS* Dufour, 1820**

Palpimanus usually has small posterior median eyes, separated by five or more times their diameter; other palpimanines generally have large posterior median eyes, separated by four times their diameter or less (Platnick, 1981). The genus currently comprises 43 nominal species globally, with four species known from India.

Type species. *Palpimanus gibbulus* Dufour, 1820.

***Palpimanus godawan* Tripathi & Sankaran, 2023**

Palpimanus godawan Tripathi & Sankaran, in Tripathi et al., 2023: 28, figs 1A-B, 2A-K, 3A-L, 4A-H, 5A-F, 6A-E (♂♀).

Distribution. India (Tripathi & Sankaran, 2023;WSC, 2025).

Abundance: Common / Uncommon / **Rare**

Natural history. *Palpimanus godawan* is found under rocks or occasionally under cattle dung. It moves slowly, is shy by nature, and always tries to hide under stones when disturbed.

Remark. A new species is described in the present study.



Figure 4.28: Live images of *Palpimanus godawan* Tripathi & Sankaran, 2023. A & C. Female, dorsal view. B. same, lateral view D. same, frontal view.

FAMILY PHILODROMIDAE Thorell, 1869

Running crab spiders

Philodromidae are small to medium-sized, agile hunters recognized by their flattened bodies and crab-like appearance, with legs extending sideways. Unlike true crab spiders (Thomisidae), their legs are relatively equal in length, aiding their swift, darting movements. Philodromids are active hunters that rely on speed and camouflage to ambush prey, often blending seamlessly into vegetation, tree bark, or other surfaces in diverse habitats. With over 500 species in about 29 genera, they play a crucial ecological role in controlling insect populations, serving as natural pest regulators in their ecosystems.

Type genus. *Philodromus* Walckenaer, 1826.

***PHILODROMUS* Walckenaer, 1826**

Type species. *Araneus aureolus* Clerck, 1757

Philodromus are typically found on tree trunks, bushes, undergrowth, and low vegetation, but they are rarely seen on bare ground. Although capable of rapid movement, they often capture prey by ambushing it with their legs extended. These spiders are generally gray to brownish-yellow, occasionally displaying a dark median marking on the opisthosoma, which may resemble spiders of the genus *Thanatus*. However, the two genera can be distinguished using specific taxonomic keys (Levy, 1977). *Philodromus* is the largest genus in the family Philodromidae, encompassing over 214 species worldwide, and 22 of them in India.

***Philodromus* sp. 1–2**

Abundance: Common / Uncommon / Rare

Natural history. *Philodromus* are commonly found in the Thar Desert, where they are frequently observed on the ground. At a glance, they closely resemble *Evippa* spiders due to their overall body shape and behaviour. However, upon closer examination, distinct differences become apparent. Their sandy colouration allows them to blend seamlessly with the desert landscape, providing excellent camouflage against the arid, sandy background. This adaptive colouration helps them avoid predators and efficiently ambush prey, making them well-suited for survival in the harsh desert environment.

***RHYSODROMUS* Schick, 1965**

Type species. *Thomisus histrio* Latreille, 1819

Rhysodromus known for their agile movements and excellent camouflage. These spiders have flattened, elongated bodies with laterigrade legs, allowing swift lateral movement across sandy or rocky surfaces. Their cryptic colouration, often in shades of brown or sandy tones, helps them blend seamlessly into arid environments like the Thar Desert. Unlike web-building spiders, *Rhysodromus* species are active hunters, relying on stealth and speed to ambush small insects. Their adaptability to harsh, dry climates highlights their ecological role as efficient predators, contributing to insect population control and ecosystem balance.

***Rhysodromus* sp. 1–2**

Abundance: Common / Uncommon / Rare

Natural history. *Rhysodromus* have swift, agile movements and laterigrade legs adapted for quick, side-to-side locomotion. These spiders are typically found in diverse habitats ranging from leaf litter and low vegetation to tree trunks and rocky

surfaces. *Rhysodromus* species are sit-and-wait predators, relying on their keen vision and speed to ambush prey rather than constructing webs. Their cryptic colouration allows them to blend seamlessly with their surroundings, aiding in both predation and evasion from predators.

***THANATUS* C. L. Koch, 1837**

Thanatus are agile hunters known for their speed and ability to chase down prey. In the field, they can easily be mistaken for wolf spiders (Lycosidae) due to their similar appearance and behaviour. These spiders are commonly found on bare ground or among low vegetation, with some species being particularly abundant in grassy areas. Their colouration typically ranges from yellow to pale brown, and the dorsal surface of the opisthosoma often features a distinctive dark rhomboid marking (Levy, 1977). The genus is represented by 97 nominal species globally and ten of them are currently known from India (WSC, 2025).

Type species. *Araneus formicinus* Clerck, 1757.

***Thanatus fabricii* (Audouin, 1826)**

Philodromus fabricii Audouin, 1826: 392, plate VI, fig. 3 (♂).

Thanatus cervini Simon, 1875: 327 (♂).

Thanatus fabricii Simon, 1875: 330.

(For the complete list of references, see WSC, 2025).

Distribution. Canary Islands, Northern Africa, South Africa, Portugal, Spain, Greece (Crete), Turkey, Caucasus, Middle East, Iran, Kazakhstan, Central Asia (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Thanatus fabricii* can be observed throughout the year, their sandy colouration providing excellent camouflage within the surroundings. Typically found on the ground, they are swift movers and are often mistaken for *Evippa* until examined closely.

Remark. First record of the species from India.

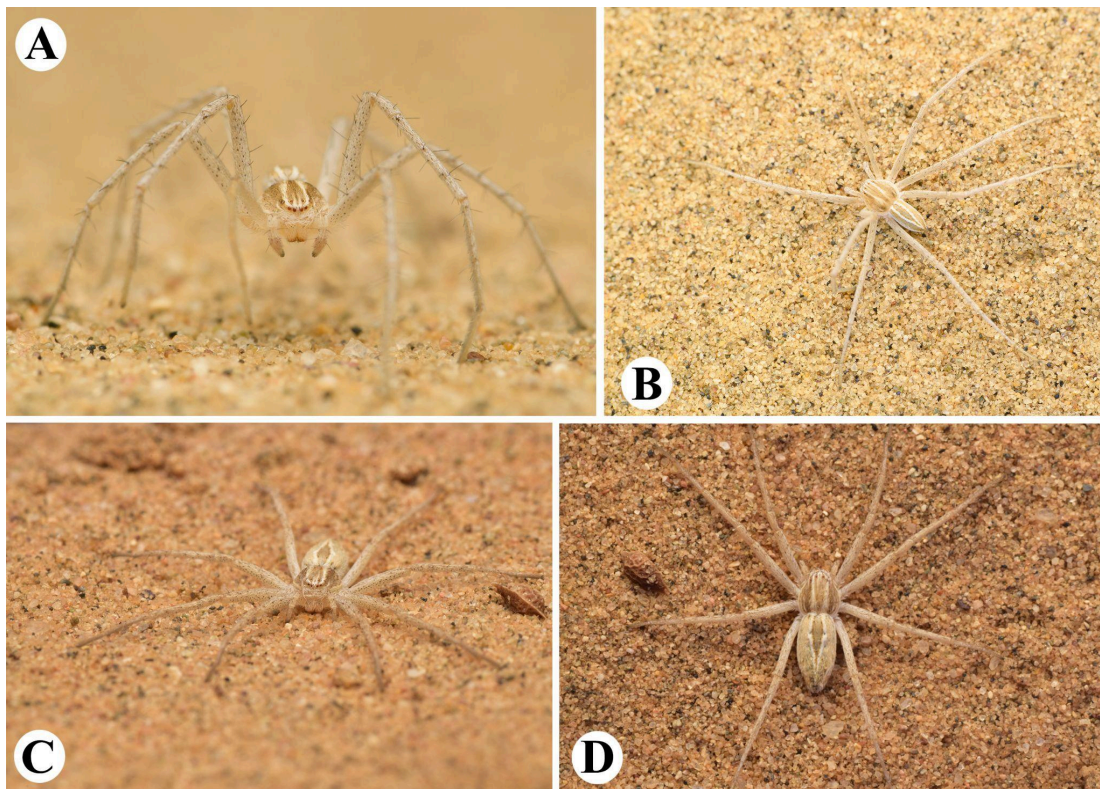


Figure 4.29: Live images of *Thanatus fabricii* (Audouin, 1826). **A.** Male, frontal view. **B.** same, dorsal view. **C.** Female, frontal view. **D.** same, dorsal view.

FAMILY PHOLCIDAE C. L. Koch, 1850

Daddy long-legged spiders

Pholcidae are small to medium-sized, pale-coloured spiders with delicate, elongated legs and six to eight eyes. They build irregular, messy webs in dark, undisturbed habitats such as caves, basements, ceilings, and corners of human dwellings, but can also be found in forests and deserts. Known for their unique vibration defense

mechanism, these spiders rapidly oscillate within their webs when disturbed, creating a blurry effect that confuses predators. The family currently comprises 2,024 species across 97 genera globally, with 16 species recorded from India (Caleb & Sankaran, 2025; WSC, 2025).

Type genus. *Pholcus* Walckenaer, 1805.

***ARTEMA* Walckenaer, 1837**

Artema is a moderately species-rich group distributed across the Oriental, Ethiopian, and Palearctic regions (WSC, 2025). While 12 species are globally represented, only one is currently recorded from India. *Artema* spiders are characterized by a circular, flat carapace with a tall, slightly protruding clypeus. Eight eyes are arranged, with two in front and two compact groups of three on the sides. Their abdomen is globular, rounded at the top, and tapers gradually toward the spinnerets.

Type species. *Artema atlanta* Walckenaer, 1837.

***Artema atlanta* Walckenaer, 1837**

Artema atlanta Walckenaer, 1837: 656 (♂♀).

Artema mauriciana Walckenaer, 1837: 657, pl. 15, fig. 1 (♂♀)

Pholcus sisypoides Doleschall, 1857: 408

(For the complete list of references, see WSC, 2025).

Distribution. North Africa, Middle East. Introduced to both Americas, St. Helena, tropical Africa, Britain, Belgium, Greece, Turkey, tropical Asia, China, Japan, Taiwan, Australia, Pacific Is.

Abundance: Common / Uncommon / Rare

Natural history. *Artema atlanta* is commonly found in human-made environments. The spider constructs loose, irregular webs to capture prey and serve as a retreat, it feeds on small insects and other arthropods. Its long legs and defensive behaviour, including rapid vibrations within its web, allow it to survive in a variety of conditions, including arid regions like the Thar Desert, where it is found in human dwellings or shaded areas.

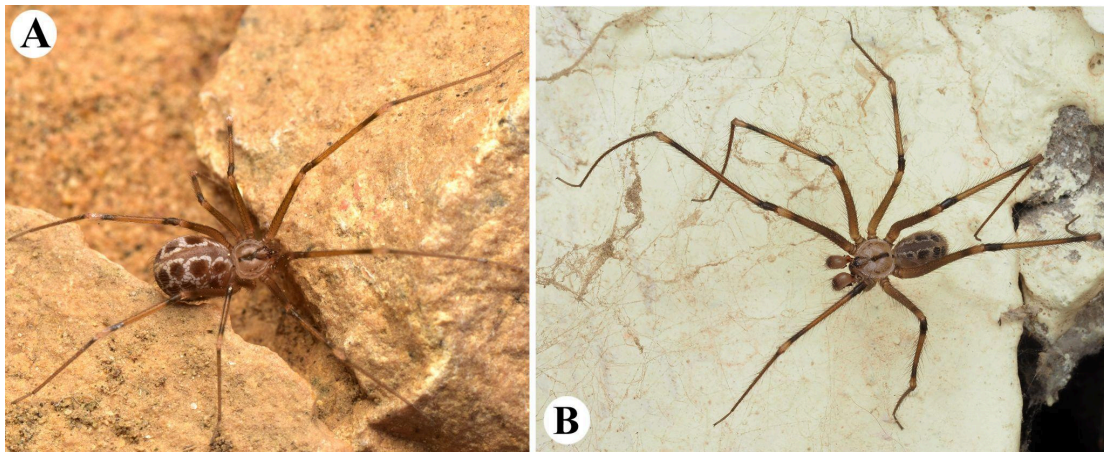


Figure 4.30: Live images of *Artema atlanta* Walckenaer, 1837. **A.** Female, dorsal view. **B.** Male, dorsal view.

***CROSSOPRIZA* Simon, 1893**

Crossopriza is a less species-rich group with a worldwide distribution and is currently represented by 27 species globally, with only three species recorded from India (WSC, 2025). Male chelicerae bearing two pairs of apophyses, one lateral and one frontal, directed inwards and legs marked with numerous short, dark longitudinal spots. Females are distinguished by a stridulatory apparatus, consisting of a pair of protuberances on the posterior side of the carapace and corresponding sclerotized plates on the abdomen (Huber et al., 1999).

Type species. *Artema pristina* Simon, 1890.

***Crossopriza* sp. 1**

Abundance: Common / Uncommon / Rare

Natural history. *Crossopriza* is often found in human-made structures like basements, ceilings, and corners. These spiders construct irregular webs. Females are known to carry their egg sacs with their chelicerae until the spiderlings hatch. While cosmopolitan in distribution, their presence in arid regions like the Thar Desert is limited to shaded, moist microhabitats, such as near irrigation canals or human dwellings, where conditions are more stable.

FAMILY PISAURIDAE Simon, 1890

Nursery-web spiders

Pisauridae are medium to large-sized spiders characterized by their elongated bodies, long legs, and distinctive eye arrangement with two rows of eyes. Pisaurids are often confused with wolf spiders (Lycosidae) but can be distinguished by their unique web-building behaviour. Instead of using webs for prey capture, they are known for constructing nursery webs to protect their egg sacs and spiderlings. Female pisaurids carry their egg sacs in their chelicerae until they find a safe spot to spin the protective nursery web. These spiders are typically found near vegetation or water bodies.

Type genus. *Pisaura* Simon, 1885.

***PERENETHIS* L. Koch, 1878**

Perenethis can be identified by ALE being smaller than PME; tibia of leg with a pair of short ventral spines at the distal end, conductor of the male palpal organ small and not provided with two guiding lamellae. The genus has recorded six species distributed in Asia, Africa, and Australia. India is currently home to two species.

Type species. *Perenethis venusta* L. Koch, 1878.

***Perenethis* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. *Perenethis* is poorly recorded in the Thar Desert, with only a few observations during the monsoon season, where they are found on the ground.

FAMILY PRODIDOMIDAE Simon, 1884

Long-spinneret ground spiders

Prodidomidae exhibit unique adaptations for a ground-dwelling lifestyle. They are typically small to medium-sized, with cylindrical bodies and relatively long legs, adapted for swift movement on the ground. These spiders are predominantly nocturnal and known for their secretive habits. They often reside under rocks, leaf litter, or burrow in sandy soils. The family currently includes 195 species across 24 genera worldwide, with 9 species belonging to 2 genera reported from India (Caleb & Sankaran, 2025; WSC, 2025).

Type genus. *Prodidomus* Hentz, 1847.

***PRODIDOMUS* Hentz, 1847**

Prodidomus are small to medium-sized spiders they are ecribellate, entelegyne spiders with two tarsal claws and typically eight eyes arranged in a circular pattern, the posterior row strongly procurved. The carapace is oval and rather flat, the sternum broad and projecting between coxae IV, and the chelicerae are strong with long fangs and dentate furrows. The genus is represented by 54 nominal species globally, and seven of them are currently known from India (WSC, 2025).

Type species. *Prodidomus rufus* Hentz, 1847

Prodidomus bastawade sp. nov.

Distribution. India (present study).

Abundance: Common / Uncommon / **Rare**

Natural history. *Prodidomus* spiders are extremely shy and elusive, with very few individuals observed during extensive sampling spanning two years. Male specimens, in particular, are rare and delicate, often encountered only once in long-term studies. Their secretive nature and delicate build make them difficult to detect, contributing to their scarce records.

Remark. *Prodidomus bastawade* is a new species described in this study.



Figure 4.31: Live images of *Prodidomus bastawade* sp. nov. **A.** Female, frontal view. **B.** same, dorsal view.

FAMILY SALTICIDAE Blackwall, 1841

Jumping spiders

Salticidae is the largest and most diverse spider family, with over 6,000 described species worldwide. These spiders are renowned for their exceptional vision, facilitated by large anterior median eyes, which they use for hunting and navigating. Unlike web-builders, jumping spiders are active hunters, relying on agility and precision to capture prey, often leaping several times their body length. They are found in a wide range of habitats, from forests and grasslands to urban areas, and are known for their vibrant colours and intricate courtship displays. The family currently represents 6,800 species in 689 genera globally, and 325 of them are known from India (WSC, 2025).

Type genus. *Salticus* Latreille, 1804.

***AELURILLUS* Simon, 1885**

Aelurillus are small, stout, and furry jumping spiders. Females are typically mottled sandy brown, while males are often black with patterns and annulated legs. Known for their myrmecophagy, they primarily prey on ants, though some have been observed leaping 30–40 times their body length to hunt larger spiders. They inhabit hot, dry, stony areas with sparse vegetation. Distributed across the Palaearctic and Africa, a few species occur in India, Sri Lanka, and Japan. The genus is represented by 75 nominal species globally and four are known from India (WSC, 2025).

Type species. *Araneus v-insignitus* Clerck, 1757.

Aelurillus sp. 1

Abundance: Common / Uncommon / Rare

Natural history. *Aelurillus* in the desert is well adapted to arid conditions, it thrives in sandy or rocky areas with little vegetation. Their colouration blends well with the desert landscape, protecting them from predators. Males perform courtship displays by raising their first pair of legs and waving them, with multiple males sometimes observed displaying simultaneously in front of a single female. Females lay eggs in silken retreats under stones and crevices.

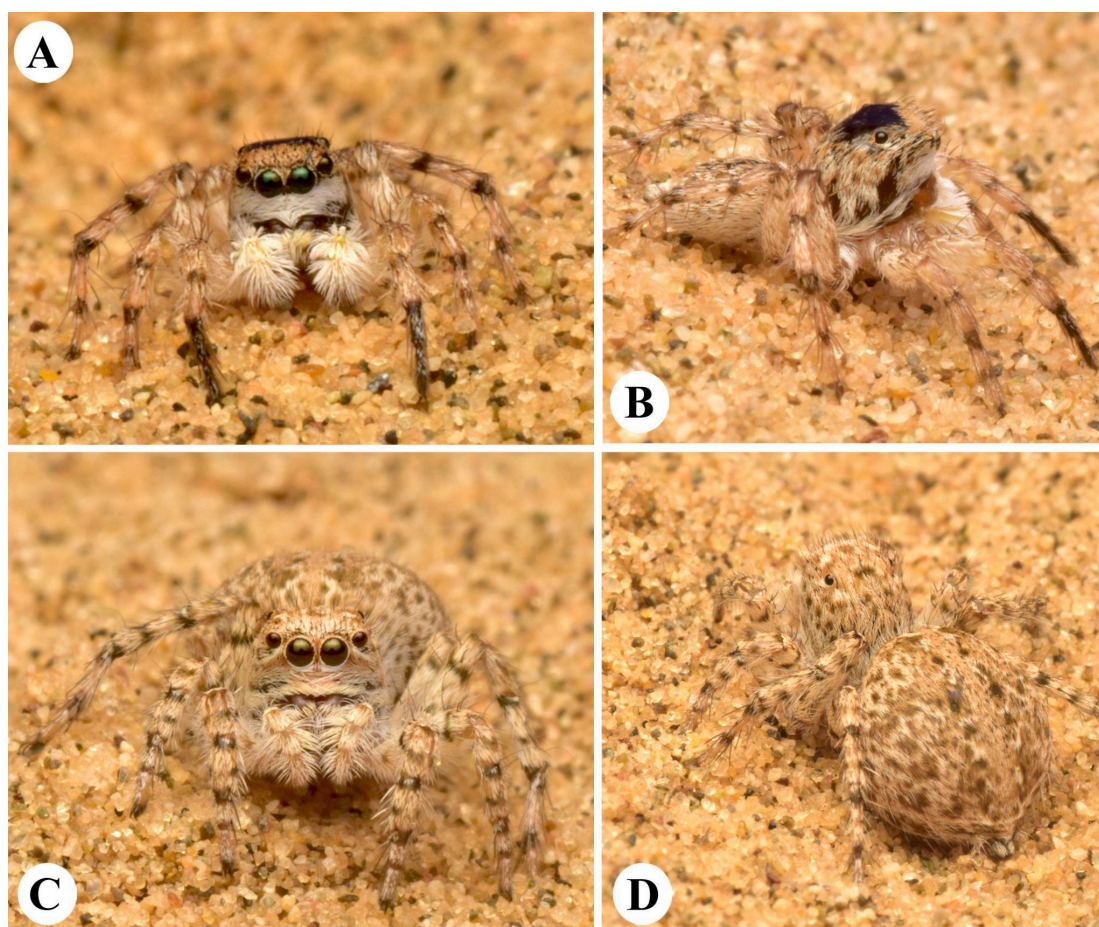


Figure 4.32: Live images of *Aelurillus* sp. 1. **A.** Male, frontal view. **B.** same, lateral view. **C.** Female, frontal view. **D.** same, dorsal view.

Aelurillus sp. 2

Abundance: Common / Uncommon / Rare

Natural history. Same as *Aelurillus* sp. 1.

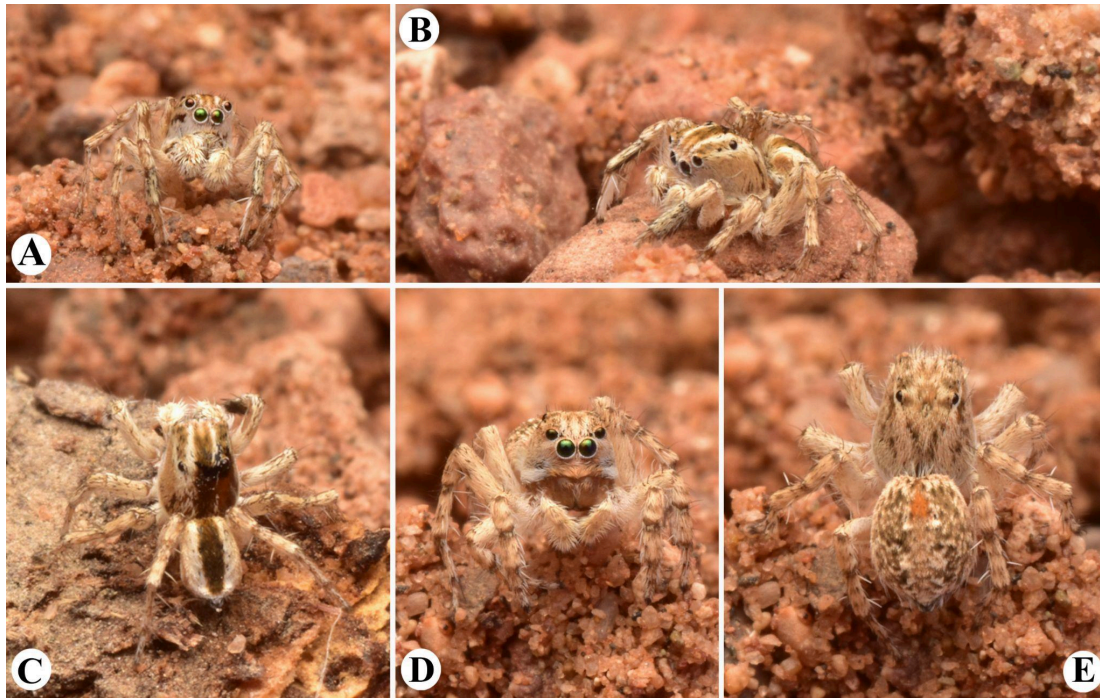


Figure 4.33: Live images of *Aelurillus* sp. 2. **A.** Male, frontal view. **B.** same, lateral view. **C.** same, dorsal view. **D.** Female, frontal view. **E.** same, dorsal view.

***AFRAFLACILLA* Berland & Millot, 1941**

Afraflacilla derives its name from "Africa," where many of its species were first identified. They are closely related to genera *Pseudicius*, *Festucula*, and *Marchena*, forming a monophyletic group. *Afraflacilla* spiders feature bristles and tubercles on their legs and carapace, which are used to produce sounds during courtship. The tubercles, especially beneath the eyes, are often visible to the naked eye. The genus is represented by 49 nominal species globally and six are known from India (WSC, 2025). Most of the Indian species in this genus are currently known only from males, and examining the females could potentially result in their reclassification into other genera.

Type species. *Afraflacilla bamakoi* Berland & Millot, 1941.

Afraflacilla miajlarensis Tripathi, Jangid, Prajapati & Siliwal, 2022

Afraflacilla miajlarensis Tripathi, Jangid, Prajapati & Siliwal, in Sudhin et al., 2022: 327, figs 1-6, 10-20, 23-32 (♂♀).

Abundance: Common / Uncommon / Rare

Distribution. India (Sudhin et al., 2022; present study, WSC, 2025).

Natural history. *Afraflacilla miajlarensis* is commonly found on tree branches and is the most abundant salticid inhabiting trees in the Thar Desert. It shares its habitat with species like *Irannatus* and *Mogrus*. Specimens were primarily collected using the inverted umbrella method. This species plays an important role in the arboreal spider community of the region.

Remark. *Afraflacilla miajlarensis* is a new species described in this study.

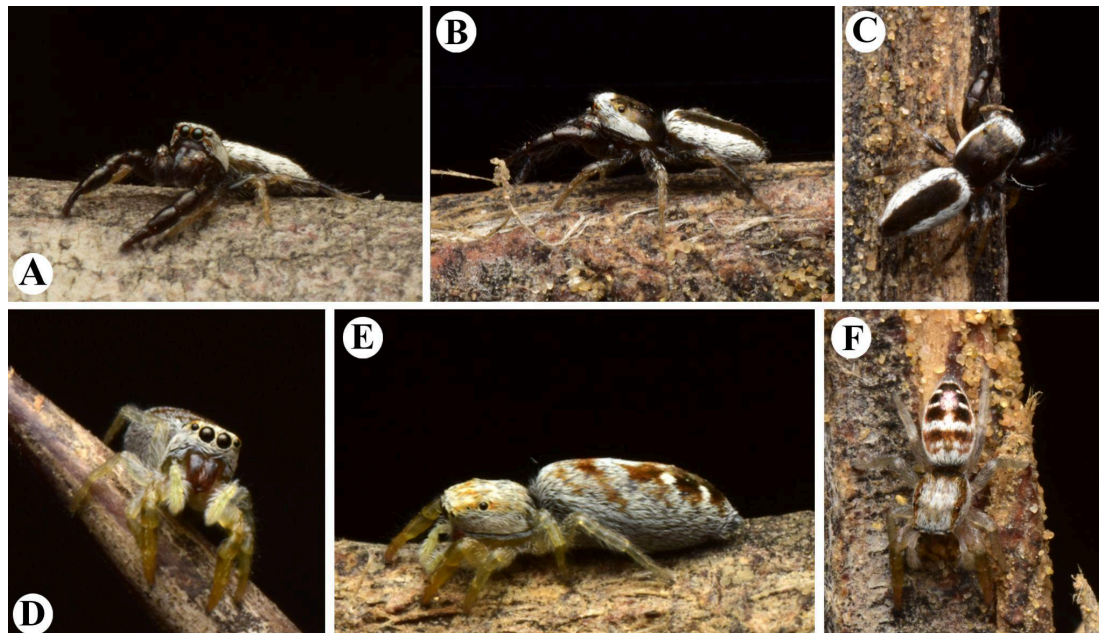


Figure 4.34: Live images of *Afraflacilla miajlarensis* Tripathi, Jangid, Prajapati & Siliwal, 2022. **A.** Male, frontal view. **B.** same, lateral view. **C.** same, dorsal view. **D.** Female, frontal view. **E.** same, lateral view. **F.** same, dorsal view.

BIANOR Peckham & Peckham, 1886

Bianor are small to medium-sized, distinguished by their compact bodies, flattened cephalothorax, and elongated abdomen. Males often exhibit bold patterns or metallic colours, while females are more subdued with cryptic colouration. These spiders are active hunters, preying on small insects, and are often found in sunny, open habitats like grasslands and forests. The genus is represented by 27 nominal species globally and 8 of them are currently known from India (WSC, 2025).

Type species. *Scythropa maculata* Keyserling, 1883.

Bianor albobimaculatus (Lucas, 1846)

Salticus albobimaculatus Lucas, 1846: 170, plate VIII, fig. 10 (♀).

Plexippa albobimaculata Simon, 1864: 326.

(For the complete list of references see WSC, 2025).

Abundance: Common / Uncommon / **Rare**

Distribution. Africa, Europe, Asia (WSC, 2025).

Natural history. *Bianor albobimaculatus* is a rare sight in the Thar Desert, observed only a few times during the monsoon near temporary water pools.

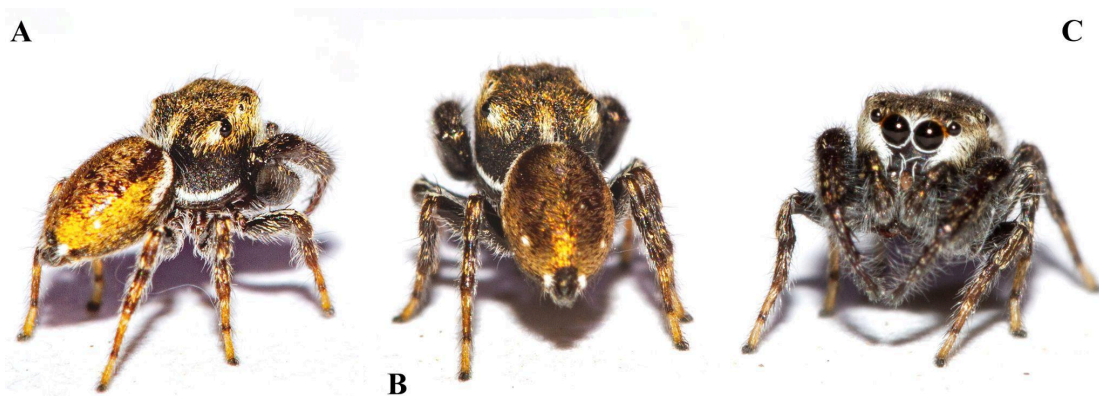


Figure 4.35: Live images of *Bianor albobimaculatus* (Lucas, 1846) **A.** Male, lateral view. **B.** same, rear view. **C.** same, frontal view.

CYRBA Simon, 1876

Cyrba consists of small to medium-sized spiders noted for their long, slender legs and abdomen. Distributed primarily across the Old World from sub-Saharan Africa through Asia to Australia the genus includes nine recognized species globally, with one species currently recorded in India (WSC, 2025).

Type species. *Salticus algerinus* Lucas, 1846.

***Cyrba ocellata* (Kroneberg, 1875)**

Euophrys ocellata Kroneberg, 1875: 48, plate V, fig. 35 (♀).

Cyrba micans Simon, 1886: 457 (♂).

Stasippus inornatus Thorell, 1887: 375 (♀).

(For the complete list of references see WSC, 2025).

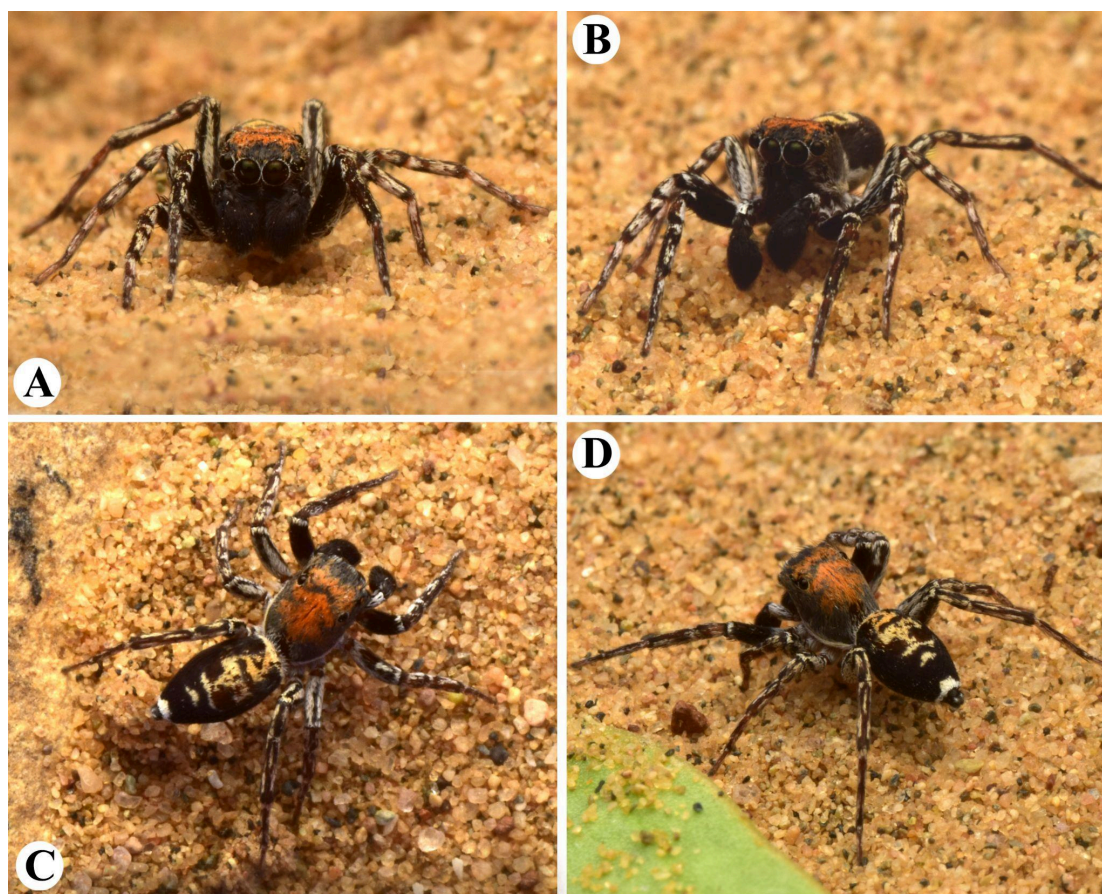


Figure 4.36: Live images of *Cyrba ocellata* (Kroneberg, 1875). A–B. Male, frontal view. C–D. same, dorsal view.

Abundance: Common / Uncommon / **Rare**

Distribution. Caucasus to Central Asia and China, Eastern Africa to India and Indonesia. Introduced to Australia (WSC, 2025).

Natural history. *Cyrba ocellata* is uncommon in the Thar Desert, but when present, they are typically found beneath rocks near human settlements in open areas with sparse vegetation.

***HELIOPHANUS* C. L. Koch, 1833**

Heliophanus is a genus of small to medium-sized jumping spiders. They have dark or bright vertical stripes on the body, and their opisthosoma is marked with dark or bright spots, with a generally dark base colouration. The male palp features a femur with both ventral-medial and ventral-apical processes. Femur of Leg I with stridulatory spines. Opisthosoma is covered with iridescent scale hairs. *Heliophanus* spiders are found in Europe, South America, North America, Africa, Eastern Europe, Asia, and the Middle East, inhabiting a variety of habitats from temperate regions to arid zones. The genus is represented by 91 nominal species globally and three of them are currently known from India (WSC, 2025).

Type species. *Aranea cuprea* Walckenaer, 1802.

***Heliophanus abditus* Wesolowska, 1986**

Heliophanus abditus Wesolowska, 1986: 221, figs 760–761 (♀).

Heliophanus abditus Wesolowska & van Harten, 2007: 218, figs 76–82 (♂♀).

(For the complete list of references see WSC, 2025).

Abundance: **Common** / Uncommon / Rare

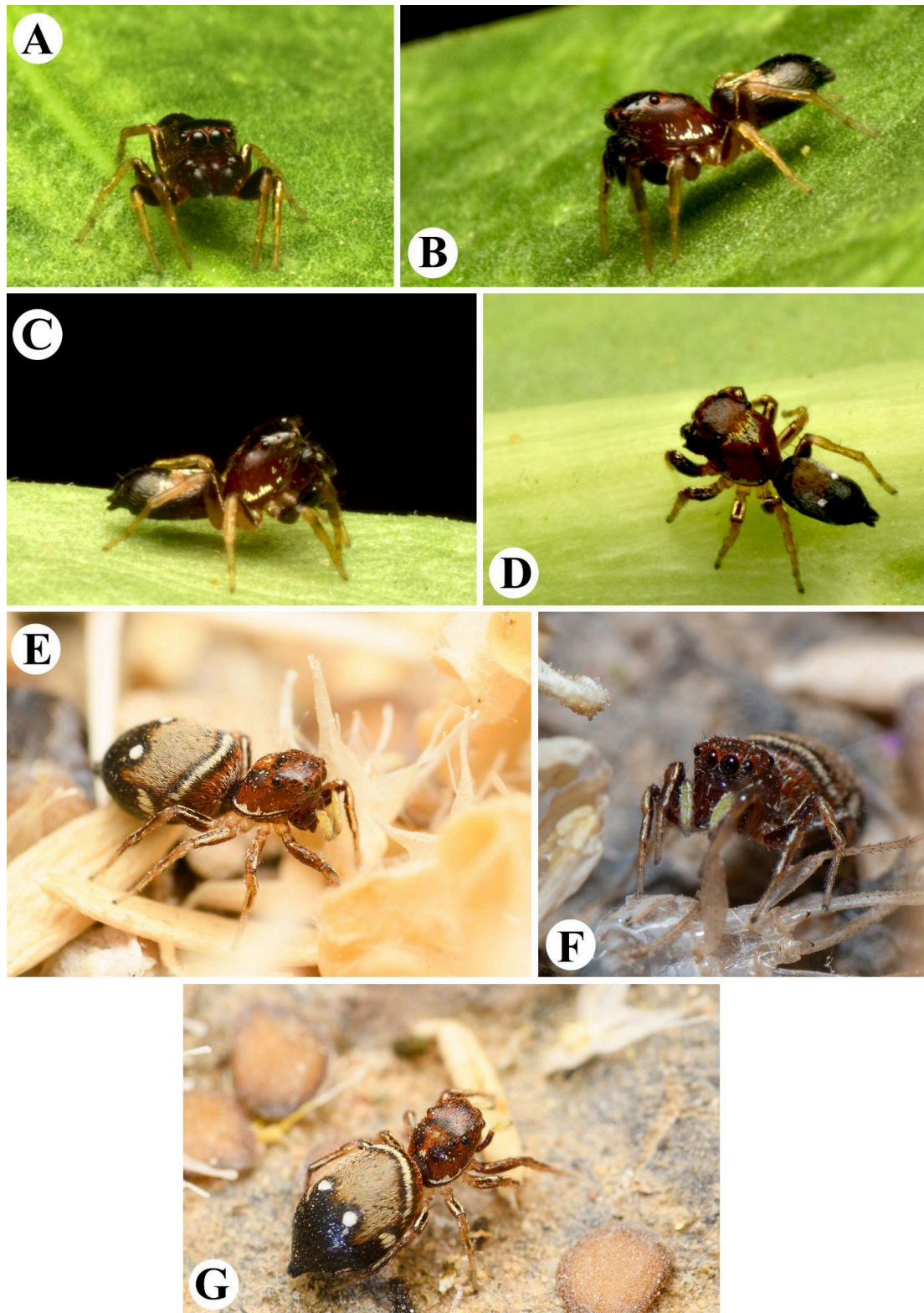


Figure 4.37: Live images of *Heliophanus abditus* Wesołowska, 1986. **A.** Male, frontal view. **B–C.** same, lateral view. **D.** same, dorsal view. **E.** Female, lateral view. **F.** same, frontal view. **G.** same, dorsal view.

Distribution. Syria, Yemen, United Arab Emirates & India (WSC, 2025 & present study).

Natural history. *Heliophanus abditus* is commonly found on low vegetation or sometimes on the ground, and it is not unusual to see 25 to 30 individuals, ranging from juveniles to mature males and females, on a single shrub. They are among the common spiders in Thar during summer. These spiders construct small retreats for shelter. On one occasion, dragonflies were observed feeding on this species.

Remark. *Heliophanus abditus* is reported for the first time from India in this study.

***IRANATTUS* Prószyński, 1992**

Iranattus is a genus of jumping spiders characterized by extremely long third legs, a scoop-shaped cymbial apophysis, and two distinct epigynal coupling pockets in females. Phylogenomic analyses place it within the subtribe Plexippina (Marathe et al., 2024)

Type species. *Iranattus rectangularis* Prószyński, 1992.

***Iranattus rectangularis* Prószyński, 1992**

Iranattus rectangularis Prószyński, 1992: 97, figs 35–40 (♂).

Iranattus rectangularis Prószyński, 2017: 33, figs 14K1 (♂).

Abundance: Common / **Uncommon** / Rare

Distribution. Iran & India (WSC, 2025 & present study).

Natural history. *Iranattus rectangularis* can be observed throughout the year, but mature individuals are primarily seen during the monsoon season, when they display more vibrant colours, including an orange face that is visible only at this time. They

are typically found on trees such as *Prosopis cineraria* (khejri) and *Ziziphus* (ber), and *Vachellia tortilis*.

Remark. The genus and species are reported for the first time from India.

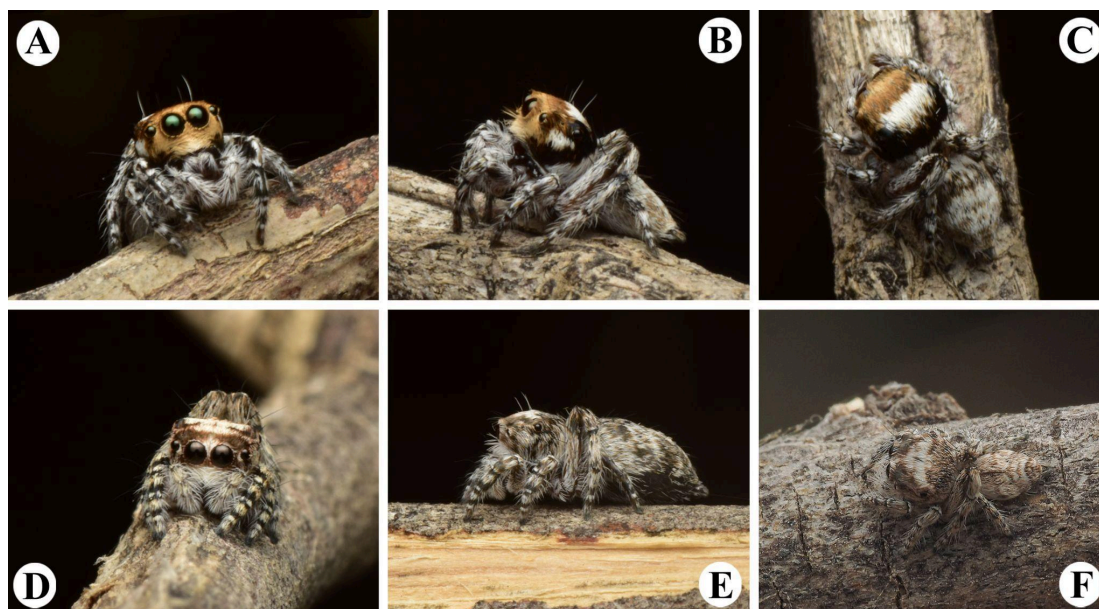


Figure 4.38: Live images of *Iranattus rectangularis*. **A.** Male, frontal view. **B.** same, lateral view. **C.** same, dorsal view. **D.** Female, frontal view. **E.** same, lateral view. **F.** same, dorsal view.

LANGONA Simon, 1901

Langona often features dark or bright vertical stripes, with the carapace being longer than wide. Legs are distinct, with tarsus I and tarsus II each having an enlarged scopula hair field. *Langona* species are found in Africa, Eastern Europe, Asia, and the Middle East, inhabiting various environments. The genus is represented by 45 nominal species globally and five of them are currently known from India (WSC, 2025).

Type species. *Attus redii* Audouin, 1826.

Langona sp. 1

Abundance: Common / Uncommon / Rare

Natural history. *Langona* inhabits diverse habitats from rocky, shrubs, and low vegetation. They build small silk retreats in sheltered spots, such as under rocks or within crevices, where they rest or lay their eggs. Due to their cryptic colouration, they are well-camouflaged in their desert habitat, making them effective predators and important contributors to controlling insect populations in arid ecosystems.

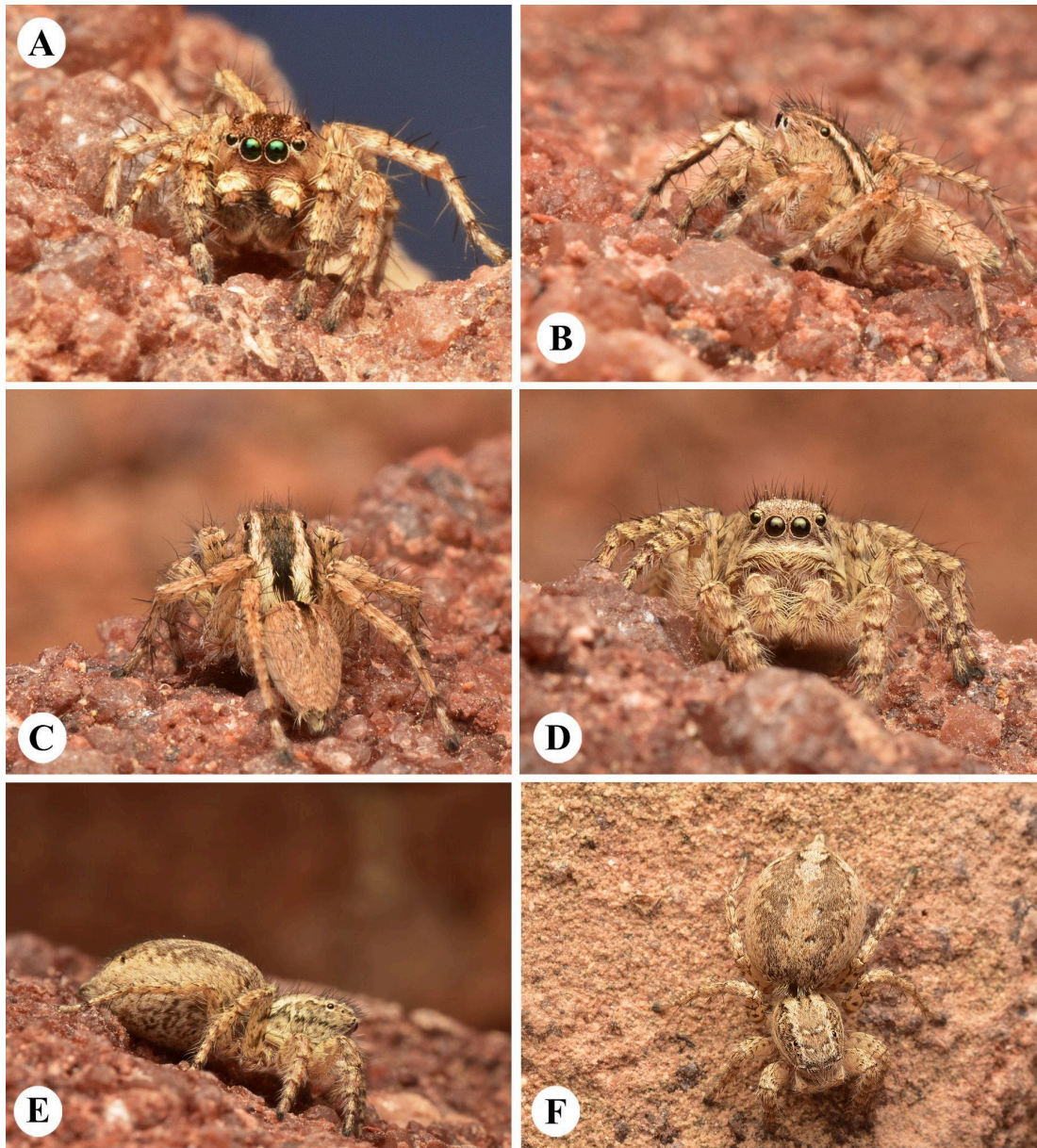


Figure 4.39: Live images of *Langona* sp. 1. **A.** Male, frontal view. **B.** same, lateral view. **C.** same, dorsal view. **D.** Female, frontal view. **E.** same, lateral view. **F.** same, dorsal view.

MENEMERUS Simon, 1868

Menemerus is a moderately diverse genus of medium-sized jumping spiders with a cosmopolitan distribution. Typically gray, brown, or black with lighter chevron or stripe patterns, they have slender, often banded legs. Males show more contrasting markings, while females are larger and duller. The genus comprises 64 recognized species worldwide, including seven reported from India (WSC, 2025).

Type species. *Euophrys vigorata* C. L. Koch, 1846.

***Menemerus marginatus* (Kroneberg, 1875)**

Marpessa marginata Kroneberg, 1875: 47, plate V, fig. 34 (♂♀).

Menemerus marginatus Simon, 1901: 604.

Menemerus cronebergi Charitonov, 1946: 31, figs 59–60 (♂).

(For the complete list of references see WSC, 2025).



Figure 4.40: Live images of *Menemerus marginatus* (Kroneberg, 1875). **A.** Male, lateral view. **B.** same, dorsal view. **C.** same, lateral view. **D.** Female, dorsal view.

Distribution. Caucasus (Russia, Azerbaijan), Kazakhstan, United Arab Emirates, Iran, Central Asia, Afghanistan, Pakistan, India (WSC, 2025; present study).

Abundance: Common / **Uncommon** / Rare

Habitat. *Menemerus marginatus* was observed on tree bark in savannah habitats.

Remark. This study presents the first report of species from India.

***MOGRUS* Simon, 1882**

Mogrus is a genus of medium-sized jumping spiders distributed from the Mediterranean region to the Arabian Peninsula, extending through the Near East and Central Asia, reaching as far as Mongolia, the western provinces of China, and the western parts of India. These spiders are commonly found in arid and semi-arid habitats such as deserts and scrublands. While males and females share a similar appearance, they exhibit sexual dimorphism. The genus is represented by 29 nominal species globally and one of them is currently known from India (WSC, 2025).

Type species. *Mogrus fulvovittatus* Simon, 1882.

***Mogrus larisae* Logunov, 1995**

Mogrus larisae Logunov, 1995: 596, figs 1–4, 7, 18–30 (♂♀).

Mogrus larisae Wesołowska, 1996: 34, figs 21B–C (♂).

Distribution. Kazakhstan, Iran, Uzbekistan, Turkmenistan, Kyrgyzstan, India (WSC, 2025; present study).

Abundance: **Common** / Uncommon / Rare

Natural history. These spiders are mainly found on grass twigs, often building small silk sacs, especially on Ghantiya grass flowers. In summer, their silk strands shimmer

in sunlight, and they are frequently seen leaping from the flowers, displaying their agility.

Remark. This study presents the first report of species from India.

Mogrus rajasthanensis Caleb, Chatterjee, Tyagi, Kundu & Kumar, 2017

Mogrus rajasthanensis Caleb et al., 2017: 332, figs 10–20 (♀).

Distribution. India (WSC, 2025).

Abundance: Common / Uncommon / Rare



Figure 4.41: Live images of *Mogrus rajasthanensis* Caleb, Chatterjee, Tyagi, Kundu & Kumar, 2017. **A.** Male, frontal view. **B–C.** same, rear view. **D.** same, lateral view.

Natural history. Same as *Mogrus larisae*.

Remark. This study provides the description of the male for the first time.

Mogrus harappan sp. nov.

Distribution. India (present study).

Abundance: Common / Uncommon / Rare

Natural history. They are typically found on tree branches, and when present, they are usually seen in good numbers.

Remark. *Mogrus harappan* is a new species described in this study.



Figure 4.42: Live images of *Mogrus harappan* sp. nov. **A.** Male, frontal view. **B.** same, lateral view. **C–D.** same, rear view. **E.** Female, frontal view. **F.** same, dorsal view.

PELLENES Simon, 1876

Pellenes is a globally distributed genus of small to medium-sized jumping spiders, currently represented by 67 species worldwide, of which three are known from India. These spiders are typically dark in color with distinct white or red markings, and many species exhibit the unique behavior of using empty snail shells as retreats or egg-laying sites, sometimes even suspending them with silk. Their body size

generally ranges from 3 to 7 mm, and several species show characteristic marking patterns that aid in identification (WSC, 2025, Caleb & Sankaran, 2025).

Type species. *Attus cruciger* Walckenaer, 1805.

Pellenes allegrii Caporiacco, 1935

Pellenes allegrii Caporiacco, 1935: 213, plate V, fig. 9 (♂♀).

Pellenes alegri Prószyński, 1984: 100 (♀).

Pellenes allegrii Logunov, Marusik & Rakov, 1999: 113, figs 60–70, 80–82, 89–90 (♂♀).

(For the complete list of references see WSC, 2025).

Distribution. Bulgaria, Ukraine, Russia (Europe), Kazakhstan, Central Asia, India (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Pellenes allegrii* are typically found resting on grass twigs inside small silk retreats, a behavior also seen in *Mogrus frontosus* and *Thyene imperialis*. Their abundance increases markedly in winter, suggesting a seasonal pattern in activity or visibility. These spiders rely on the grass structure for both hunting perches and protection from predators.

Pellenes rajasthan sp. nov.

Distribution. India (present study).

Abundance: Common / Uncommon / Rare

Natural history. Similar to *Pellenes allegrii*.

Remark. New species described in this study.

***PLEXIPPUS* C. L. Koch, 1846**

Plexippus are medium-sized jumping spiders they are represented by about 40 species worldwide, of which six are known from India. These spiders are robust and agile hunters, commonly found in both natural habitats and human-made structures, where they play an important role in controlling insect pests. With their adaptability, cosmopolitan distribution, and characteristic jumping behavior, *Plexippus* spiders are among the most familiar members of the Salticidae.

Type species. *Plexippus ligo* C. L. Koch, 1846.

***Plexippus minor* Wesołowska & van Harten, 2010**

Plexippus minor Wesołowska & van Harten, 2010: 49, plate XIX, figs 57–58 (♂).

Plexippus minor Prószyński, 2017: 61, fig. 2N, 4D1 (♂).

Plexippus minor Wesołowska & van Harten, 2020: 610, figs 10-11, 15–16 (♀).

(For the complete list of references see WSC, 2025).

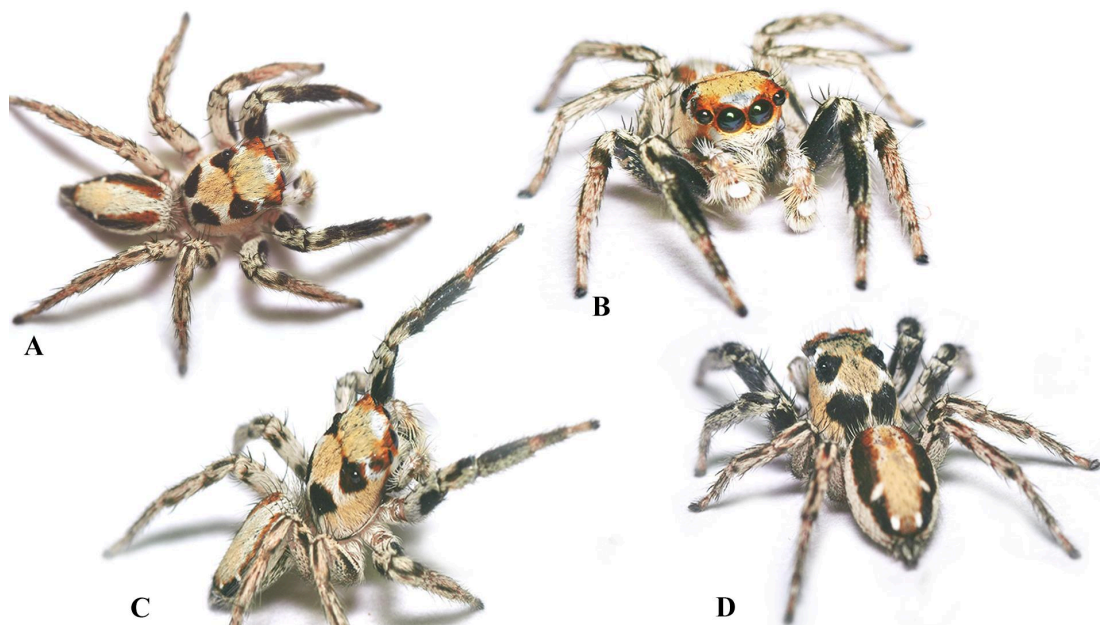


Figure 4.43: Live images of *Plexippus minor* Wesołowska & van Harten, 2010. **A.** Male, dorsal view. **B.** same, frontal view. **C.** same, lateral view. **D.** same, rear view.

Distribution. United Arab Emirates, India (Present study; WSC, 2025).

Abundance: Common / **Uncommon** / Rare

Natural history. *Plexippus minor* are abundant during the winter, particularly around fencing areas where dry, entangled shrubs provide suitable habitats.

Remark. First report of the species from India.



Figure 4.44: Live images of *Plexippus minor* Wesolowska & van Harten, 2010. **A.** Female, dorsal view. **B–C.** same, frontal view. **D.** same, lateral view.

***PSEUDOMOGRUS* Simon, 1937**

Pseudomogrus comprises 35 valid species, distributed in Africa, Eastern Europe & Asia, Middle East. This study addresses the first report of the genus from India.

Type species. *Attus univittatus* Simon, 1871.

***Pseudomogrus sudhii* Logunov, Tripathi & Jangid, 2022**

Pseudomogrus sudhii Logunov, Tripathi & Jangid, 2022: 72, figs 1–16 (♂♀).

Abundance: Common / **Uncommon** / Rare

Distribution. India (Present study; Logunov, Tripathi & Jangid, 2022; WSC 2025).

Natural history. Not much is known about *Pseudomogrus sudhii*, as they have only been observed a few times, typically found on the ground or in low vegetation.

Remark. This study presents the first record of a genus from India with a new species.

***RUDAKIUS* Prószyński, 2016**

Rudakius is characterized by a lateral subocular row of short bristles on protuberances, a modified tibia on the robust leg I, a flattened body, and a distinctive colour pattern. Distributed across Eastern Europe, Asia, and the Middle East, indicating its adaptation to a range of environmental conditions. The genus is represented by seven nominal species globally and one of them are currently known from India (WSC, 2025).

Type species. *Menemerus cinctus* O. Pickard-Cambridge, 1885.

***Rudakius ludhianaensis* (Tikader, 1974)**

Marpissa ludhianaensis Tikader, 1974: 205, figs 1–3 (♂♀).

Marpissa ludhianaensis Sadana & Kaur, 1974: 49, figs 1–5 (♂♀).

Phlegra citri Sadana, 1980: 229, figs 1–5 (♂♀).

(For the complete list of references see WSC, 2025).

Abundance: Common / **Uncommon** / Rare

Distribution. Egypt, Iran, Pakistan, India (WSC, 2025).

Natural history. *Rudakius ludhianaensis* is rarely encountered in the Thar Desert, with only a few sightings on tree branches near human settlements.



Figure 4.45: Live images of *Rudakius ludhianaensis* (Tikader, 1974). **A.** Male, frontal view. **B.** same, lateral view. **C.** same, dorsal view.

***THYENE* Simon, 1885**

Thyene are small to medium-sized, comprising about 59 species worldwide, with three recorded from India. They feature a slightly elevated carapace, elongated abdomens, and males possess distinctive palps with a long, coiling embolus.

Type species. *Attus imperialis* Rossi, 1846.

***Thyene imperialis* (Rossi, 1846)**

Attus imperialis Rossi, 1846: 12 (♂).

Salticus moreletii Lucas, 1846: 147, plate VI, fig. 3 (♀).

Attus regillus L. Koch, 1867: 879 (♂).

(For the complete list of references see WSC, 2025).

Distribution. Southern Europe, North and East Africa, Middle East to Central Asia and China, Pakistan, India, Indonesia (WSC, 2025).

Natural history. *Thyene imperialis* is a moderately common species in the Thar Desert, often observed atop grass blades, where they create small retreats using a few grass blades and silk. Males are less numerous than females. In the Rasla and Sipla enclosures, they were found in relatively large numbers.

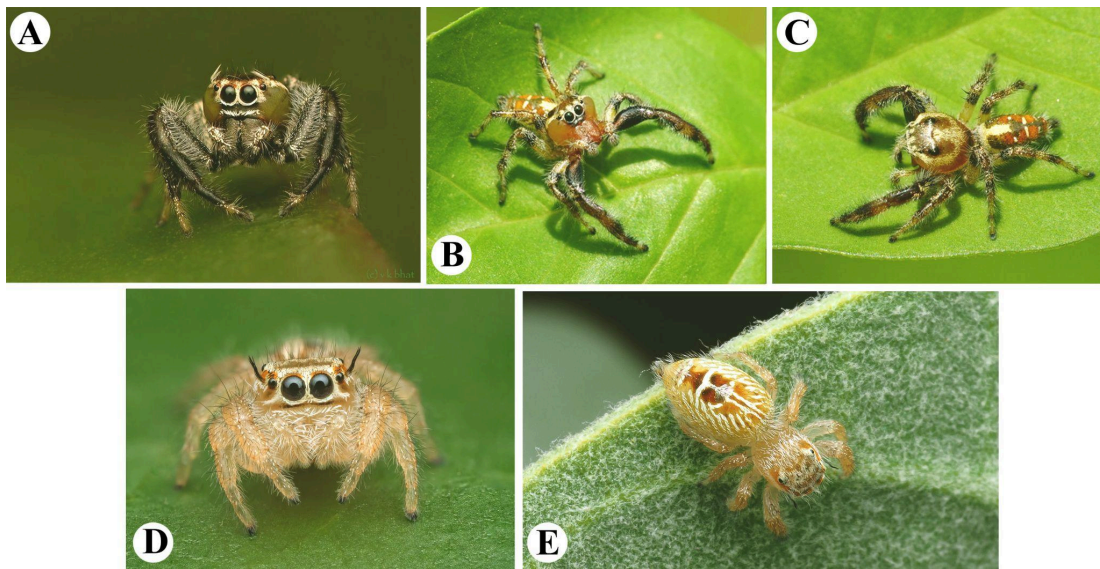


Figure 4.46: Live images of *Thyene imperialis* (Rossi, 1846). **A–B.** Male, frontal view. **C.** same, dorsal view. **D.** Female, frontal view. **E.** same, dorsal view.

FAMILY SCYTODIDAE Blackwall, 1864

Spitting spiders

Scytodidae are small to medium-sized spiders with a dome-shaped cephalothorax, six eyes, and long legs. They hunt by ejecting sticky, venomous silk in a rapid zig-zag to immobilize prey, are mainly nocturnal, and females carry egg sacs with their chelicerae. The family includes 253 species in four genera worldwide, with 11 species reported from India (WSC, 2025).

Type genus. *Scytodes* Latreille, 1804.

SCYTODES Latreille, 1804

Scytodes have unique hunting, they eject sticky, venom-laced silk from fangs to immobilize prey, and this always proves to be precise and fast action, making them efficient hunters. They are easily recognizable by the domed cephalothorax and six whitish to light-coloured eyes, ranging in three widely spaced diads. Carapace lacks a fovea and forms a characteristic hump posteriorly, whereas their abdomen is ovoid to subglobular. They are slow-moving and inhabit hidden habitats such as under rocks and tree bark, where they play an important role in pest control. *Scytodes* is a very diverse genus that has a cosmopolitan distribution. A total of 229 species of this genus are described from the entire world. There are 10 species recorded from India (WSC, 2025).

Type species. *Aranea thoracica* Latreille, 1802.

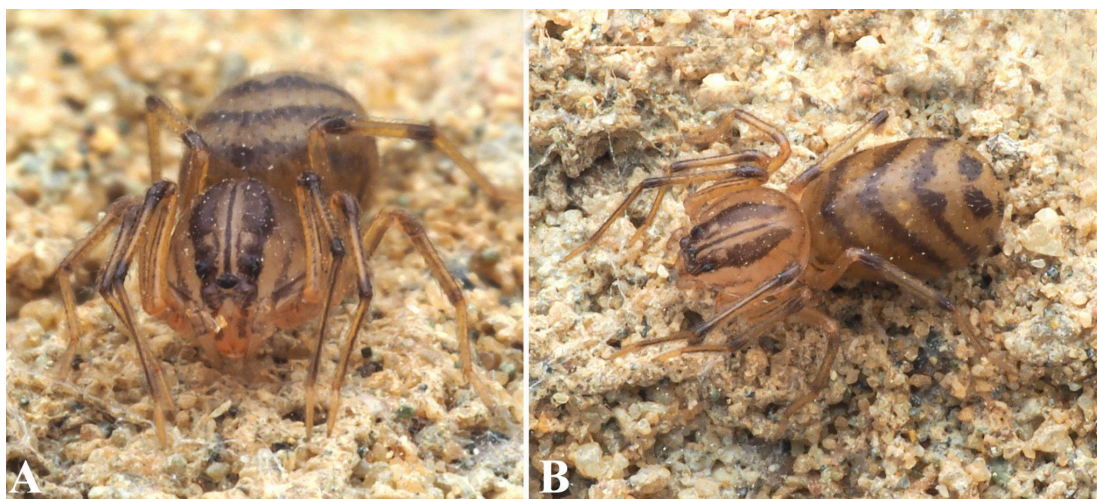
***Scytodes* sp. 1**

Figure 4.47: Live images of *Scytodes* sp. 1. **A.** Female, frontal view. **B.** same, dorsal view.

Abundance: Common / Uncommon / **Rare**

Scytodes sp. 2

Abundance: Common / Uncommon / **Rare**

Natural history. *Scytodes* spiders are generally not considered rare, but in the Thar Desert, they are observed only occasionally. Their sightings are typically limited to areas near human habitation, particularly in plantations or greener patches. They are notably absent from the harsher, more arid conditions of the desert landscape.

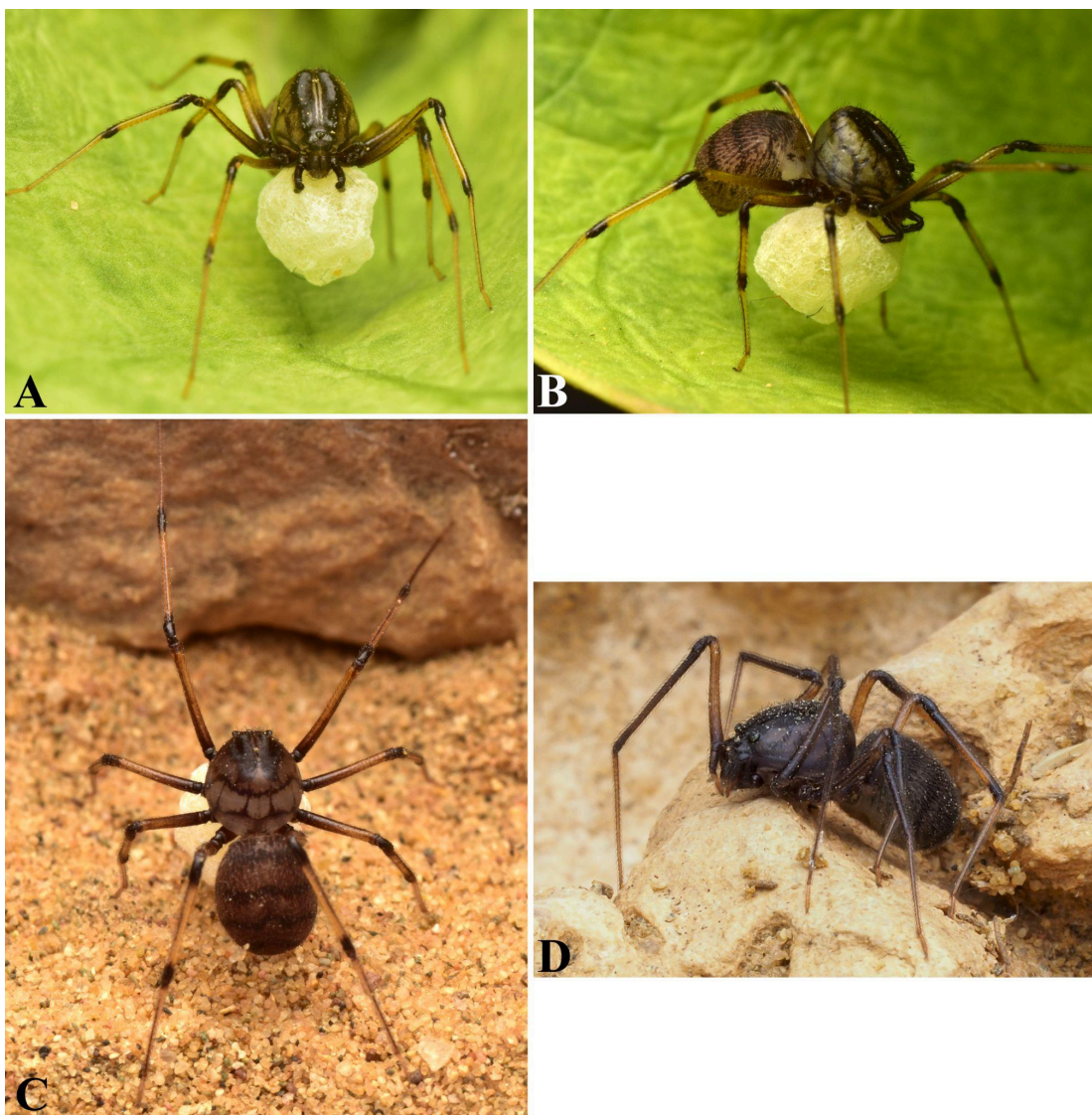


Figure 4.48: Live images of *Scytodes* sp. 2. **A.** Female, frontal view. **B & D.** same, lateral view. **C.** same, dorsal view.

FAMILY SICARIIDAE Keyserling, 1880

Violin Spiders

Family Sicariidae includes some of the most fascinating yet medically significant spiders, such as the recluse spiders (*Loxosceles*) and six-eyed sand spiders (*Sicarius*). Found predominantly in warm, arid regions, these spiders are recognized for their unique cytotoxic venom containing sphingomyelinase D, which can cause necrotic lesions in humans. Sicariidae spiders are typically reclusive, favoring secluded habitats like crevices, leaf litter, or sand. Their hunting strategy relies on ambush and web-based detection, showcasing their adaptability. With over 176 species classified in more than three genera, only one species is known from India.

Type genus. *Sicarius* Walckenaer, 1847.

LOXOSCELES Heineken & Lowe, 1832

Loxosceles, commonly known as violin or fiddleback spiders, is one of the most diverse genera within the family Sicariidae. These spiders are relatively small, typically about 1/2 inch in length, and are easily recognizable by the distinctive violin-shaped marking on the dorsal surface of their cephalothorax. They have six eyes, arranged in three pairs, a unique feature among spiders. *Loxosceles* spiders are of medical importance due to their venom, which has been utilized in the development of certain drugs. They are medium-sized to large spiders, and currently, a total of 147 species have been described worldwide. However, only one species is known to occur in India (WSC, 2025).

Type species. *Loxosceles citigrada* Heineken & Lowe, 1832.

***Loxosceles* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. They have been observed only a few times, primarily in the Ramdeora area, with fewer sightings in the Sam region. They are typically found hiding beneath rocks.

FAMILY SPARASSIDAE Bertkau, 1872**Huntsman spiders**

Sparassidae is a family of large, agile spiders widely distributed in tropical and subtropical regions. They are characterized by their flattened bodies and sideways-oriented legs, enabling them to hide under bark, rocks, and crevices. These nocturnal hunters of insects and other arthropods are known for their speed. Many species exhibit maternal care, where females guard or carry the egg sac. With over 1,508 species classified into more than 97 genera, they play a crucial ecological role as primary agents of pest control. India is home to 89 of these species.

Type genus. *Micrommata* Latreille, 1804.

***CEBRENNUS* Simon, 1880**

Cebrennus are primarily distributed in arid and semi-arid regions, with many species adapted to live in deserts. They are bright or pale yellow to yellow-brown. Abdomen in a few species with indistinct darker pattern, ventrally without markings. Some species within the genus, such as *Cebrennus rechenbergi*, are known for their unique adaptations, including the ability to perform a cartwheel-like movement to escape predators, a behaviour that has garnered significant scientific interest. The genus is

represented by 20 nominal species globally, with the first record of the genus from India (WSC, 2025).

Type species. *Cebrenis wague* Simon, 1874.

***Cebrennus* sp. 1**

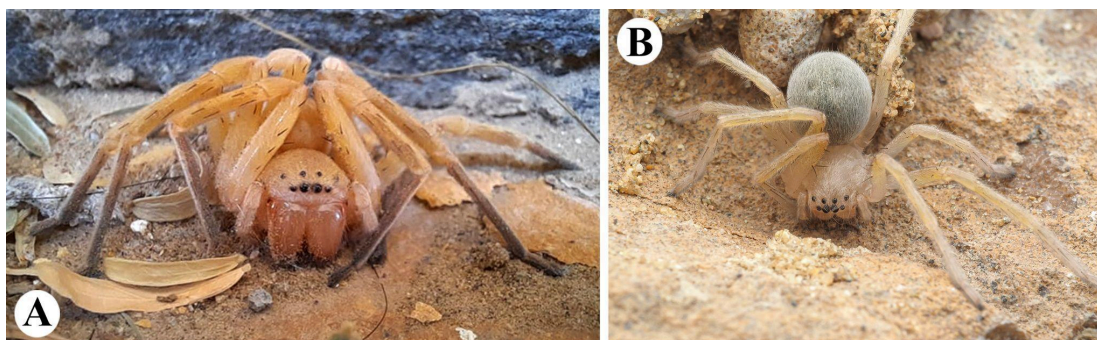


Figure 4.49: Live images of *Cebrennus*. **A.** Female, frontal view. **B.** same, dorsal view.

Abundance: Common / Uncommon / **Rare**

Natural history. Little is known about *Cebrennus*, as it has been observed only a few times. When encountered, they were found on the ground.

Remark. This study presents the first record of a genus from India that was previously known only from Africa, the Middle East, and parts of Central Asia.

***OLIOS* Walckenaer, 1837**

Olios is a speciose genus, characterized by its widespread global distribution. *Olios* can be distinguished from other Sparassidae by specific morphological features. Males exhibit a tegular apophysis, a membranous conductor lacking a defined shape, and a simple retrolateral tibial apophysis (RTA) arising distally. Females possess a simple epigyne with a median septum typically visible only in the posterior half near

the epigastric furrow. The genus currently includes 166 described species worldwide, with 22 species documented from India.

Type species. *Micrommata spongitaris* Dufour, 1820.

***Olios kiranae* Sethi & Tikader, 1988**

Olios kiranae Sethi & Tikader, 1988: 38, figs 181–185 (juv. ♀).

Olios kiranae Jäger, 2020: 75 (nomen dubium).

Olios kiranae Jäger, Sudhikumar & Tripathi, 2022: 622, figs 1–3, 7–9, 22–27, 35–40 (♂♀, removed from nomen dubium).

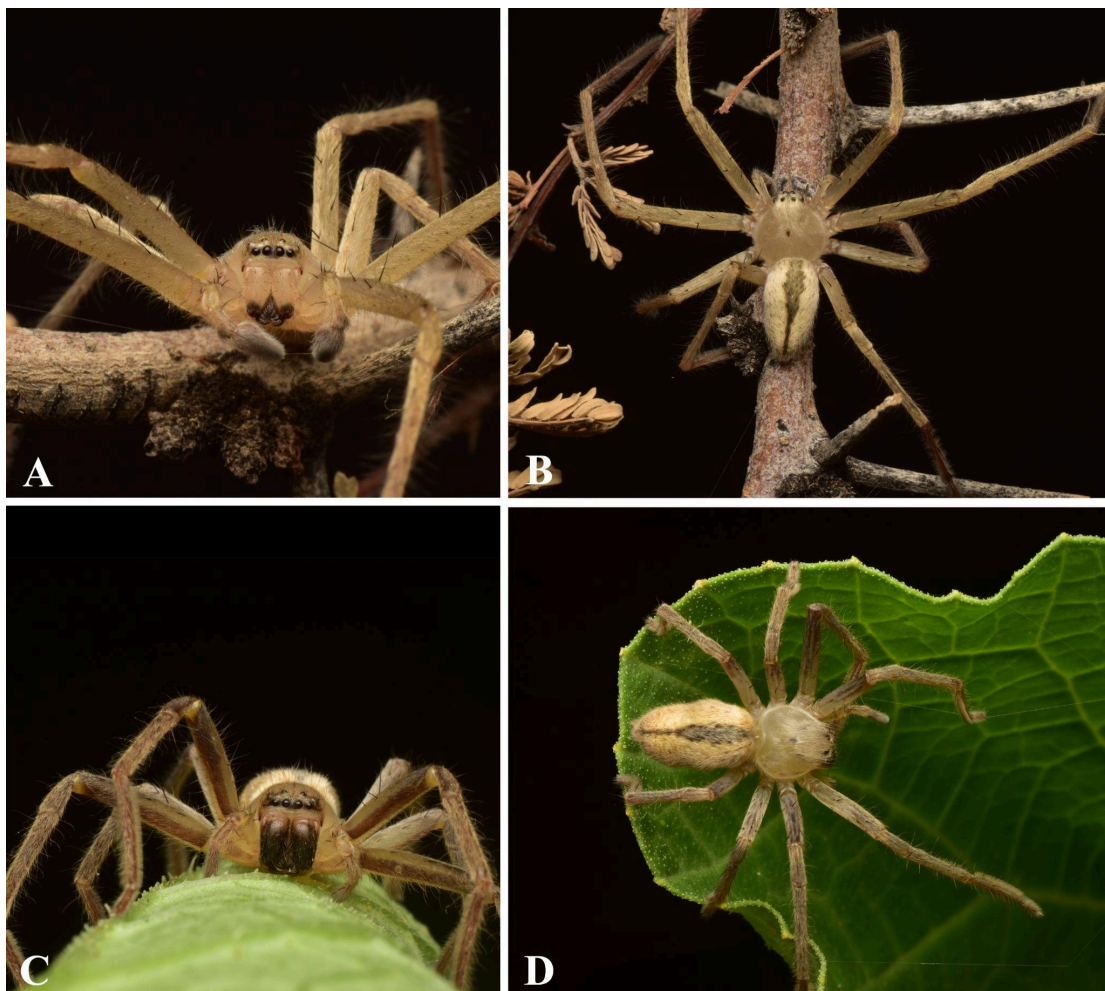


Figure 4.50: Live images of *Olios kiranae* Sethi & Tikader, 1988. **A.** Male, frontal view. **B.** same, dorsal view. **C.** Female, frontal view. **D.** same, dorsal view.

Distribution. India (Present study; Jäger, Sudhikumar & Tripathi, 2022; WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Olios kiranae* is a seasonal species, commonly observed in large numbers during the monsoon. They thrive in grassland habitats, coinciding with an increase in other insect populations. Their sac webs closely resemble those of *Cheiracanthium melanostomum*, and they inhabit similar environments.

Remark. In this study, we removed species from nomen dubium and presented the first record of species from Rajasthan.

***PSEUDOMICROMMATA* Järvi, 1912**

Pseudomicrommata are medium-sized huntsman spiders commonly known as “grass huntsman spiders” due to their close association with grasslands and savannahs. These spiders are easily distinguished among African Sparassidae by their unique colouration, featuring a prominent darker median stripe running dorsally along the body, which stands out against the lighter surrounding body parts (Moradmand, 2015). The genus comprises six described species globally, with recent documentation marking the first records of species from India.

Type species. *Micrommata longipes* Bösenberg & Lenz, 1895.

***Pseudomicrommata* sp. 1**

Abundance: Common / **Uncommon** / Rare

Natural history. *Pseudomicrommata* sp. 1 are abundant during the season, particularly in winter, when they are frequently found in large numbers on *Leptadenia pyrotechnica* (Kheep), especially as it dries out, the colour of dry kheep and this spider's blend help them to camouflage. Additionally, as Kheep is commonly used as

a roofing material for huts in villages, this species is sometimes observed in such structures as well.

Remark. This study reports the first record of a genus from India that was previously known only from Africa and the Middle East.



Figure 4.51: Live images of *Pseudomicrommata*. **A.** Subadult, dorsal view. **B.** same, frontal view.

FAMILY TETRAGNATHIDAE Menge, 1866

Long-jawed Orb weavers

Tetragnathidae consists of elongated bodies and chelicerae, which are especially prominent in males. They are found worldwide, often inhabiting vegetation near water bodies such as streams and wetlands. Tetragnathids build horizontal orb-shaped webs. Their unique adaptations, such as their slender body and long legs, allow them to rest in a straight alignment with twigs or leaves, making them camouflaged from predators. The family currently represents 989 species in 45 genera globally, and 55 are known from India (Caleb & Sankaran, 2025; WSC, 2025).

Type genus. *Tetragnatha* Latreille, 1804.

***TETRAGNATHA* Latreille, 1804**

Tetragnatha includes 320 species globally, thriving in tropical, temperate, and arctic regions, with a notable presence in wetland ecosystems. These spiders are recognized for their long, narrow bodies, oval carapace, and distinct eye patterns. They build orb webs in vegetation near water bodies and are characterized by elongated legs and chelicerae, especially in males. *Tetragnatha* species are diverse, with 28 species recorded in India (WSC, 2025).

Type species. *Aranea extensa* Linnaeus, 1758.

***Tetragnatha javana* (Thorell, 1890)**

Eucta javana Thorell, 1890: 236 (♂).

Eucta javana Thorell, 1895: 146 (♀).

Eucta javana Gravely, 1922: 1047, plate II, fig. 4 (♀).

(For the complete list of references, see WSC, 2025).



Figure 4.52: Live images of *Tetragnatha javana* (Thorell, 1890). **A.** Subadult, dorsal view. **B.** same, lateral view.

Distribution. Africa and Asia (WSC, 2025).

Abundance: Common / Uncommon / **Rare**

Natural history. *Tetragnatha javana* is not a common species in the Thar Desert, which is expected since the Tetragnathidae family typically prefers wet habitats. During the survey, they have only been observed a few times during the monsoon season, near a temporary water pool. This suggests that *Tetragnatha javana* may be a migratory species, arriving in the desert when the climate is optimal.

***Tetragnatha nitens* (Audouin, 1826)**

Eugnatha nitens Audouin, 1826: 323, plate II, fig. 2 (♀).

Eugnatha pelusia Audouin, 1826: 325, plate II, fig. 3 (♂♀).

Tetragnatha gracilis Lucas, 1838: 43, plate VI, fig. 8 (♀).

(For the complete list of references, see WSC, 2025).

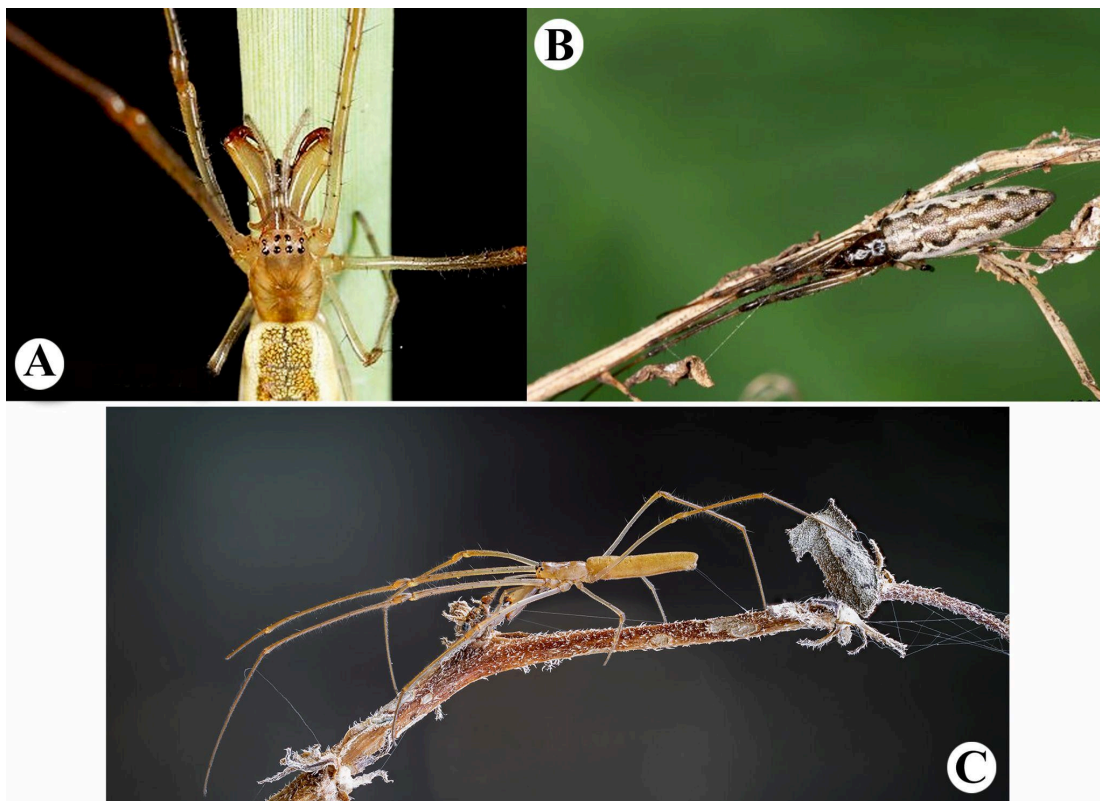


Figure 4.53: Live images of *Tetragnatha nitens* (Audouin, 1826). **A.** Female, eye view. **B.** same, dorsal view. **C.** Male, lateral view.

Distribution. Tropical and subtropical Asia. Introduced to the Americas, Macaronesia, Mediterranean, South Africa, Madagascar, Pacific Islands, and New Zealand (WSC, 2025).

Abundance: Common / Uncommon / **Rare**

Natural history. Same as *Tetragnatha javana*.

FAMILY THERIDIIDAE Sundevall, 1833

Cobweb spiders

Theridiidae consists of small to medium-sized spiders with key diagnostic features including a variable carapace, eyes in two rows, and a comb of serrated bristles on tarsus IV. They build irregular webs with radiating threads and are found in a variety of habitats. While some species, like the widow spiders (*Latrodectus*), are venomous and have medical significance, many are harmless and play an important role in controlling insect populations. Theridiidae comprises 2,586 species across 131 genera, with 90 species found in India (WSC, 2025).

Type genus. *Theridion* Walckenaer, 1805.

***EURYOPIS* Menge, 1868**

Euryopis are small, often inconspicuous spiders that are globally distributed. Many species prefer ground-level habitats or low vegetation. They are particularly known for their specialized diet, with many species preying primarily on ants, a rare trait among spiders. The genus includes over 82 described species worldwide, with two species recorded from India.

Type species. *Micryphantes flavomaculatus* C. L. Koch, 1836.

Euryopis episinoides (Walckenaer, 1847)

Theridion acuminatum Lucas, 1846: 268, plates XVII, fig. 10 (♂♀).

Argus episinoides Walckenaer, 1847: 501 (♂♀).

Theridion scriptum O. Pickard-Cambridge, 1872: 283 (♂♀).

(For the complete list of references see WSC, 2025).

Distribution. Mediterranean to Turkey, Georgia, Israel. Introduced to South Africa, Réunion, India, and China (WSC, 2025).

Abundance: Common / **Uncommon** / Rare

Natural history. They are specialized ant predator that relies on minimal silk for hunting and retreat construction. These spiders are typically found on low vegetation, under leaf litter, or in other concealed microhabitats where ants are abundant. Their stealthy hunting strategy allows them to ambush ants effectively, and they rarely build extensive webs, instead using small silk retreats for shelter and protection.

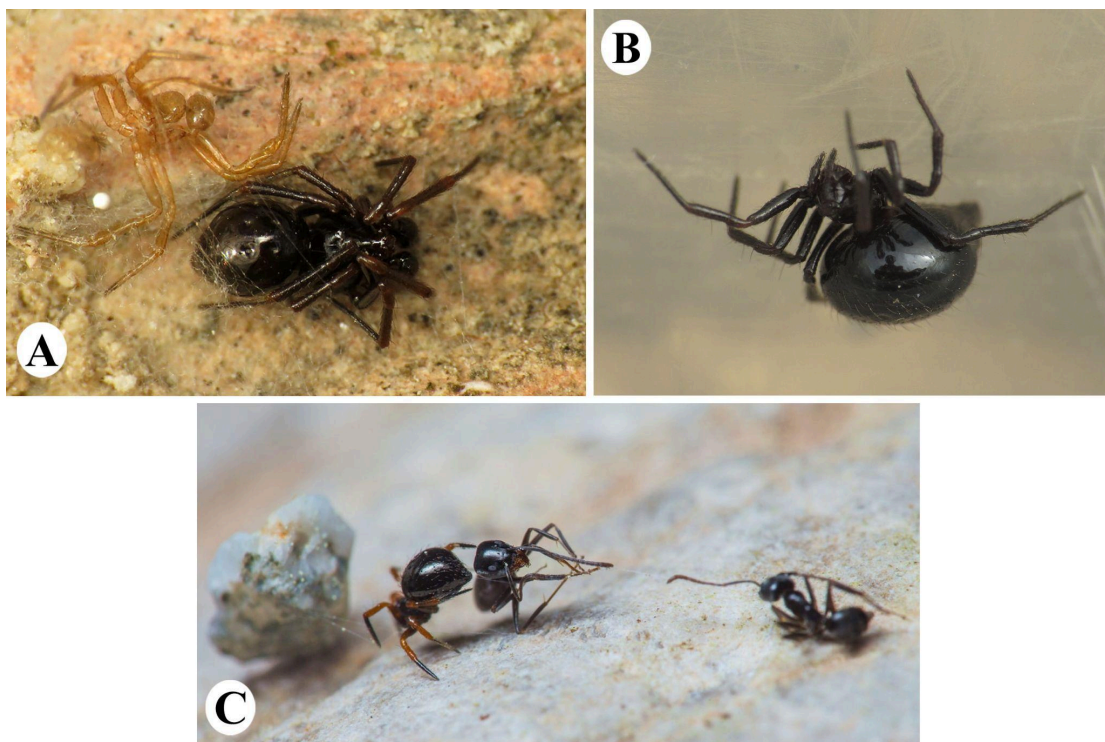


Figure 4.54: Live images of *Euryopis episinoides* (Walckenaer, 1847). **A.** Female, dorsal view. **B.** same, lateral view. **C.** Female with ant prey.

***LATRODECTUS* Walckenaer, 1805**

Latrodectus, commonly known as widow spiders, is globally distributed and comprises some of the most recognizable and medically significant spiders. This genus includes approximately 35 described species of them four are reported from India. These spiders are renowned for their potent venom, containing neurotoxins that can cause latrodectism, a condition of severe pain and systemic symptoms in humans. *Latrodectus* are medium-sized with round, glossy abdomens often marked with distinct red or orange patterns on the ventral side. Females are significantly larger and more venomous than males. Mating behaviour in this genus is notable for the risk of sexual cannibalism, although it does not always occur.

Type species. *Aranea tredecimguttata* Rossi, 1790.

***Latrodectus geometricus* C. L. Koch, 1841**

Latrodectus geometricus C. L. Koch, 1841: 117, fig. 684 (♀).

Latrodectus geometricus Thorell, 1875: 138, plate XXV, fig. 4 (♀).

Theridium zickzack Karsch, 1878: 311, plate VIII, fig. 1 (♀).

(For the complete list of references, see WSC, 2025).



Figure 4.55: Live images of *Latrodectus geometricus* C. L. Koch, 1841. **A.** Female, dorsal view. **B.** same, lateral view.

Distribution. Africa, the Americas, the Middle East, Pakistan, India, China, Japan, Thailand, Malaysia, Papua New Guinea, Australia, and Hawaii (WSC, 2025).

Abundance: Common / Uncommon / **Rare**

Natural history. *Latrodectus geometricus* are generally easy to locate in other parts of India but remain relatively rare in the Thar Desert. These spiders are often found near human habitation.

Latrodectus indicus sp. nov.

Latrodectus hasseltii Thorell, 1870: 369 (♂, juv ♀).

Latrodectus scelio Thorell, 1870: 370 (♀).

Latrodectus hasselti L. Koch, 1872: 276, plates XXIII, figs 2–3 (♂♀).

(For the complete list of references, see WSC, 2025).

Distribution. India (present study).

Abundance: Common / Uncommon / **Rare**

Natural history. *Latrodectus indicus* is a new species, and its natural history remains largely unknown. These spiders are typically found under rocks and within gerbil or natural burrows, where they construct sticky cobwebs that often contain the remains of numerous insects, unlike other spiders that tend to clean their webs. They have a round, oval-shaped abdomen featuring a red or orange hourglass marking on the posterior part, though this marking can vary or even be absent in some individuals. Primarily nocturnal, *Latrodectus indicus* is active at night, tending to its web and capturing prey.

Remark. New species described in this study.



Figure 4.56: Live images of *Latrodectus indicus* sp. nov. **A.** dorsal view. **B.** rear view.

***STEATODA* Sundevall, 1833**

Steatoda, commonly known as false widow spiders. It includes 121 described species distributed worldwide, with six species known from India. They are small to medium-sized, with shiny, globular abdomens often marked with distinctive patterns or bands. They are known for constructing irregular, sticky webs in sheltered locations such as under rocks, in crevices, or inside human dwellings.

Type species. *Araneus castaneus* Clerck, 1757.

***Steatoda albomaculata* (De Geer, 1778)**

Aranea albo-maculata De Geer, 1778: 257, plate XV, figs 2–4.

Aranea maculata Olivier, 1789: 209.

Aranea albolunulata Panzer, 1804: 206, plate. 225, fig. 6.

(For the complete list of references, see WSC, 2025).

Distribution. North America, Europe, North Africa to Israel, Russia (Europe to Far East), Caucasus, Kazakhstan, Iran, Central Asia, India, China, Korea, and Japan (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Steatoda albomaculata* is often found in dry, sheltered habitats such as under rocks, in leaf litter, crevices, under cattle dung, or in human-made structures like sheds and walls. They build a tangled, sticky web with irregular strands, often with a funnel-like retreat area where the spider waits for prey to become entangled.

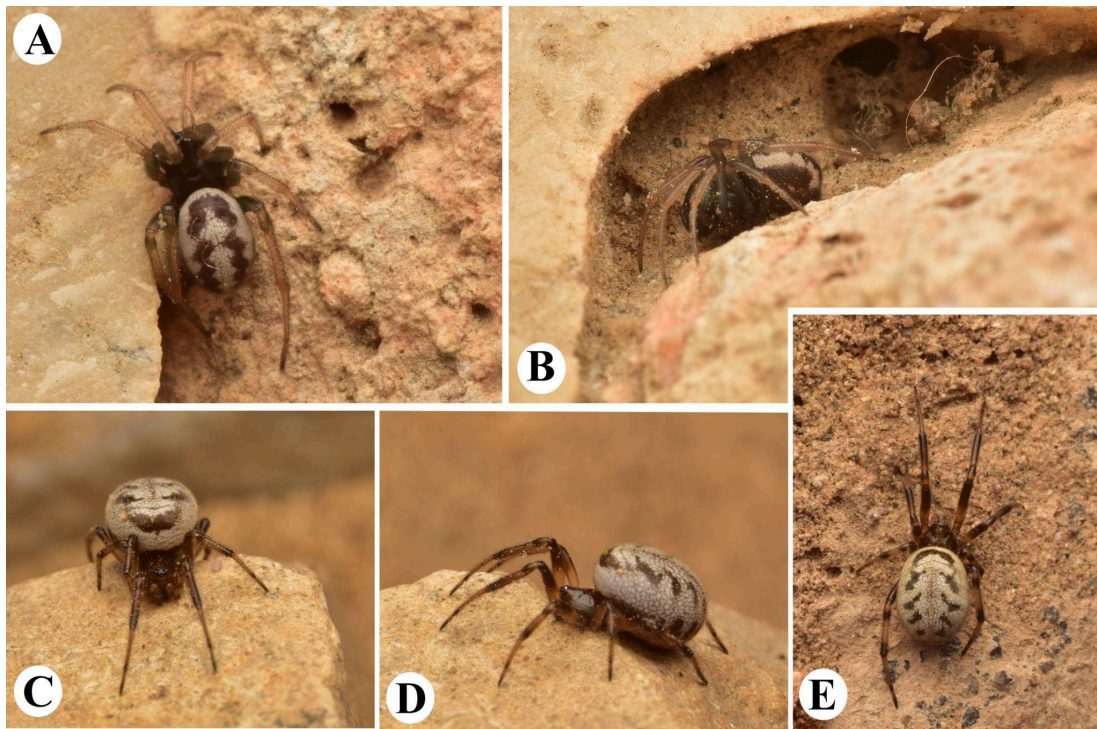


Figure 4.57: Live images of *Steatoda albomaculata* (De Geer, 1778). **A.** Male, dorsal view. **B.** same, lateral view. **C.** Female, frontal view. **D.** same, lateral view. **E.** same, dorsal view.

Steatoda erigoniformis (O. Pickard-Cambridge, 1872)

Theridion erigoniforme O. Pickard-Cambridge, 1872: 284 (♂♀).

Steatoda signata O. Pickard-Cambridge, 1876: 568 (♀).

Crustulina signata Simon, 1881: 161.

(For the complete list of references, see WSC, 2025).

Distribution. East Mediterranean, Middle East, Caucasus, India, China, Korea, Japan. Introduced to USA, Caribbean, Venezuela, and South Africa (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *Steatoda erigoniformis* is the smallest *Steatoda* species in Thar Desert. It lives under stones. Mature individuals are seen in monsoon. They are not as common as *S. albomaculata*.



Figure 4.58: Live images of *Steatoda erigoniformis* (O. Pickard-Cambridge, 1872). **A.** Egg sac. **B.** Female, dorsal view with egg sac. **C.** same, lateral view.

FAMILY THOMISIDAE Sundevall, 1833

Crab spiders

Thomisidae is a diverse family of ambush predators, renowned for their crab-like appearance and behaviour. With over 2,100 species worldwide, they are typically found on flowers, foliage, or bark, relying on camouflage to blend into their surroundings and capture prey. Instead of spinning webs, these spiders use their strong forelegs to grasp unsuspecting insects like bees and butterflies. Some species can change colour to match their environment, enhancing their hunting efficiency. Found in various habitats from forests to deserts, crab spiders play a crucial role in

regulating insect populations and influencing plant-pollinator interactions. India hosts 173 species of crab spiders many of which require taxonomic revision.

Type species. *Thomisus* Walckenaer, 1805.

AZARKINA gen. nov.

Azarkina gen. nov. differs from *Firmicus* by possessing a flattened body (vs. not flattened), a carapace that is 1.1–1.25 times longer than wide (vs. less than 1.1 times), and an abdomen that is at least 1.33 times longer than wide with subparallel lateral margins (vs. 1.15 times longer, pentagonal in shape). Additionally, the embolus forms a 360° loop (vs. approximately 135°), and the most dorsal tibial apophysis is longer than the others (vs. shorter). The epigyne is characterized by an anterior hood and distinct copulatory ducts (vs. absence of both structures). Furthermore, *Azarkina* gen. nov. differs from other genera with an elongated abdomen, such as *Oxytate* L. Koch, 1878 and *Runcinia* Simon, 1875, by its flattened body shape.

Azarkina rehmani sp. nov.

Abundance: Common / Uncommon / Rare

Natural history. *Azarkina rehmani* are similar to *Bassaniodes tristrami*, and are commonly found at the base or crown of Sewan grass (*Lasiurus indicus*). Remarkably, like *Peucetia*, they exhibit seasonal colour changes, blending with the dry grass in summer and winter by adopting a brownish hue and turning green during the monsoon to match the lush vegetation.

Remark. New genera and species are described in this study.



Figure 4.59: Live images of *Azarkina rehmani* gen. sp. nov. **A.** Female, frontal view. **B.** same, lateral view. **C–D.** same, dorsal view. **E.** Male, dorsal view.

***BASSANIODES* Pocock, 1903**

Bassaniodes are often found in open habitats, such as grasslands and deserts, where they rely on their camouflage to blend with the ground or vegetation. Unlike many other crab spiders, they typically lack the vibrant colouration associated with flower-dwelling species, often exhibiting earth-toned hues that match their terrestrial surroundings. Distributed across parts of Greece, Turkey, Caucasus, Russia Central Asia and the Middle East, with several species adapted to arid environments. To date, the genus includes 40 nominal species globally (WSC, 2025), this study presents the first record of the genus from India.

Type species. *Bassaniodes socotrensis* Pocock, 1903.

Bassaniodes tristrami (O. Pickard-Cambridge, 1872)

Thomisus tristrami O. Pickard-Cambridge, 1872: 304, plate XIV, fig. 16 (♂♀).

Xysticus tristrami Simon, 1889: 380.

Xysticus tristrami Kulczyński, 1911: 32, plate I, figs 31, 34-35 (♂♀).

(For the complete list of references, see WSC, 2025).

Distribution. Greece, Turkey, Caucasus, Russia (Europe) to Central Asia, the Middle East, and India (WSC, 2025).

Abundance: Common / **Uncommon** / Rare

Natural history. They typically found at the base or crown of Sewan grass (*Lasiurus indicus*), making them challenging to locate. While they have been observed multiple times, mature individuals are seen only during the monsoon season, with both males and females often found at the same grass base. They have never been seen active away from the crown of the grass.



Figure 4.60: Live images of *Bassaniodes tristrami* (O. Pickard-Cambridge, 1872). **A.** Male, dorsal view. **B.** same, frontal view. **C.** same, lateral view. **D.** Female, dorsal view.

***DIAEA* Thorell, 1869**

Diaea are relatively small, with females usually larger than males, and they exhibit colours ranging from green to yellow, often with intricate patterns that enhance their mimicry of plant surfaces. *Diaea* Thorell, 1869 is known for its aerial dispersal ability for migration and movement (Nishiki 1966; Blandenier & Fürst, 1998), yet it has limited distribution range records, often showing endemism to various continents (Szymkowiak, 2014). The genus consists of 43 species globally and in India, there are three species known to date (Caleb & Sankaran, 2025; WSC, 2025).

Type species. *Aranea dorsata* Fabricius, 1777.

***Diaea thar* sp. nov.**

Figure 4.61: Live images of *Diaea thar* sp. nov. **A.** Male, dorsal view. **B.** Female, dorsal view.

Distribution. India (Present study).

Abundance: Common / Uncommon / Rare

Natural history. *Diaea thar* is among the most common thomisids in the Thar Desert and is frequently found on the flowers of Ghanitya grass (*Dactyloctenium indicum*),

where they construct small silken retreats. Females are more abundant than males, and mature individuals are predominantly observed during the monsoon season.

Remark. New species described in this study.

***RUNCINIA* Simon, 1875**

Runcinia is characterized by a short, oval body and eyes situated on a carina; a broad pale band extends from the eyes to the posterior margin, flanked by two wide brown bands on either side. Abdomen elongated, spun, and tapers toward the rear, exhibiting prominent longitudinal muscular corrugations on the lateral sides. They are a lesser-known genus of crab spiders, with limited geographical distribution. Globally, the genus comprises 27 recognized species, with 10 species reported from India (WSC, 2025).

Type species. *Thomisus lateralis* C. L. Koch, 1837.

***Runcinia* sp. 1**

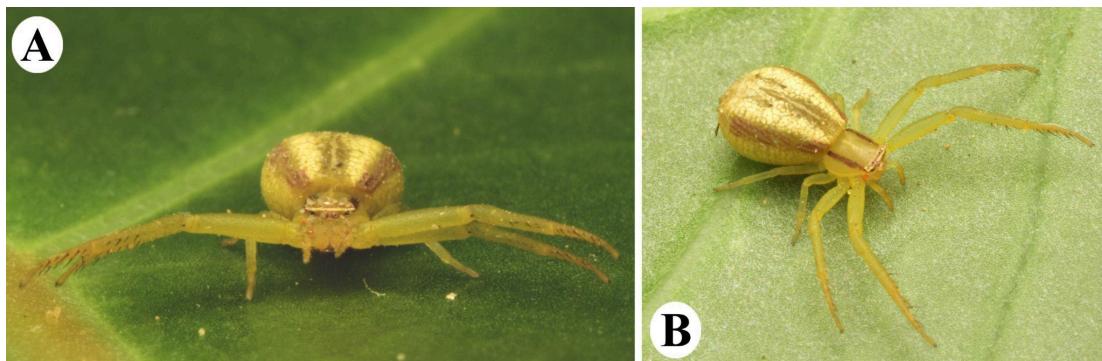


Figure 4.62: Live images of *Runcinia*. **A.** Female, frontal view. **B.** same, dorsal view.

Abundance: Common / Uncommon / **Rare**

Natural history. *Runcinia* sp. 1 is not commonly found in the Thar Desert and may exhibit monsoon migratory behaviour similar to tetragnathids, as it has only been

observed a few times during the monsoon season. It is typically seen in low vegetation and shrublands interspersed with grass patches.

***THOMISUS* Walckenaer, 1805**

Thomisus spiders are known for their bright colours and flower-dwelling characteristics. Members of this genus generally dwell on flowers, where their secretive colouration helps them capture pollinators such as bees, butterflies, and flies. *Thomisus* are highly adaptable spiders that can change the colour of their bodies to blend into their floral surroundings, improving their hunting effectiveness and preventing predators from finding them easily. It is distributed throughout the world, with species found in a wide range of habitats in Asia, Africa, Europe, and the Americas. Females are usually larger than males, and their bodies are broader and more colourful. Morphologically, *Thomisus* species are crab-like in appearance, with the first two pairs of legs longer and more powerful, adapted for catching prey. The genus currently comprises 143 nominal species globally, with 45 species known from India (WSC, 2025).

Type species. *Thomisus onustus* Walckenaer, 1805.

***Thomisus unidentatus* Dippenaar-Schoeman & van Harten, 2007**

Thomisus unidentatus D. Schoeman & Van Harten, 2007: 180, figs 27–29 (♂♀).

Thomisus unidentatus Seyyar, Demir & Najim, 2016: 221, figs 2a–f (♂♀).

Thomisus unidentatus Kiany et al., 2017: 4, figs 8a–e (♂♀).

(For the complete list of references see WSC, 2025).

Distribution. Yemen, Iraq, Iran, India (WSC, 2025).

Abundance: Common / Uncommon / Rare

Natural history. *T. unidentatus* is typically found on flowers or foliage, where its body shape and coloration, especially in females, provide excellent camouflage. Males are much smaller and rarer.

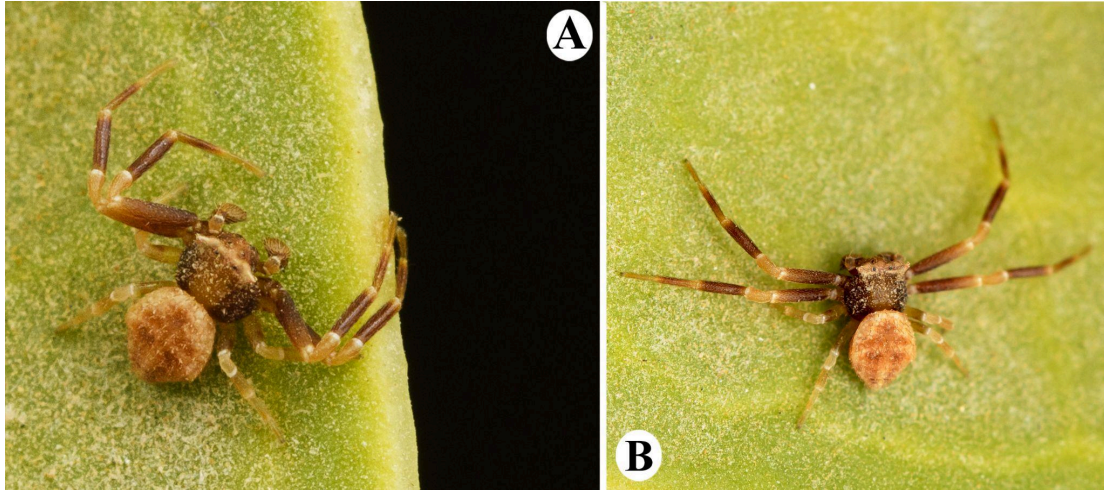


Figure 4.63: Live images of *Thomisus unidentatus*. A–B. Male, dorsal view.

Thomisus sp. 1

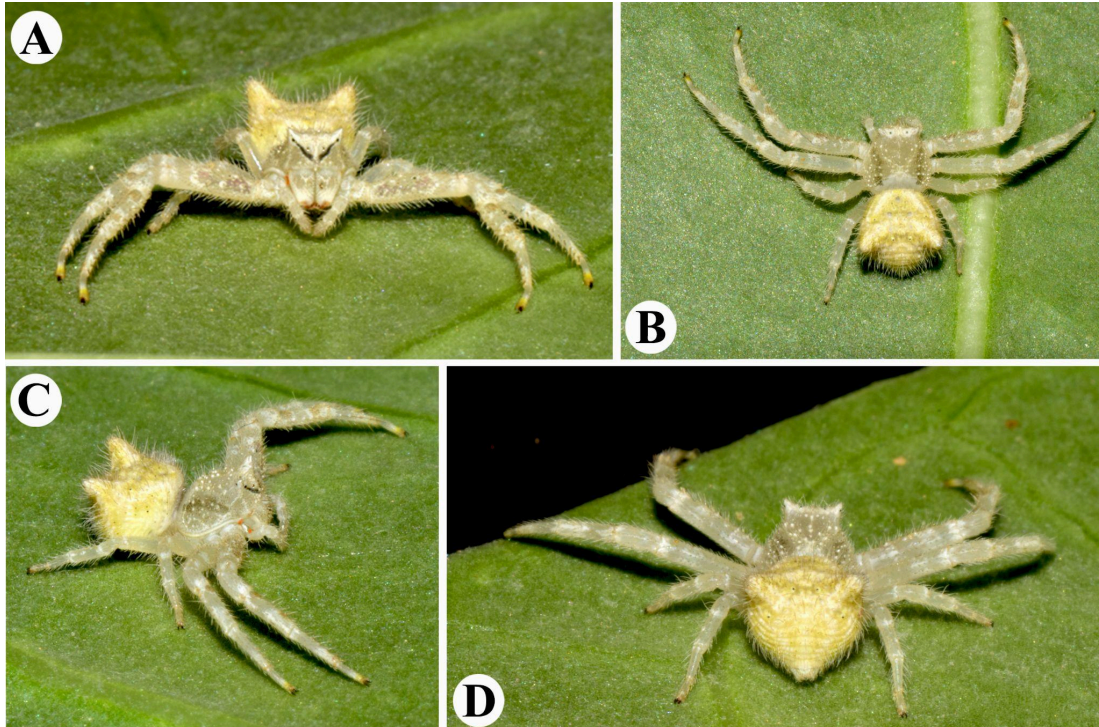


Figure 4.64: Live images of *Thomisus* sp. 1. A. Female, frontal view. B. same, dorsal view. C. same, lateral view. D. same, rear view.

Abundance: Common / **Uncommon** / Rare

Natural history. *Thomisus* sp. 1 has a hairy abdomen adorned with white erect hairs, resembling the texture of the Bue/ Bui plant (*Aerva javanica*), also known as the desert cotton, it inhabits, whose flowers share a similar hairy structure, allowing it to blend effectively with its surroundings. Additionally, the posterior end of the spider displays an eye-like pattern, which may serve to confuse potential predators.

***TMARUS* Simon, 1875**

Tmarus comprises over 228 species distributed globally across forests, grasslands, and shrublands of them six are reported from India. Known for their elongated bodies and twig-like appearance, these spiders exhibit exceptional camouflage, often blending seamlessly into branches and twigs.

Type species. *Aranea pigra* Walckenaer, 1802.

***Tmarus* sp. 1**

Abundance: Common / **Uncommon** / Rare

Natural history. *Tmarus* sp. 1 is a cryptic species with an abdomen resembling the prickles of Ber (*Ziziphus*) trees, where it is commonly found. This resemblance allows them to blend seamlessly with their surroundings, making them nearly invisible to both prey and predators. Their excellent camouflage and unique posture enhance their concealment. Due to their cryptic nature, the inverted umbrella method was used to locate these spiders, as they are challenging to detect through visual observation alone.



Figure 4.65: Live images of *Tmarus* sp. 1. **A–B.** Female, lateral view.

FAMILY ULOBORIDAE Thorell, 1869

Hackled-orb weavers or Triangle web spiders

Uloboridae is a globally distributed group renowned for their unique adaptation of using cribellate silk rather than venom to capture prey. These small to medium-sized spiders have a wide variety of eye arrangements and are equipped with a cribellum and calamistrum, enabling them to produce dry, fuzzy silk that effectively entangles flying insects. They construct intricate orb-shaped webs, often horizontal, and immobilize prey by wrapping it extensively in silk. Lacking venom glands, uloborids rely entirely on their silk's physical properties for predation. Peng et al. (2023) describe the feeding behaviour: Uloborids employ a distinct hunting method involving extensive silk-wrapping and regurgitation of digestive fluids onto the whole

prey, yet the precise mechanism by which prey is immobilized remains unknown. One hypothesis is that toxins may have shifted from the venom to other secretions that come into contact with prey, such as silk or digestive fluids. The family currently has 285 species in 19 genera globally, and 26 of them are known from India (Caleb & Sankaran, 2025; WSC, 2025).

Type genus. *Uloborus* Latreille, 1806.

***ULOBORUS* Latreille, 1806**

Uloborus has a widespread distribution (WSC, 2025), most species occur in the tropics and subtropics, with only a few species in northern America and Europe. The genus currently comprises 79 nominal species globally, with 8 species known from India (Caleb & Sankaran, 2025).

Type species. *Uloborus walckenaerius* Latreille, 1806.

***Uloborus* sp. 1**



Figure 4.66: Live images of *Uloborus* sp. 1. **A–B.** Female, dorsal view.

Abundance: Common / Uncommon / **Rare**

Natural history. *Uloborus* sp. 1 is rare in the Thar Desert, having been observed only a few times near the IGNP canal. Its scarcity might be attributed to the harsh desert climate, which may limit its ability to thrive.

FAMILY ZODARIIDAE Thorell, 1881**Burrowing or Ant-Eating spiders**

Zodariids are small to medium-sized, wandering or burrowing spiders; they are terrestrial and often associated with soil debris and leaf litter or found under stones or decaying logs (Barrion & Litsinger, 1992). They are characterized by three tarsal claws, with the paired claws bearing teeth and implanted laterally, facing the opposing claw. These ecribellate and entelegyne spiders may possess six or eight eyes, lack a serrula, and have very short cheliceral fangs (Jocqué & Dippenaar-Schoeman, 2006). Zodariids are predominantly ground-dwelling, ant-mimicking spiders that exhibit myrmecomorphic appearance and behaviour traits, aiding in predation and protection from predators. The family currently has 1,303 species in 90 genera globally, and 30 of them are known from India (Caleb & Sankaran, 2025; WSC, 2025).

Type genus. *Zodarion* Walckenaer, 1826.

***TROPIZODIUM* Jocqué & Churchill, 2005**

Tropizodium belong to femoral-organ clade, a group of small zodariids characterized by a gland on the prolateral face of femora I–III. Members of the genus are recognised by tiny spiders with minute secondary eyes, the PME close to the AME; epigyne very simple without clearly defined entrance ducts. The genus currently comprises 11 nominal species globally, with 5 species known from India (Caleb & Sankaran, 2025).

***Tropizodium* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. Similar to *Zodarion* sp.1.

ZODARION Walckenaer, 1826

Zodarion, a prominent genus within the family Zodariidae, comprises over 170 described species known for their specialized ant mimicry and predation. These small to medium-sized spiders are with diverse colouration mimicking ants, and distinctive features such as short cheliceral fangs. Distributed widely across Europe, Asia, and North Africa, these spiders inhabit various environments, including forests, grasslands, and arid regions, often constructing silk retreats. Strictly myrmecophagous, they are nocturnal hunters, preying on ants through stealth and precision.

Type species. *Enyo nitida* Audouin, 1826.

***Zodarion* sp. 1**

Abundance: Common / Uncommon / **Rare**

Natural history. Zodariids are rare and have been observed only a few times. They typically live in rocky habitats with sparse grass. These ground-dwelling spiders often shelter under rocks, leaf litter, or small burrows to avoid extreme temperatures and predation.



Figure 4.67: Live images of *Zodarion* sp. 1. **A.** Male, lateral view. **B.** Female, dorsal view.

Family	Species	Remarks
Agelenidae C. L. Koch, 1837	<i>Benoitia</i> sp. 1	First report of genus from India
Araneidae Clerck, 1757	<i>Argiope lobata</i> (Pallas, 1772)	
	<i>Argiope trifasciata</i> (Forsskal, 1775)	
	<i>Cyclosa</i> sp. 1	
	<i>Larinia</i> sp. 1	
	<i>Neoscona bihumpi</i> Patel, 1988	
	<i>Neoscona nautica</i> (L. Koch, 1875)	
	<i>Neoscona theisi</i> (Walckenaer, 1841)	
	<i>Neoscona</i> sp. 1	
	<i>Neoscona</i> sp. 2	
Cheiracanthiidae Wagner, 1887	<i>Cheiracanthium melanostomum</i> (Thorell, 1895)	
Cithaeronidae Simon, 1893	<i>Cithaeron praedonius</i> O. Pickard-Cambridge, 1872	
Corinnidae Karsch, 1880	<i>Castianeira zetes</i> Simon, 1897	
Dictynidae O. Pickard-Cambridge, 1871	<i>Emblyna</i> sp. 1	First record of genus from India with a new species
Eresidae C. L. Koch, 1845	<i>Stegodyphus pacificus</i> Pocock, 1900	Matriphagy behaviour reported for the first time
	<i>Stegodyphus thar</i> sp. nov.	New species
Filistatidae Ausserer, 1867	<i>Sahastata ashapuriae</i> Patel, 1978	
Gnaphosidae Banks, 1892	<i>Anagraphis</i> sp. nov.	First record of genus from India with a new species
	<i>Berlandina bishnoi</i> sp. nov.	First record of genus from India with a new species
	<i>Cryptodrassus ovalus</i> sp. nov.	New species
	<i>Cryptodrassus pallidus</i> sp. nov.	New species
	<i>Drassodes</i> sp. 1	
	<i>Drassodes</i> sp. 2	
	<i>Hitobia</i> sp. 1	

	<i>Marinarozelotes jaxartensis</i> (Kroneberg, 1875)	Redescription of species
	<i>Megamyrmaekion caudatum</i> Reuss, 1834	Redescription of species
	<i>Micaria ignea</i> O. Pickard-Cambridge, 1872	First record of species from India
	<i>Minosiella intermedia</i> Denis, 1958	First record of genus from India with syn.
	<i>Odontodrassus sutirthai</i> sp. nov.	First record of genus from India with a new species
	<i>Pterotricha marusthala</i> sp. nov.	New species
	<i>Setaphis latus</i> sp. nov.	New species
	<i>Trichothyse jodhpurensis</i> (Gajbe, 1993)	First record of genus and male description; Genus transfer
	<i>Xerophaeus aridocampus</i> sp. nov.	First record of genus from India with a new species
	<i>Zelotes</i> sp. 1–6	
Hersiliidae Thorell, 1869	<i>Hersilia sukshma</i> sp. nov.	New species
Lycosidae Sundevall, 1833	<i>Draposa</i> sp. 1	
	<i>Evippa fortis</i> Roewer, 1955	First record of species from India
	<i>Evippa rajasthanica</i> Tikader & Malhotra, 1980	
	<i>Hippasa agelenoides</i> (Simon, 1884)	
	<i>Hogna</i> sp. 1	
	<i>Wadicosa fidelis</i> (O. Pickard-Cambridge, 1872)	
Mimetidae Simon, 1881	<i>Ero</i> sp. nov.	First record of genus from India with a new species
Oecobiidae Blackwall, 1862	<i>Oecobius thar</i> Tripathi, Sudhikumar & Sherwood, 2023	New species
	<i>Uroctea thaleri</i> Rheims, Santos & van Harten, 2007	
Oonopidae Simon, 1890	<i>Gamasomorpha</i> sp. nov.	New species
Oxyopidae Thorell, 1869	<i>Hamataliwa</i> sp. 1	
	<i>Hamataliwa</i> sp. 2	

	<i>Oxyopes kusumae</i> Gajbe, 1999	
	<i>Oxyopes orange</i>	New species
	<i>Oxyopes</i> sp. 1	
	<i>Peucetia viridis</i> (Blackwall, 1858)	First record of species from India
Palpimanidae Thorell, 1869	<i>Palpimanus godawan</i> Tripathi & Sankaran, 2023	New species
Philodromidae Thorell, 1869	<i>Philodromus</i> sp. 1	
	<i>Philodromus</i> sp. 2	
	<i>Rhysodromus</i> sp. 1	
	<i>Rhysodromus</i> sp. 2	
	<i>Thanatus fabricii</i> (Audouin, 1826)	First record of species from India
	<i>Thanatus</i> sp. 1	
Pholcidae C. L. Koch, 1850	<i>Artema atlanta</i> Walckenaer, 1837	
	<i>Crossopriza</i> sp. 1	
Pisauridae Simon, 1890	<i>Pisaura</i> sp. 1	
Prodidomidae Simon, 1884	<i>Prodidomus bastawade</i> sp. nov.	New species
Salticidae Blackwall, 1841	<i>Aelurillus</i> sp. 1	
	<i>Aelurillus</i> sp. 2	
	<i>Afraflacilla miajlarensis</i> Tripathi, Jangid, Prajapati & Siliwal, 2022	New species
	<i>Bianor albobimaculatus</i> (Lucas, 1846)	
	<i>Cyrba ocellata</i> (Kroneberg, 1875)	
	<i>Heliophanus abditus</i> Wesołowska, 1986	First record of species from India
	<i>Iranattus rectangularis</i> Prószyński, 1992	First record of genus from India; female is described for the first time.
	<i>Langona</i> sp. 1	
	<i>Menemerus marginatus</i>	First record of species from India

	(Kroneberg, 1875)	
	<i>Mogrus rajasthanensis</i> Caleb, Chatterjee, Tyagi, Kundu & Kumar, 2017	First description of male of the species
	<i>Mogrus harappan</i>	New species
	<i>Mogrus larisae</i>	First record of species from India
	<i>Pellenes allegrii</i> Caporiacco, 1935	
	<i>Pellenes rajasthan</i> sp. nov.	New species
	<i>Plexippus minor</i> Wesołowska & van Harten, 2010	First record of species from India
	<i>Pseudomogrus sudhii</i> Logunov, Tripathi & Jangid, 2022	New species
	<i>Rudakius ludhianaensis</i> (Tikader, 1974)	
	<i>Thyene imperialis</i> (Rossi, 1846)	
Scytodidae Blackwall, 1864	<i>Scytodes</i> sp. 1	
Sicariidae Keyserling, 1880	<i>Loxosceles</i> sp.1	
Sparassidae Bertkau, 1872	<i>Cebrennus</i> sp. 1	First record of genus from India
	<i>Olios kiranae</i> Sethi & Tikader, 1988	Species removed from nomen dubium
	<i>Olios</i> sp. 1	
	<i>Pseudomicrommata</i> sp. 1	First record of genus from India
Tetragnathidae Menge, 1866	<i>Tetragnatha javana</i> (Thorell, 1890)	
	<i>Tetragnatha nitens</i> (Audouin, 1826)	
Theridiidae Sundevall, 1833	<i>Euryopsis episinoides</i> (Walckenaer, 1847)	
	<i>Latrodectus geometricus</i> C. L. Koch, 1841	
	<i>Latrodectus indicus</i> sp. nov.	New species
	<i>Steatoda albomaculata</i> (De Geer, 1778)	First record of species from India
	<i>Steatoda erigoniformis</i> (O. Pickard-Cambridge, 1872)	First record of species from India

	<i>Steatoda</i> sp. 1	
	<i>Theridion</i> sp. 1	
	<i>Theridion</i> sp. 2	
Thomisidae Sundevall, 1833	<i>Azarkina rahmani</i>	New genus and species
	<i>Bassaniodes tristrami</i> (O. Pickard-Cambridge, 1872)	First record of species from India
	<i>Diaea thar</i>	New species
	<i>Runcinia</i> sp. 1	
	<i>Thomisus</i> sp. 1	
	<i>Thomisus unidentatus</i>	
	<i>Tmarus</i> sp. 1	
	<i>Tmarus</i> sp. 2	
	<i>Tmarus</i> sp. 3	
Uloboridae Thorell, 1869	<i>Uloborus</i> sp. 1	
Zodariidae Thorell, 1881	<i>Tropizodium</i> sp. 1	
	<i>Zodarion</i> sp. 1	New species

Table 4.1: Comprehensive annotated checklist of spider taxa documented in the Desert National Park Wildlife Sanctuary.

4.2. Spider Diversity Across Habitats

The study recorded a total of 16,775 individuals, representing 29 families, 80 genera, and 114 species. Grasslands comprise the vast majority of spider diversity (8,512, accounting for more than 50.7% of records), indicating that they represent important habitats that support high spider diversity. Agricultural habitats follow with 2,351 (approximately 14%), suggesting that even heavily modified landscapes can support considerable spider diversity, perhaps due to habitat heterogeneity or proximity to native habitats. Conversely, barren landscapes show the lowest number of records (883, ~5.3%). This trend suggests a lack of vegetation and potential shelter. The remaining habitats (scrublands, shrublands, and woodlands) were similar in contribution to the total (1,670 to 1,688 records, roughly 10% each), suggesting that they provide moderately suitable conditions for spiders but are less ideal than grasslands.

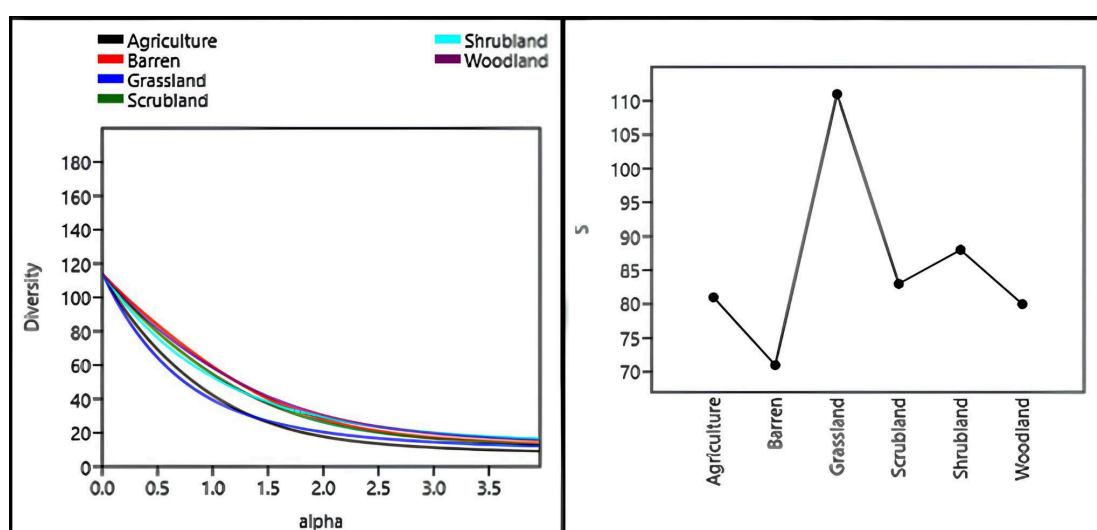


Figure 4.68. Spider diversity across habitats. Rényi profiles (left) show grasslands as richest but less even, while shrublands and woodlands maintain higher evenness. Species richness (right) peaks in grasslands and is lowest in barren habitats.

4.3. Comparison of species richness and diversity indices among habitats

In terms of diversity indices, Grassland recorded the highest species richness ($Taxa_S = 111$) and individual abundance, followed by Shrubland (88) and Scrubland (83). The lowest richness was observed in the barren land (71). Diversity indices such as Shannon's (H) and Simpson's index showed maximum diversity in the grassland ($H = 3.619$; Simpson = 0.9485), indicating higher evenness and lower dominance, while the barren land showed relatively lower diversity ($H = 3.212$). Fisher's alpha values were also highest in shrubland (19.73), suggesting considerable diversity. The Rényi diversity profiles reveal that while all habitats exhibit comparable species richness (~110–120 species), differences emerge when accounting for species evenness. Grasslands, despite their highest richness, show a steep decline across α , indicating dominance by a few abundant species. Conversely, shrublands and woodlands maintain higher effective diversity at increasing α values, suggesting more balanced species distributions. Agricultural and scrubland habitats occupy intermediate positions, while barren habitats, though less rich, display moderate evenness. This pattern highlights that grasslands serve as species-rich habitats, but structurally complex habitats, such as woodlands and shrublands, support more even communities.

A Mann–Whitney U test revealed a highly significant difference between the two groups ($U = 76,064$, $z = 14.01$, $p < 0.001$). Values inside the enclosure (mean = 2.04, SD = 0.57, mean rank = 319.49) were significantly higher compared to those outside (mean = 1.52, SD = 0.59, mean rank = 229.01). This indicates that conditions inside the enclosure are markedly different and more favourable relative to the outside areas. Sample-size and coverage-based rarefaction and extrapolation analyses revealed clear

differences in spider diversity across the six habitat types (Fig. 3.3). Since all assemblages were sampled at very high completeness (sample coverage >98%), diversity comparisons were made at their maximum coverage values (0.99–1.0). For species richness ($q = 0$), grassland supported the highest number of species (111.6), followed by shrubland (96.7), agriculture (92.9), woodland (87.1), and scrubland (87.0), with barren habitats showing the lowest richness (81.1). For Shannon diversity ($q = 1$), which accounts for both species richness and evenness, grassland again supported the highest diversity (37.5), followed by shrubland (33.2), woodland (31.4), scrubland (30.9), barren land (25.7), and agriculture (20.3). For Simpson diversity ($q = 2$), which emphasizes dominant species, grassland retained the highest effective number of dominant species (19.4), followed by shrubland (18.5), woodland (16.3), scrubland (15.0), barren land (12.0), and agriculture (9.4). Overall, grasslands consistently supported the highest spider diversity across all diversity orders ($q = 0, 1, 2$), while agricultural and barren habitats showed comparatively reduced diversity. These results highlight the importance of natural habitats such as grassland, shrubland, and woodland in maintaining both species richness and evenness in spider communities.

Global beta diversity estimates indicated moderate to high turnover among habitats. The Whittaker index (0.3307) suggested a considerable difference in community composition between habitats, while Wilson-Shmida (0.9047) indicated high species turnover. Other indices like Routledge (0.0836) and Harrison (0.0661) showed relatively low dissimilarity values, whereas Cody's index (77.5) indicated significant species replacement.

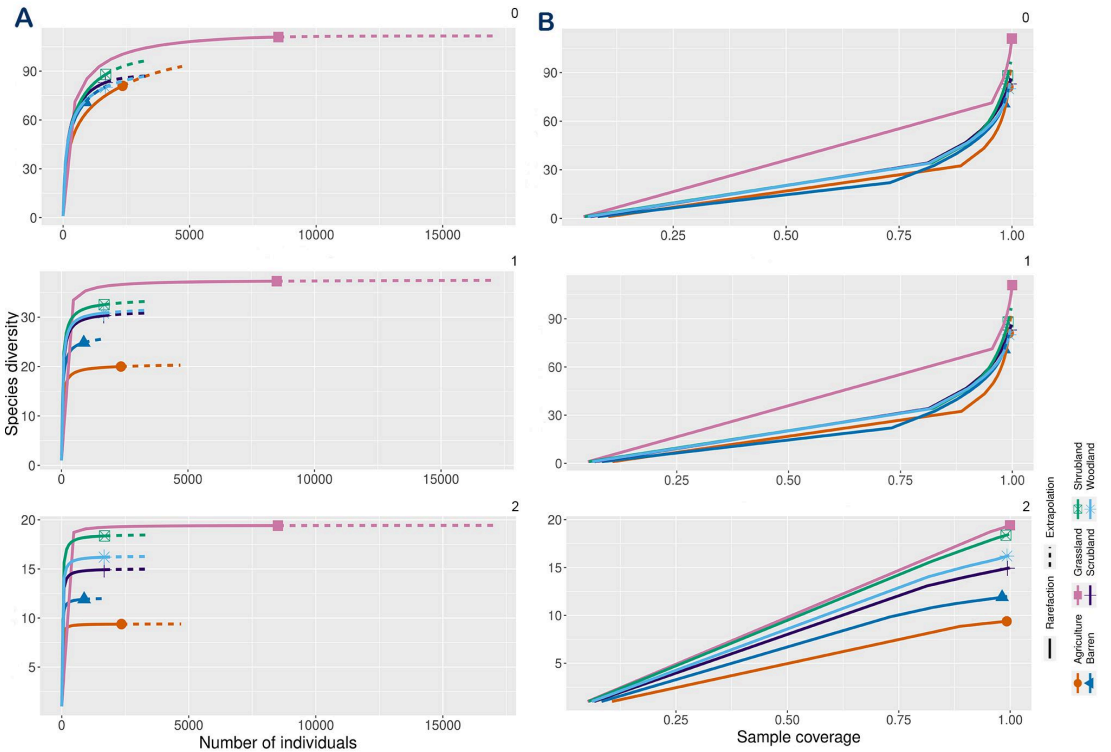


Figure 4.69: Sample and coverage-based rarefaction and extrapolation curves: **A.** Sample-size-based rarefaction of spider species diversity across. **B.** Coverage-based rarefaction and extrapolation curves showing species diversity with 95% confidence intervals, estimated using Hill numbers ($q = 0, 1, 2$).

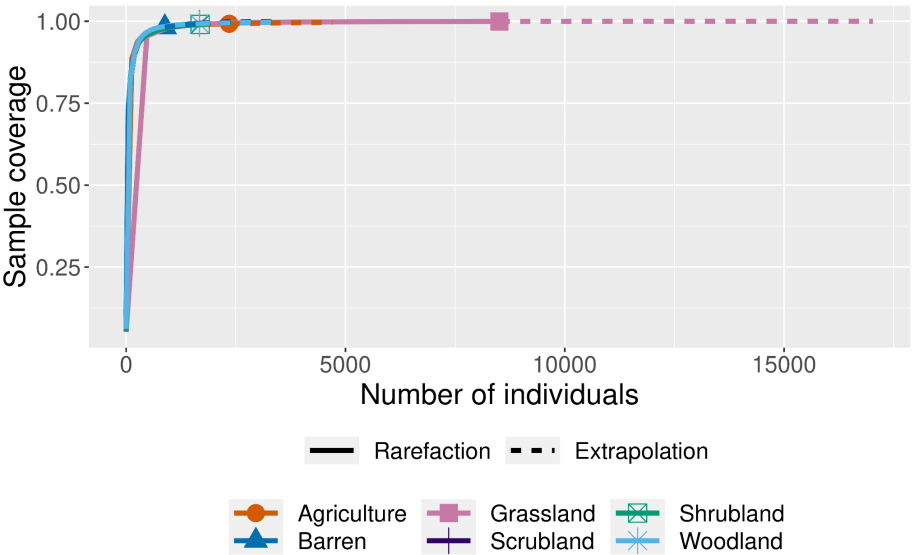


Figure 4.70: Sample completeness curve showing sample coverage for rarefied and extrapolated samples as a function of sample size for spider samples.

4.4. Evaluation of species richness using estimators

The observed species richness (S) across quadrats was 114. Richness estimators suggested slightly higher values than observed, indicating the presence of undetected species. Chao-2 estimated 115.5 species, Jackknife-1 estimated 120.7, and Bootstrap estimated 118 species. After resampling, Chao-2 predicted 116.6 species, while Jackknife-2 estimated up to 117, supporting the reliability of observed data and highlighting hidden diversity. The estimator values were not substantially higher, indicating that only a few species are likely to have been missed.

	Agriculture	Barren	Grassland	Scrubland	Shrubland	Woodland
Taxa_S	81	71	111	83	88	80
Individuals	2351	883	8512	1671	1688	1670
Dominance_D	0.1066	0.08397	0.05149	0.06703	0.05445	0.06173
Simpson_1-D	0.8934	0.916	0.9485	0.933	0.9456	0.9383
Shannon_H	2.996	3.212	3.619	3.411	3.482	3.428
Evenness_e^H/S	0.2469	0.3498	0.336	0.3651	0.3697	0.3852
Brillouin	2.932	3.078	3.587	3.318	3.387	3.337
Menhinick	1.671	2.389	1.203	2.03	2.142	1.958
Margalef	10.31	10.32	12.16	11.05	11.71	10.65
Equitability_J	0.6817	0.7536	0.7684	0.772	0.7778	0.7823
Fisher_alpha	16.26	18.19	18.02	18.35	19.73	17.51
Berger-Parker	0.2658	0.222	0.15	0.1981	0.1392	0.1754
Chao-1	98	84.33	111.4	86.75	98	88.25

Table 4.2: Estimates of spider diversity across six selected habitats.

4.5. Seasonal Changes in spider richness and abundance

4.5.1. Spider Species Richness

A comparative analysis of spider species richness was consistently higher inside enclosures than outside of them during all three seasons (Fig. 4.71), suggesting that grazing regulation has a beneficial effect on preserving spider diversity.

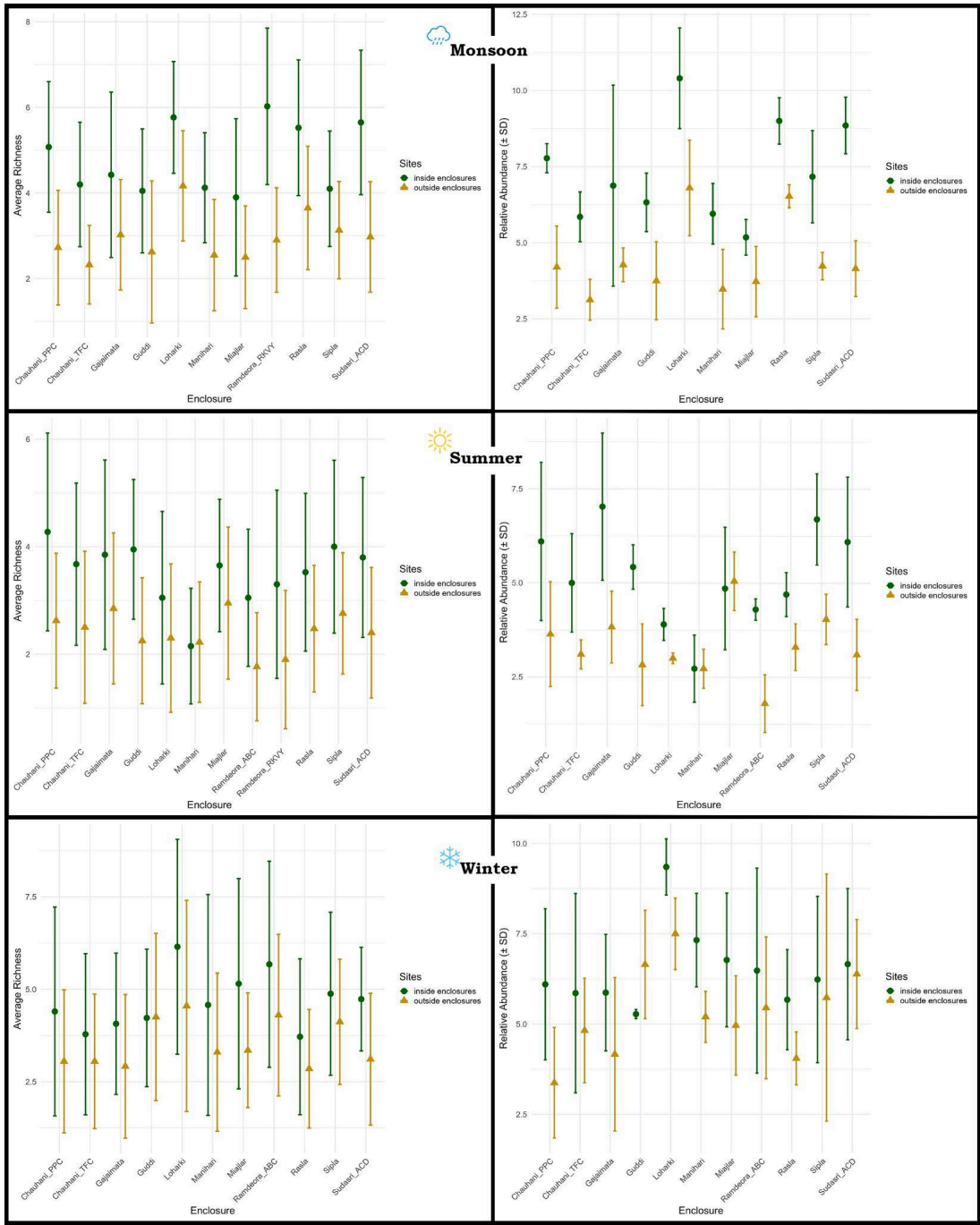


Figure 4.71. Seasonal variation in spider species richness and relative abundance inside and outside enclosures across multiple sites. The plots show comparisons for three seasons: monsoon, summer, and winter, with relative abundance (mean $\pm$ SD) on the right and species richness on the left.

Richness peaked in Ramdeora_RKVY (6.03 ± 1.83), Loharki (5.77 ± 1.30), and Sudasri_ACD (5.65 ± 1.69) during the monsoon, while outside values were

significantly lower, especially in Chauhani_TFC (2.33 ± 0.92) and Miajlar (2.50 ± 1.20). Similarly, during the summer, sites with the highest inside richness were Chauhani_PPC (4.28 ± 1.84) and Sipla (4.00 ± 1.61), while the sites with the lowest outside richness were Ramdeora_ABC (1.77 ± 1.01) and Ramdeora_RKVY (1.90 ± 1.29). In winter, richness again favoured enclosures, with Loharki (6.15 ± 2.91), Ramdeora_ABC (5.68 ± 2.79), and Miajlar (5.15 ± 2.85) showing high diversity, while outside values remained suppressed, particularly in Gajaimata, Rasla, and Sudasri_ACD (see Appendix 7.1). While a few sites like Guddi showed marginal differences inside (4.22 ± 1.86) and outside (4.25 ± 2.26), the overall seasonal pattern consistently supports the role of fenced enclosures in enhancing and sustaining spider diversity across the landscape. Overall seasonal averages showed higher richness inside enclosures in all three seasons: monsoon (4.80 ± 1.56 vs. 2.96 ± 1.28), summer (3.52 ± 1.49 vs. 2.41 ± 1.24), and winter (4.66 ± 2.36 vs. 3.53 ± 1.97), further confirming the consistent positive influence of enclosure management on spider diversity (Fig. 4.72).

4.5.2. Spider Relative Abundance

All sites displayed a consistent seasonal pattern in spider relative abundance, with encounter rates inside grazing enclosures being generally higher than those outside, highlighting the beneficial effects of grazing regulation on spider populations. The highest abundance was found inside Loharki (10.40 ± 1.65), followed by Sudasri_ACD (8.85 ± 0.93), Chauhani_PPC (7.78 ± 0.48), and Rasla (9.00 ± 0.76) during the monsoon season. Outside, the abundance was significantly lower, particularly at Chauhani_TFC (3.13 ± 0.67) and Manihari (3.48 ± 1.30). In the summer, inside abundance was highest at Gajaimata (7.03 ± 1.96), Sipla ($6.70 \pm$

1.21), and Chauhani_PPC (6.10 ± 2.10), whereas outside abundance was lowest at Ramdeora_ABC (1.80 ± 0.77) and Guddi (2.83 ± 1.09). During the winter, Loharki once again had the highest abundance (9.35 ± 0.78), followed by Manihari (7.33 ± 1.29) and Sudasri_ACD (6.66 ± 2.09). Rasla (4.05 ± 0.73) and Chauhani_PPC (3.38 ± 1.53), on the other hand, had low encounter rates outside. The overall pattern across seasons strongly supports the role of livestock exclusion zones in maintaining higher spider activity and population density throughout the year, despite a few exceptions, such as Guddi, where outside abundance (6.65 ± 1.50) was slightly higher than inside (5.28 ± 0.13) (see Appendix 7.2). Overall seasonal averages showed higher abundance inside enclosures in all three seasons: monsoon (7.34 ± 1.20 vs. 4.43 ± 0.96), summer (5.16 ± 1.56 vs. 3.31 ± 0.75), and winter (6.51 ± 1.73 vs. 5.30 ± 1.57) (Fig. 4.71).

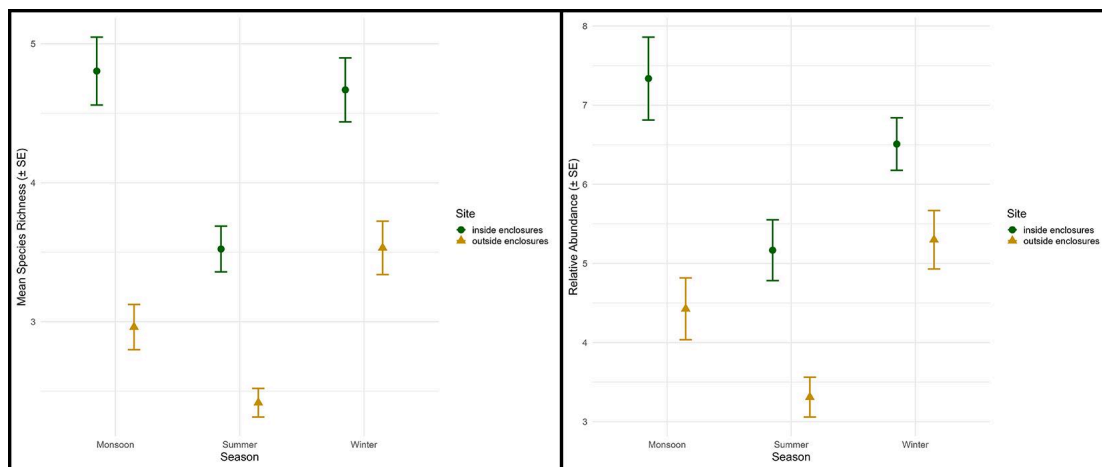


Figure 4.72. Seasonal trends in mean spider abundance (left) and species richness (right), pooled across all enclosures and compared between inside and outside.

4.6. Ecological Drivers of Spider Assemblages

Spider assemblages in the Thar Desert are shaped by a combination of environmental and ecological factors, including vegetation structure, habitat heterogeneity, and grazing intensity.

4.6.1. Correlation analysis of habitat variables

Pearson correlation analysis for inside the enclosure revealed a strong negative relationship between barren ground and ground vegetation cover ($r = -0.73$) and a moderate negative correlation between barren ground and bush cover ($r = -0.47$). The age of enclosure was positively correlated with area ($r = 0.62$), indicating that older sites tended to be larger in size. Other vegetation variables, including tree cover and large bush cover, exhibited weak correlations ($|r| < 0.20$) with most habitat attributes. A similar pattern was observed outside the enclosure, where barren ground was also strongly negatively correlated with ground vegetation cover ($r = -0.73$) and moderately negatively correlated with bush cover ($r = -0.47$). A weak positive association was observed between bush and large bush cover ($r = 0.15$). Tree cover remained weakly correlated with other vegetation variables ($|r| \leq 0.17$). Unlike the inside-enclosure dataset, the outside-enclosure matrix did not include age and area variables, as these sites lacked a defined date of establishment and a specific demarcated area.

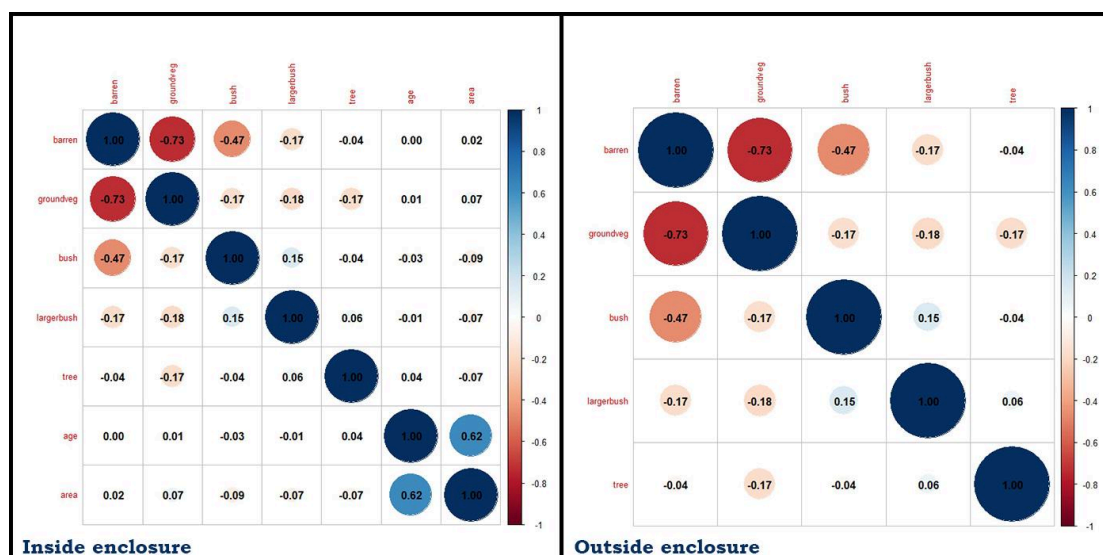


Figure 4.73. Pearson correlation matrices of habitat variables inside (left) and outside (right) grazing enclosures.

4.6.2. Drivers of Spider Species Richness

4.6.2.1. Inside Enclosures (mixed-effects model—mod3)

The best-supported mixed-effects model for species richness inside enclosures (mod3) revealed that season, land cover, and ground vegetation cover were significant predictors of log-transformed species richness. Species richness was significantly lower in summer compared to the monsoon season (estimate = -0.20, 95% CI: -0.26 to -0.15, $p < 0.001$), whereas winter did not differ significantly from the monsoon (estimate = -0.02, 95% CI: -0.07 to 0.03, $p = 0.454$). Among landcover types, richness was significantly higher in grassland (estimate = 0.29, 95% CI: 0.17 to 0.41, $p < 0.001$), scrubland (estimate = 0.25, 95% CI: 0.10 to 0.39, $p = 0.001$), shrubland (estimate = 0.24, 95% CI: 0.11 to 0.38, $p < 0.001$), and woodland habitats (estimate = 0.44, 95% CI: 0.30 to 0.58, $p < 0.001$), compared to barren land. Additionally, ground vegetation proportion positively influenced richness (estimate = 0.03, 95% CI: 0.02 to 0.03, $p < 0.001$). The random effect of enclosure accounted for a small but meaningful part of the variation (ICC = 0.03). Fixed effects explained 10% of the variance (marginal $R^2 = 0.100$), increasing to 13.1% when including random effects (conditional $R^2 = 0.131$). These findings were reinforced by predicted values showing greater richness in habitats with higher ground vegetation and structural complexity, as well as seasonal declines in summer inside enclosures.

4.6.2.1. Inside-outside Enclosures (mixed-effects model—mod4)

The best-supported mixed-effects model for species richness inside and outside enclosures (mod4) included site type, land cover, season, and ground vegetation as significant predictors of log-transformed species richness. Species richness was significantly higher inside enclosures than outside (estimate = -0.27, 95% CI: -0.31 to -0.23, $p < 0.001$). Among land cover types, richness was greatest in woodland habitats

(estimate = 0.19, 95% CI: 0.11 to 0.26, $p < 0.001$), with positive contributions also from grassland and scrubland, while barren land negatively affected richness (estimate = -0.11, 95% CI: -0.19 to -0.04, $p = 0.002$). The proportion of ground vegetation was positively associated with richness (estimate = 0.02, 95% CI: 0.02 to 0.03, $p < 0.001$).

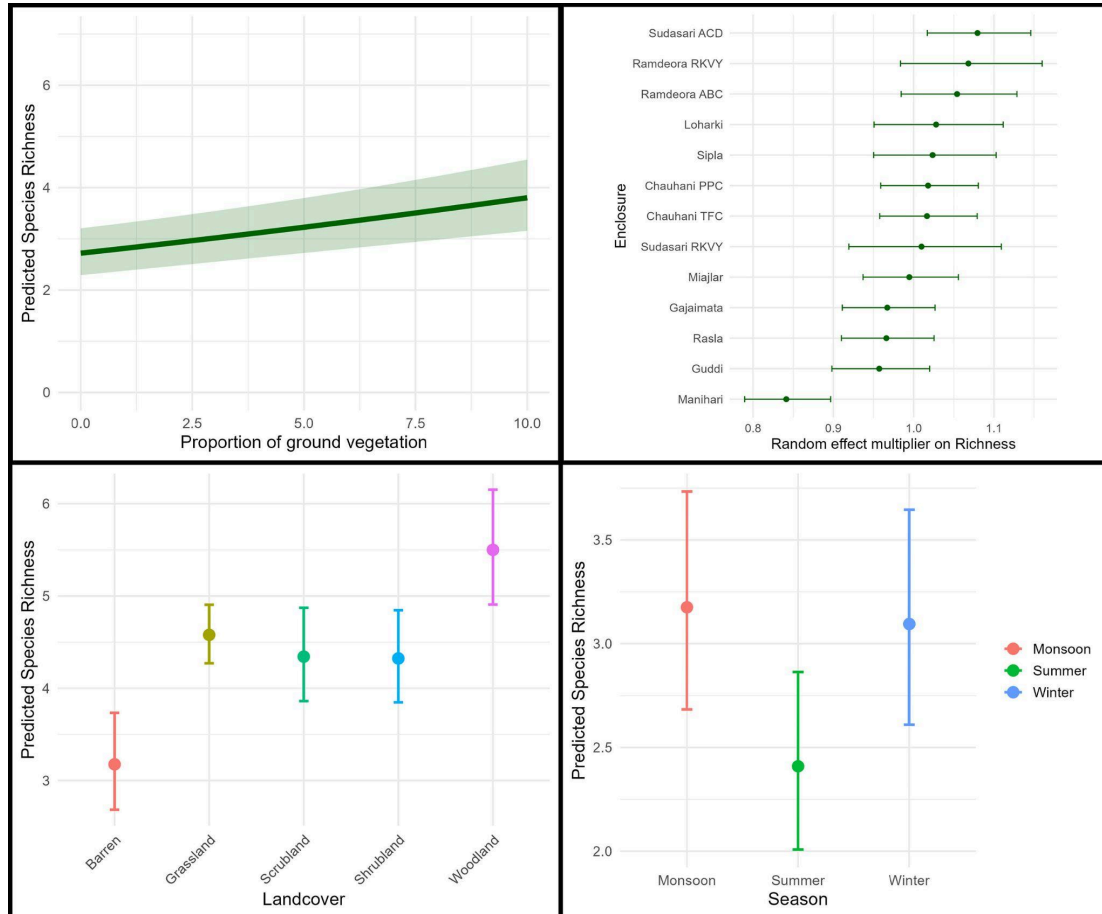


Figure 4.74. Predicted species richness of spiders in relation to proportion of ground vegetation, individual enclosure (random effects), landcover type, and season (inside enclosure only). Error bars and shaded areas represent 95% confidence intervals.

Seasonally, richness declined during summer (estimate = -0.13, 95% CI: -0.18 to -0.09, $p < 0.001$) and increased during winter (estimate = 0.08, 95% CI: 0.04 to 0.12, $p < 0.001$) relative to the monsoon. This model accounted for approximately 20.5% of the variance through fixed effects (marginal R^2) and 21.8% including random effects

(conditional R^2), with the enclosure random effect explaining a small but meaningful proportion of variance ($ICC = 0.02$).

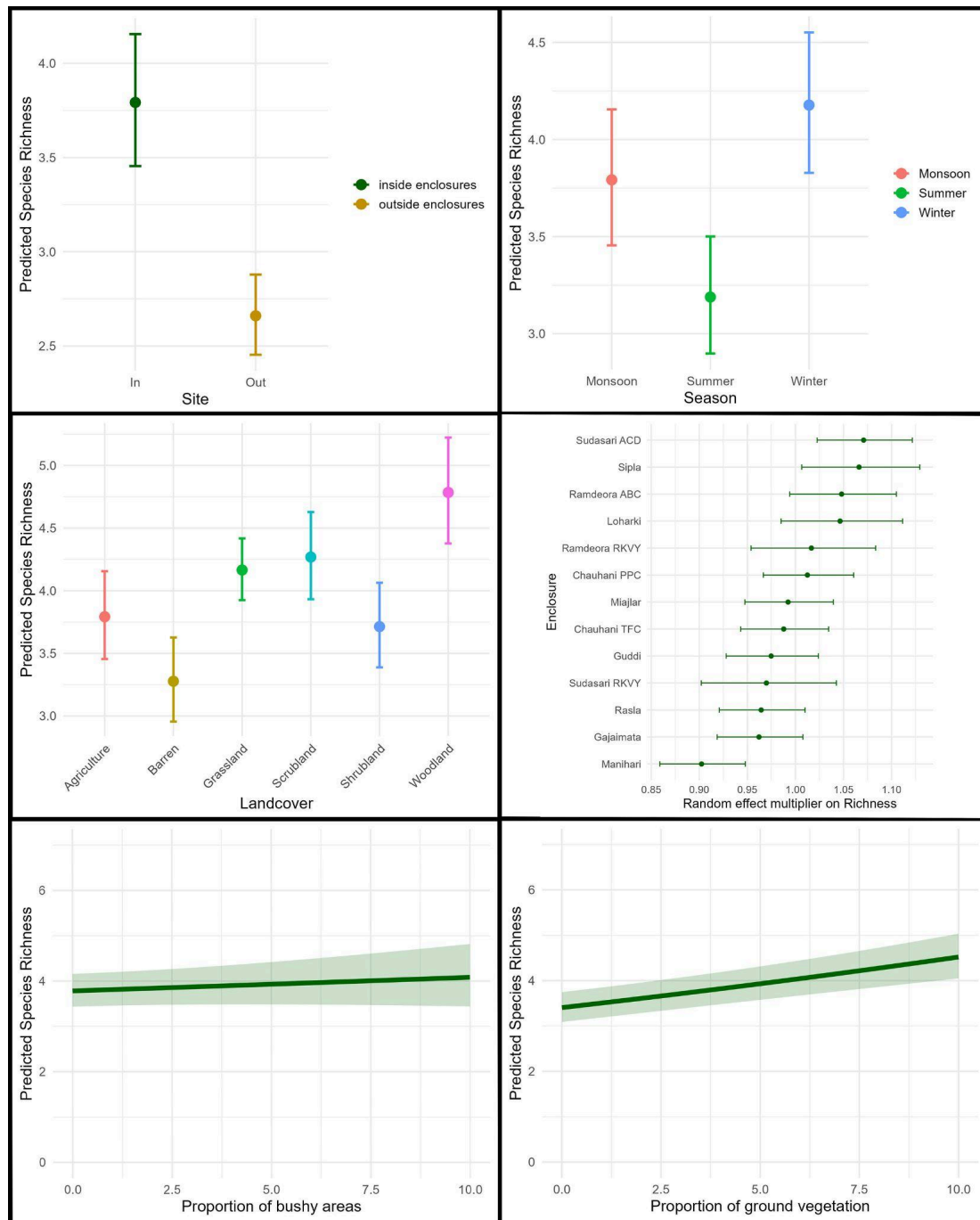


Figure 4.75. Predicted species richness of spiders with site (inside vs. outside enclosures), season, landcover type, individual enclosure (random effects), and vegetation structure (proportion of bushy areas and ground vegetation). Error bars and shaded areas represent 95% confidence intervals.

4.6.3. Drivers of Spider Species Abundance

4.6.3.1. Inside enclosure (mixed-effects model—mod2)

The best-supported mixed-effects model for log-transformed spider relative abundance inside enclosures (mod2) revealed that both season and land cover type were significant predictors. Relative abundance was significantly lower in summer compared to the monsoon season (estimate = -0.27, 95% CI: -0.33 to -0.20, $p < 0.001$), while there was no significant difference between winter and the monsoon (estimate = -0.04, 95% CI: -0.10 to 0.02, $p = 0.202$). When compared to barren land, abundance was significantly higher in grassland (estimate = 0.46, 95% CI: 0.33 to 0.60, $p < 0.001$), scrubland (estimate = 0.37, 95% CI: 0.20 to 0.54, $p < 0.001$), shrubland (estimate = 0.37, 95% CI: 0.21 to 0.52, $p < 0.001$), and woodland (estimate = 0.59, 95% CI: 0.43 to 0.76, $p < 0.001$) habitats. The random effect of enclosure accounted for a modest proportion of variation (ICC = 0.07). Fixed effects explained 9.2% of the variance in abundance (marginal $R^2 = 0.092$), which increased to 15.8% after accounting for random effects (conditional $R^2 = 0.158$). Visualization of model predictions confirmed these results: the predicted relative abundance increased substantially from barren to woodland habitats and displayed a clear seasonal decline in summer within enclosures.

4.6.3.2. Inside-outside Enclosures (mixed-effects model—mod4)

The best-supported mixed-effects model for log-transformed spider relative abundance across all sites (mod4) demonstrated that site type (in_out), land cover, the proportion of barren ground, and season were significant predictors. Spider abundance was significantly higher inside enclosures than outside (estimate = -0.28, 95% CI: -0.33 to -0.23, $p < 0.001$). Compared to reference landcover types, abundance was highest in woodland habitats (estimate = 0.20, 95% CI: 0.11 to 0.30, p

< 0.001) and was also significantly higher in grassland (estimate = 0.10, 95% CI: 0.02 to 0.18, $p = 0.011$); in contrast, abundance was significantly lower in barren areas (estimate = -0.14, 95% CI: -0.22 to -0.05, $p = 0.003$).

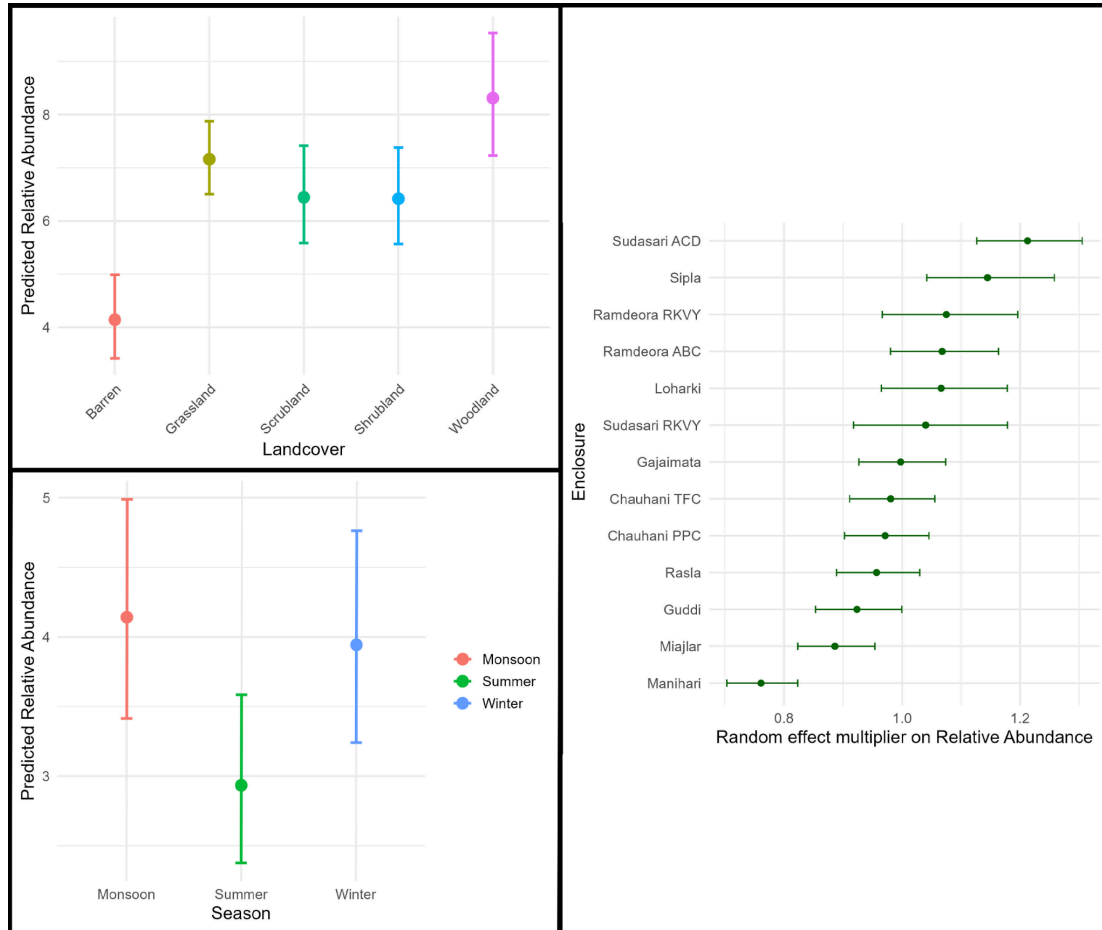


Figure 4.76. Predicted relative abundance of spiders with landcover type, season, and individual enclosure (random effects), inside enclosure. Error bars represent 95% confidence intervals.

Further, a greater proportion of barren ground within a site was associated with lower relative abundance (estimate = -0.02, 95% CI: -0.03 to -0.01, $p < 0.001$). Seasonal effects were also prominent: abundance declined in summer compared to monsoon (estimate = -0.21, 95% CI: -0.27 to -0.16, $p < 0.001$) and increased slightly in winter (estimate = 0.07, 95% CI: 0.02 to 0.12, $p = 0.011$). The random effect of enclosure accounted for a modest proportion of variance (ICC = 0.03). Fixed effects explained 19.7% of the variability in abundance (marginal $R^2 = 0.197$), increasing to 22.4%

when random effects were included (conditional $R^2 = 0.224$). Visualization of predicted values confirmed that spider abundance peaked in woodland and grassland habitats, was suppressed in barren sites, and was consistently higher inside enclosures, while a pronounced decline was evident during summer across all sites.

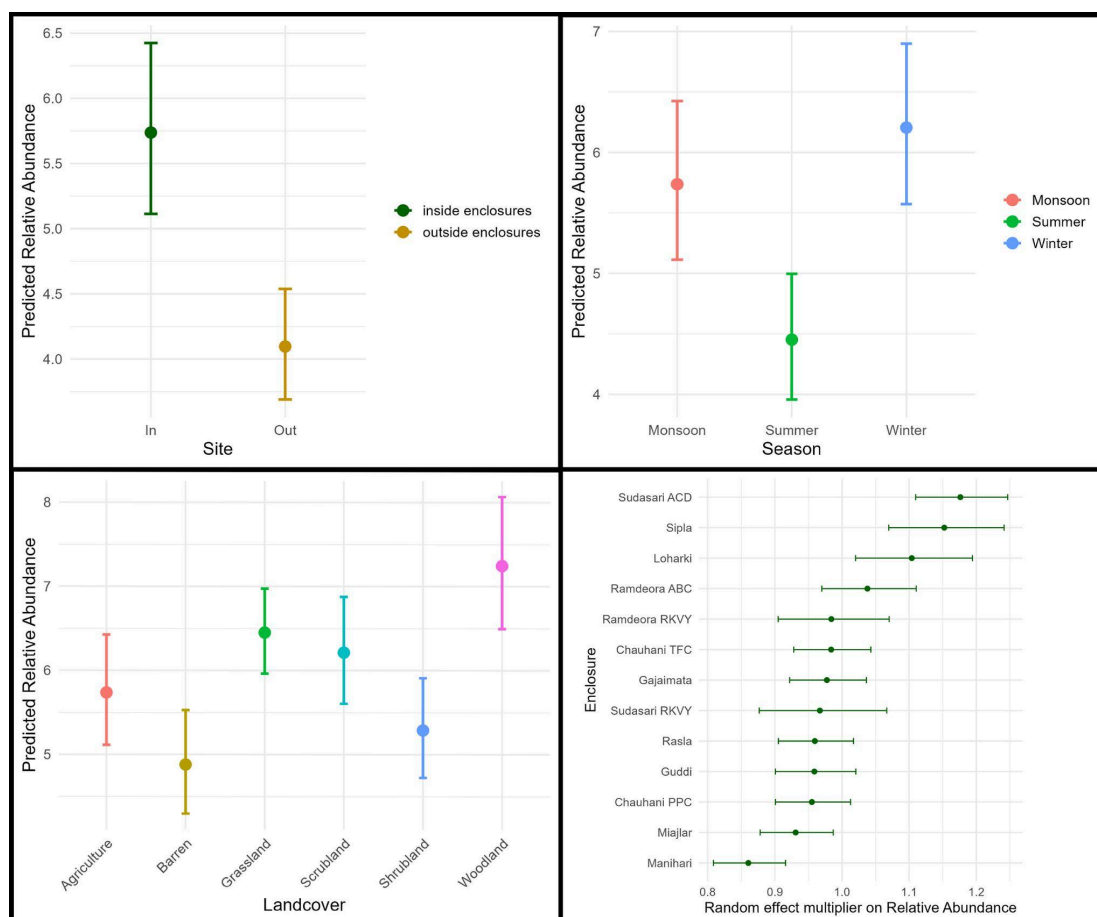


Figure 4.77. Predicted relative abundance of spiders with site (inside vs. outside enclosures), season, landcover type, and individual enclosure (random effects). Error bars represent 95% confidence intervals.

4.7. Species richness across sites

The boxplot illustrates that spider species richness is higher inside enclosures than outside. The median species richness inside enclosures is 2.1, with an interquartile range (IQR) of roughly 1.7 to 2.5, and values ranging from about 0.5 to 3.1. In contrast, outside enclosures, the median richness is about 1.6, with an IQR of around 1.1 to 2.0, and values ranging from below 1.0 up to 2.8. The notches of the boxplots

do not overlap, indicating a statistically significant difference in medians. Thus, enclosures support notably higher spider species richness compared to open areas.

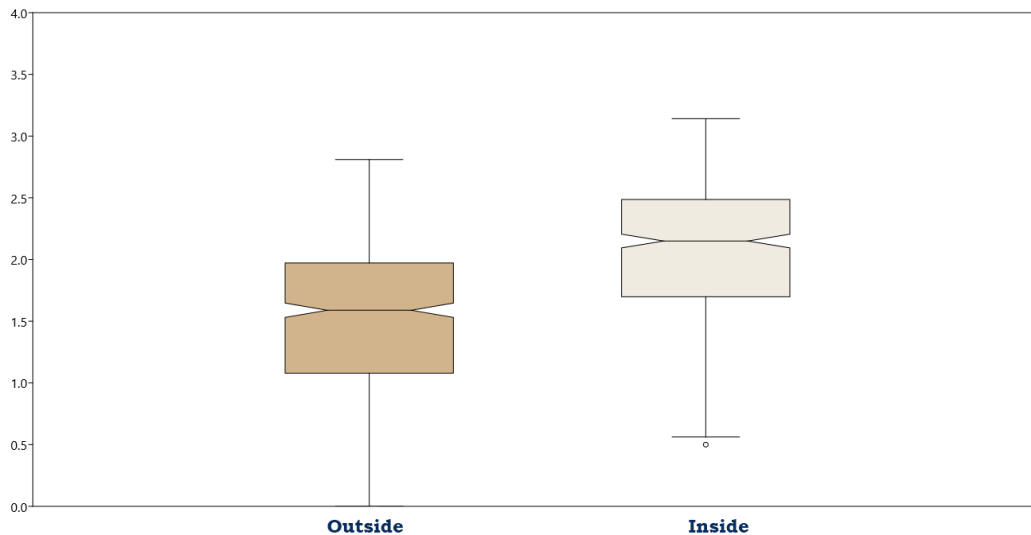


Figure 4.78. Boxplot showing the distribution of log-transformed species richness inside and outside enclosures.

4.8. Multivariate Analysis of Spider Assemblages

4.8.1. Principal Component Analysis (PCA)—inside enclosure

To minimize multicollinearity among environmental predictors, Principal Component Analysis (PCA) was performed on 22 environmental variables for inside enclosure sampling sites. The first principal component (PC1) had an eigenvalue of 243,951, accounting for 99.76% of the total variance in the data set. PC2 accounted for 0.0748%, PC3 for 0.0516%, and PC4 for 0.0216% of the variance (see Appendix 7.3). The scree plot (Fig. 4.81) demonstrated a sharp drop after PC1, followed by a nearly flat progression, confirming that almost all variation is concentrated in the first component.

Environmental variables displaying the strongest loadings on PC1 and PC2 included Barren, Grassland, Scrubland, Soil, GHC3, and Area, indicating that these factors

represent the principal environmental gradient within the inside-enclosure habitats. This gradient contrasts largely barren or open grassland sites with those containing greater soil cover and vegetation structure. Based on the patterns in eigenvalues, variable loadings, and ecological context, six representative environmental variables were subsequently selected for Canonical Correspondence Analysis (CCA), successfully capturing the dominant environmental gradients while minimizing redundancy among predictors.

4.8.2. Canonical Correspondence Analysis (CCA)—inside enclosure

CCA revealed strong and significant associations between the composition of spider assemblages and environmental gradients inside the enclosure. The first canonical axis yielded an eigenvalue of 0.06055 (29.78%), while the second axis had an eigenvalue of 0.04845 (23.83%), together explaining 53.61% of the total constrained variance. The global permutation test was significant (trace = 0.2033, $p = 0.016$), indicating that the multivariate model captured meaningful ecological structure. Axis-wise permutation tests revealed significance for the first four axes ($p < 0.05$), with subsequent axes showing a decline in explanatory value and significance.

The CCA ordination biplot (Fig. 4.79) showed distinct relationships between environmental gradients and assemblage structure: variables such as Area and GHC3 were strongly aligned with Axis 1. Barren land and scrubland had a strong influence along Axis 2, shaping specific assemblages. The plot revealed clear clustering of species according to habitat associations: for instance, *Loxosceles* sp. 1 and *Castianeira zetes* were associated with more extreme barren or specialized microhabitats, while generalist or intermediate species occupied central positions, indicating broad ecological tolerance.

Overall, these ordination results demonstrate that spider assemblages inside the enclosure are primarily structured by gradients of ground cover and enclosure size, with distinct groups of species exhibiting specialized or broad habitat preferences.

4.8.3. Principal Component Analysis (PCA) — inside-outside enclosure

To minimize multicollinearity among environmental predictors across inside and outside enclosure habitats, a Principal Component Analysis (PCA) was performed on 23 environmental variables. The first principal component (PC1) had an eigenvalue of 35.51, explaining 35.35% of the total variance. The second principal component (PC2) accounted for 21.27%, the third (PC3) 16.26%, the fourth (PC4) 9.01%, and the fifth (PC5) 5.31% of the variance, cumulatively capturing 87.20% of the variation (Appendix 7.4). The scree plot (Fig. 4.81) showed a steep decline after PC1, with subsequent components exhibiting more gradual decreases, confirming that the majority of environmental variability was captured within the first few components.

Environmental variables with strong loadings on PC1 included outside enclosure, scrubland, barren land, and grassland cover, reflecting a dominant gradient. Variables related to vegetation cover (GHC) also contributed strongly across PC2 to PC5, indicating complex vegetation structure gradients across the sites. This PCA informed variable selection for CCA by retaining those that best represented the major environmental gradients while avoiding redundancy. A total of 10 variables were selected; see Appendix 7.4.

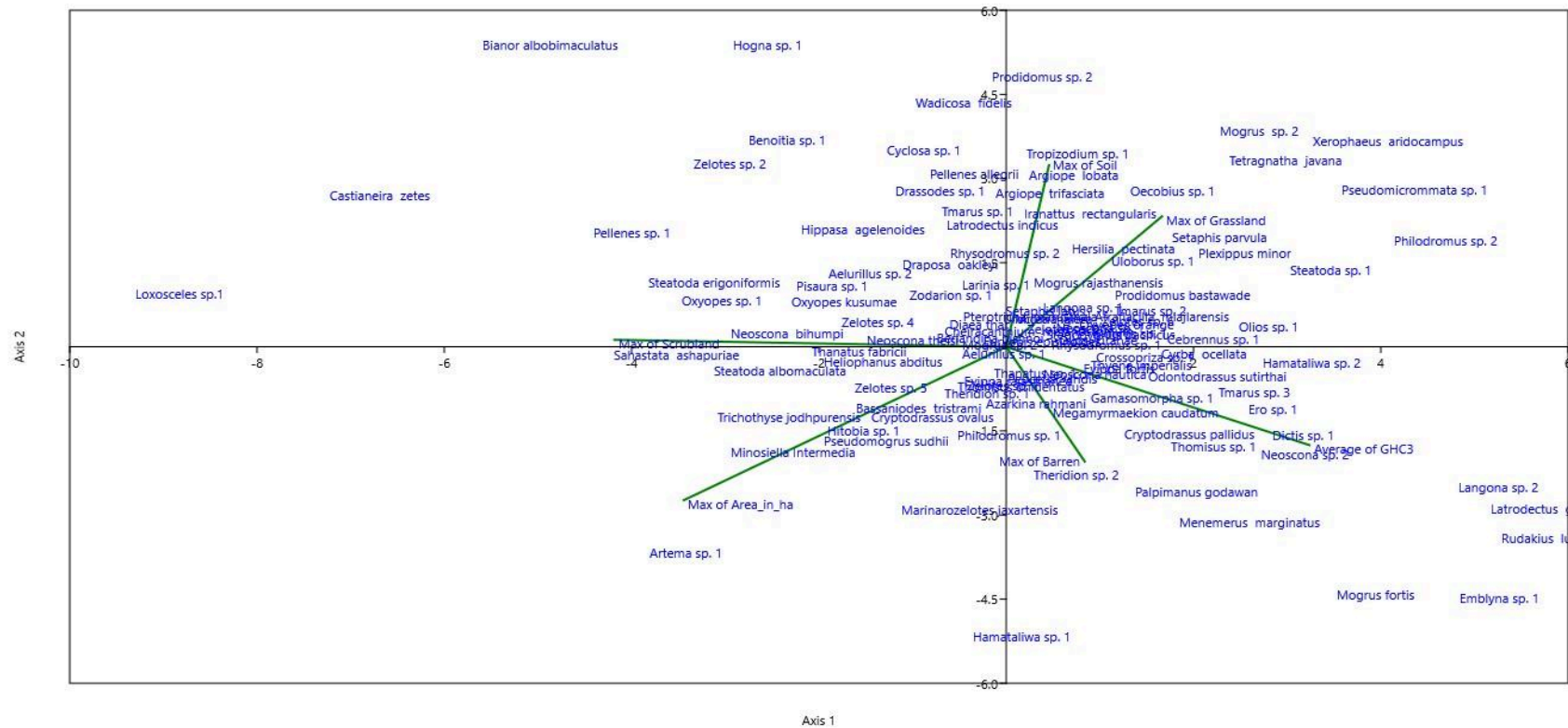


Figure 4.79. Canonical Correspondence Analysis (CCA) ordination diagram showing the relationship between spider species composition and environmental variables inside enclosures.

4.8.4. Canonical Correspondence Analysis (CCA)—inside-outside enclosure

The CCA assessed relationships between spider assemblage composition and environmental predictors across both inside and outside enclosure sites. Axis 1 had an eigenvalue of 0.108 (35.35%), and Axis 2 explained 0.065 (21.27%) of the constrained variance, together accounting for 56.62% of the total explained variation. The global permutation test demonstrated high significance (trace = 0.3055, $p = 0.001$), affirming a robust overall model. Axis-wise permutation tests revealed significance ($p < 0.05$) for the first seven axes, while the eighth axis was not significant ($p = 0.127$).

The CCA biplot (Fig. 4.80) revealed clear segregation of spider species in relation to environmental gradients extending across the inside and outside enclosure habitats. Agricultural variables and species such as *Anagraphis* sp. 1 and *Marinarozelotes jaxartensis* aligned strongly with Axis 1, representing human-disturbed landscapes. Variables representing barren and scrubland habitats loaded prominently on Axis 2, influencing species like *Prodidomus* sp. 1 and *Artema* sp. 1. This ordination indicated distinct habitat-specific species assemblages structured by gradients of land use intensity and vegetation openness.

Together, these multivariate analyses illustrate that spider assemblages spanning inside and outside enclosures respond strongly to environmental gradients shaped by agricultural expansion, barren land, and vegetation structure, underscoring habitat heterogeneity's role in community assembly.

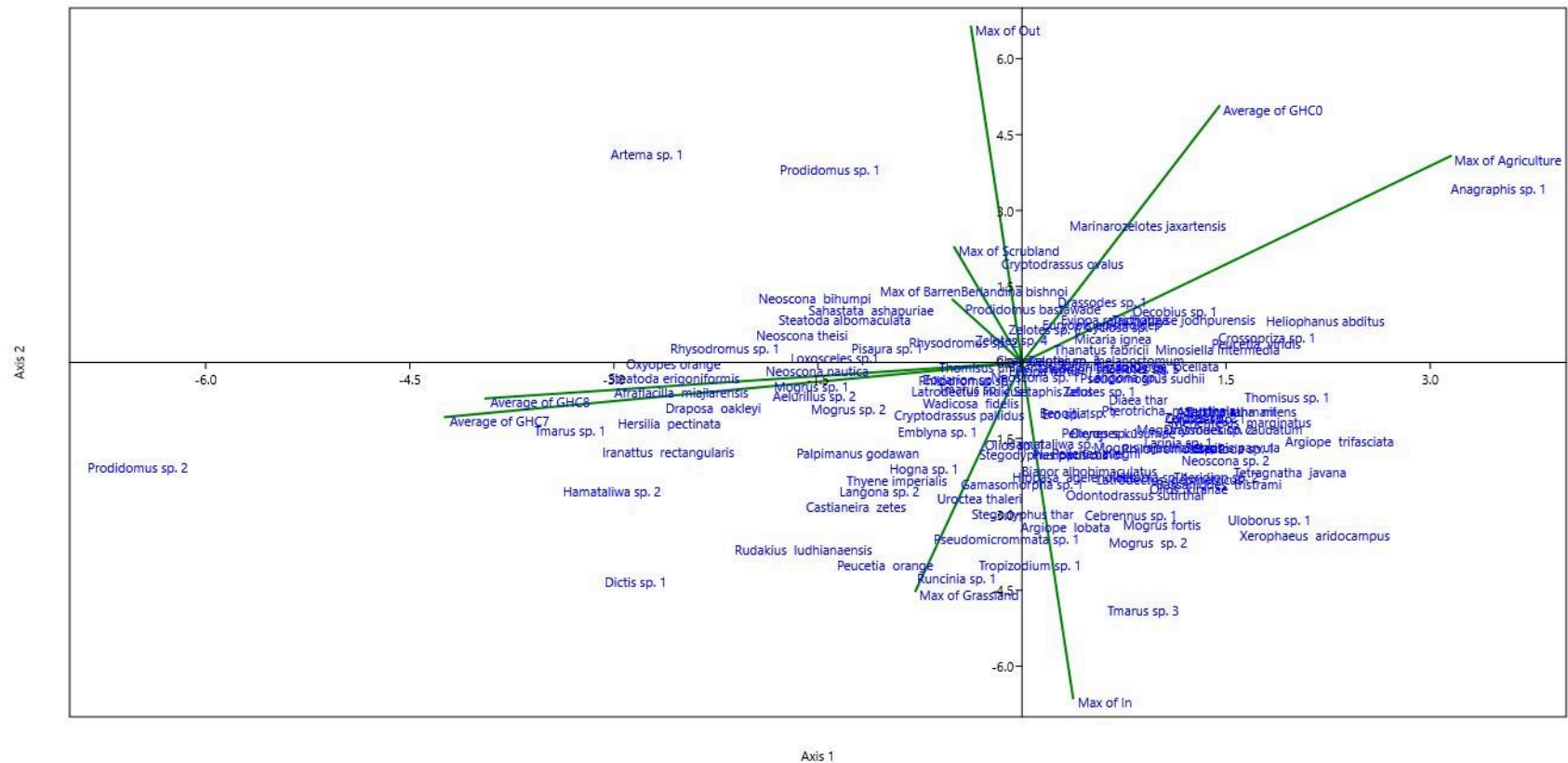


Figure 4.80. Canonical Correspondence Analysis (CCA) ordination diagram showing the relationship between spider species composition and environmental variables inside-outside enclosures.

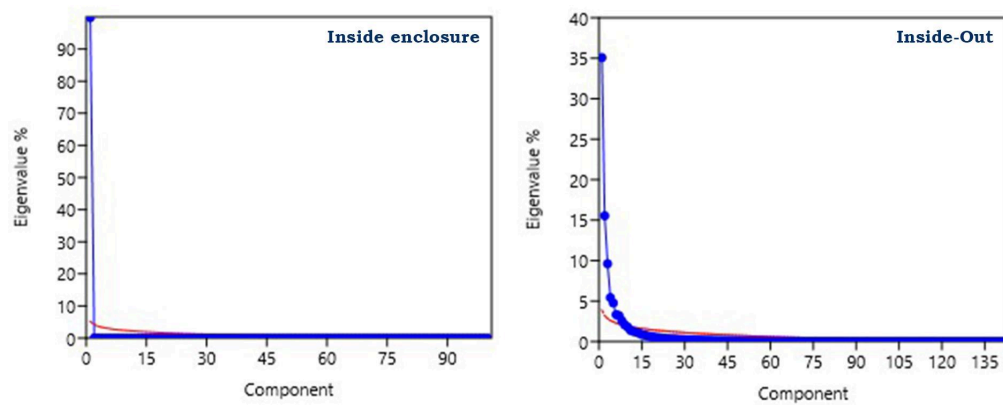


Figure 4.81. Scree plots of PCA for environmental variables. Inside enclosure (left): PC1 explains 99.8% variance. Inside-Out (right): PC1 explains 36.5%, later PCs each < 6%.

4.9. Guild structure

The concept of ecological guilds has long been of interest in ecological studies. Hutchinson (1957) first proposed that species were restricted by ecological niche boundaries due to competition, later termed as "guilds" by Root (1976), which are non-phylogenetic groups of species sharing important resources. The study of guilds is key to understanding ecosystem responses to environmental changes such as climate change and habitat disturbance. Spider guild classification has traditionally been based on foraging strategies. Uetz (1977) recognized two guild classification systems.

In contrast, Post & Riechert (1977) examined eleven guilds and their niche partitioning, while Young & Edwards (1990) categorized spiders into five guilds based on prey capture strategies. Uetz (1999) emphasized that an important consideration is that not all species within a family necessarily belong to the same guild, and such exceptions should be considered. More recently, Cardoso et al. (2011) proposed an eight-guild classification system based on ecological characteristics relating to foraging strategy, prey range, vertical stratification, circadian activity, body size, and phenology. The present study follows the same guild classification framework, as outlined below.

4.9.1 Guild Categories and Characteristics

The study categorizes spiders into distinct guilds based on their hunting strategies and ecological characteristics. Ambush hunters, which rely on stealth and camouflage to surprise their prey, comprise two families, seven genera, and ten species, with a total of 1,208 individuals recorded, representing 7.23% of the relative abundance. Ground

hunters, which actively roam on the ground to capture prey without using webs, are more diverse, with 6 families, 24 genera, and 32 species, totaling 5,682 individuals and a relative abundance of 34.01%. Orb-web weavers, known for constructing vertical, wheel-shaped webs to catch flying prey, comprise 3 families, 6 genera, and 12 species, with 605 individuals and a relative abundance of 3.62%.

The category of other hunters includes predators with diverse foraging strategies. This group is the most abundant, with 6 families, 25 genera, and 36 species, a total of 8,110 individuals, and a relative abundance of 48.54%. Sensing web weavers, which build webs to detect prey through vibrations, are less common, with 3 families, 4 genera, and 4 species, a total of only 168 individuals, and a relative abundance of 1%. Sheet-web weavers spin dense, horizontal webs to trap prey, including 3 families, 3 genera, and 4 species, with 232 individuals and a relative abundance of 1.39%.

Sr. no.	Guilds	Families
1	Ambush hunters	Thomisidae (1197), Sicariidae (11)
2	Ground hunters	Cithaeronidae (1), Corinnidae (10), Oonopidae (13), Prodidomidae (21), Gnaphosidae (2498), Lycosidae (3139)
3	Orb web weavers	Araneidae (592), Tetragnathidae (10), Uloboridae (3)
4	Other hunters	Cheiracanthiidae (355), Oxyopidae (1102), Philodromidae (3751), Salticidae (2540), Scytodidae (2), Sparassidae (360)
5	Sensing web weavers	Filistatidae (54), Hersiliidae (100), Oecobiidae (14)
6	Sheet web weavers	Agelenidae (7), Eresidae (110), Pisauridae (115)
7	Space web weavers	Dictynidae (11), Pholcidae (35), Theridiidae (592)
8	Specialists	Mimetidae (19), Palpimanidae (19), Zodariidae (26)

Table 4.3: Spider families are categorized by their respective guilds, with the number of individuals recorded in each family indicated in parentheses.

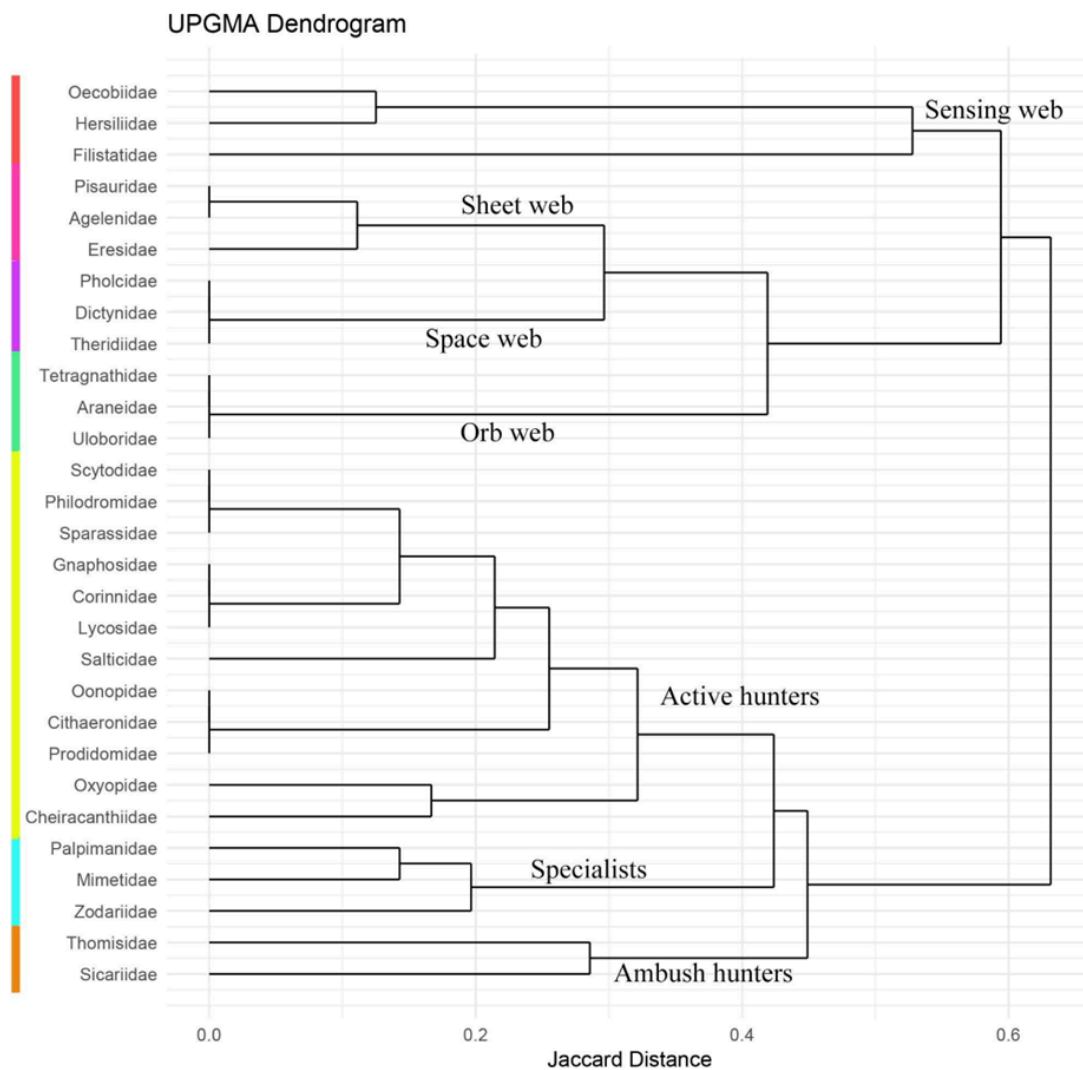


Figure 4.82: Hierarchical clustering of spider families from Desert National Park based on UPGMA analysis using the Jaccard Index of similarity.

Space-web weavers, which construct irregular, three-dimensional webs to capture prey, consist of 3 families, 7 genera, and 11 species, with 638 individuals and a relative abundance of 3.82%. Finally, specialists, which feed on very specific prey and form a distinct ecological group, include 3 families, 4 genera, and 4 species, with only 64 individuals recorded and a relative abundance of 0.39%. This categorization highlights the diversity of spider hunting strategies and their ecological roles in the Desert National Park.

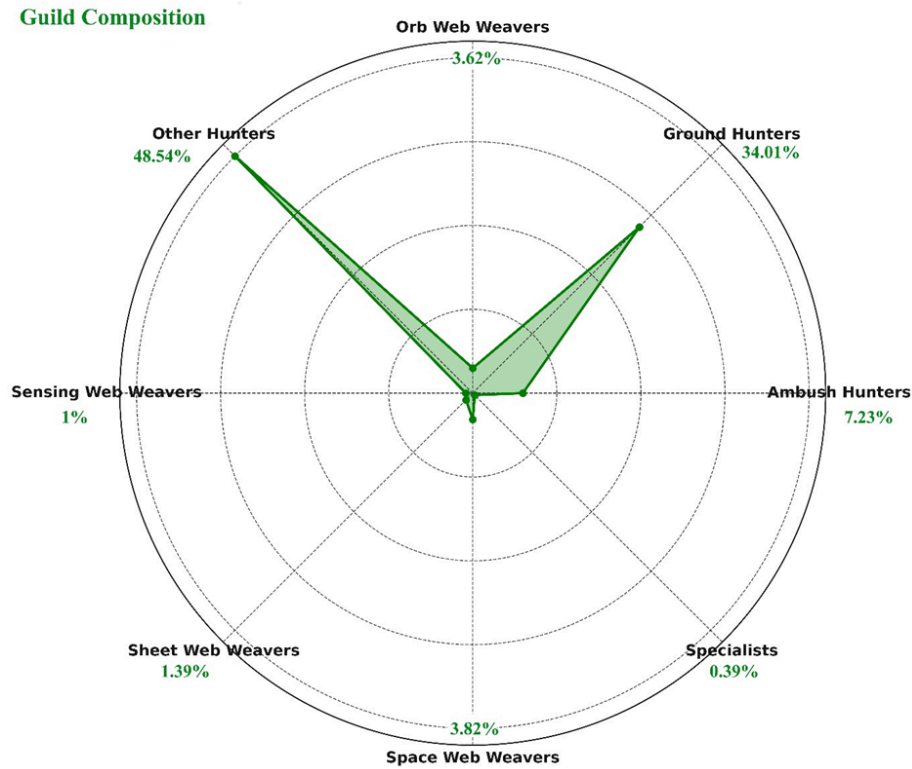


Figure 4.83: Radar chart illustrating the composition of spider guilds based on relative abundance.

A total of eight spider guilds, as classified by Cardoso et al. (2011), were documented in the Thar Desert ecosystem. Among these, Other hunters emerged as the dominant group, representing 48.54% of the total observed individuals. When combined with Ground hunters, these active foragers constituted an overwhelming 82.55% of the spider assemblage. The prevalence of cursorial hunters aligns with ecological predictions for arid environments, where the scarcity of dense vegetation and the presence of extreme abiotic conditions, such as high temperatures, low humidity, and strong winds, favour active predation over web-building strategies. Families like Gnaphosidae, Lycosidae, Philodromidae, and Salticidae, which are particularly well-adapted to endure the harsh desert environment, contribute to their high abundance and species richness (Russell-Smith, 2002; Bizuet-Flores et al., 2015). In contrast, ambush hunters accounted for 7.23% of the recorded individuals. These

spiders employ a sit-and-wait strategy, often enhanced by cryptic colouration, which proves highly effective in desert ecosystems. The limited vegetation in such environments provides few structured microhabitats, making camouflage and energy conservation through reduced activity critical for survival. Web-building guilds were notably underrepresented in the Thar Desert. Orb Web Weavers (3.62%), Space Web Weavers (3.82%), Sheet Web Weavers (1.39%), and Sensing Web Weavers (1%) collectively made up only a small fraction of the total assemblage. The scarcity of web-building spiders in deserts can be attributed to several factors, including the lack of stable web anchors, harsh abiotic conditions, low prey availability, the high energy costs associated with web maintenance, and the competitive dominance of more efficient cursorial hunting strategies. The least abundant guild was Specialists, representing a mere 0.39% of the assemblage. These spiders typically exhibit highly specific ecological requirements, and their low representation underscores the challenges of adapting to the extreme conditions of arid environments.

4.10 References

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CHAPTER 5 DISCUSSION



The study was conducted to enhance the understanding of spider diversity, their response to changes in grazing regulations, and their guild structure in the desert ecosystem. To date, no prior research of this nature has been carried out in India, particularly within DNP WLS.

5.1 Species Diversity and Community Composition

The taxonomic survey of spiders in DNP WLS documented a total of 16,775 individuals, belonging to 29 families, over 80 genera, and 114 species. The most abundant families were Philodromidae (22.52%), Lycosidae (18.80%), and Gnaphosidae (14.90%), which together contributed more than half of the total spider population sampled. In contrast, the least abundant families were Scytodidae (0.01%), Uloboridae (0.02%), and Agelenidae (0.04%). The dominant families are primarily ground-dwelling, and their sandy coloration enables effective camouflage in the desert environment. Similar patterns were noted by Lubin et al. (2020), who reported high diversity of ground-hunting spiders, with 136 species recorded from the Negev desert habitats in Israel.

Earlier studies in DNP WLS documented only 28 species, representing 13 families and 21 genera (Sivaperuman & Rathore 2004, 2009). Apart from these, no detailed investigations on the spiders had been reported. The increase from 28 previously recorded species to the current 114 reflects a significant contribution to the knowledge of spider diversity in one of India's largest national parks. Notably, Gnaphosidae were particularly diverse, with 22 species, including 8 species new to science and 6 new genus records. Similarly, Zamani et al. (2021) documented 19 new species and one new genus from Iranian desert habitats, which share similar landscapes.

5.2. Habitat Features Shaping Spider Diversity

Grasslands supported the highest spider richness (111 species) and abundance (>8,500 individuals), followed by shrubland and scrubland, while barren habitats were consistently species-poor. The strong association between spider diversity and vegetation cover is well supported by previous research in arid ecosystems (Zografou et al., 2017). Rarefaction analyses also confirmed grasslands as the richest across all Hill numbers, though they also revealed dominance patterns, suggesting that a few species thrive disproportionately in these habitats. This aligns with observations from other arid ecosystems, where resource pulses allow certain dominant spiders to proliferate (Polis and Yamashita, 1991).

In contrast, barren land, with limited vegetation and microhabitat structure, harboured the lowest richness and abundance (71 species). Although barren areas displayed relatively higher evenness, this likely reflects a community lacking dominant specialists rather than a balanced, species-rich assemblage. Agricultural fields, although heavily modified, supported moderate spider richness (81 species), a finding that echoes those from Mediterranean and Asian agroecosystems, where spiders persist due to habitat heterogeneity and spillover from adjacent natural vegetation (Yaacobi et al., 2007; Zhao et al., 2018).

5.3 Seasonal and Environmental Influences

Spider richness and abundance peaked during the monsoon, declined sharply in summer, and partially recovered in winter. These patterns reflect climatic constraints on activity and prey availability, as also noted in other arid ecosystems studies (Uetz, 1991; Henschel et al., 1996). Extreme summer aridity reduces vegetation cover and prey populations, whereas the monsoon flush of annual plants creates favorable

microhabitats and prey surges, boosting spider diversity. Mixed-effects models confirmed this by identifying ground vegetation cover as a strong positive predictor of diversity and abundance, while barren ground was consistently negative. Thus, vegetation acts as a mediator of seasonal fluctuations by providing both shelter from harsh conditions and a structural basis for web attachment.

Species-specific associations also highlighted the role of vegetation and substrate in shaping assemblages. For example, *Anagraphis* and *Marinarozelotes* were closely linked to agriculture, whereas *Prodidomus* and *Artema* were associated with scrubland and barren habitats. Canonical Correspondence Analysis further demonstrated that environmental filters such as vegetation cover, soil type, and seasonal resource availability jointly structured spider communities. Together, these results suggest that both temporal (climatic seasonality) and spatial (habitat features) drivers interact to determine spider diversity in desert ecosystems, reinforcing patterns observed in other arid and semi-arid regions (Cardoso et al., 2011; Ayal, 2007).

5.4 Grazing Regulation and Spider Assemblages

Spider diversity and abundance were consistently higher inside grazing enclosures compared to open-access areas, showing that livestock exclusion has a strong positive influence on spider communities. The effect was significant and consistent across seasons, with richness and abundance nearly 60% higher inside than outside during the monsoon, and similar patterns were evident in winter. These results demonstrate that enclosure management enhances both the richness and density of spider assemblages in arid habitats.

This positive response is largely due to vegetation recovery inside enclosures, which increases structural complexity, stabilizes microclimatic conditions, and improves

prey availability. Vegetation cover emerged as the strongest predictor of spider diversity. Similar patterns have been reported from other arid and semi-arid systems, where grazing exclusion allowed plant cover to regenerate and supported richer arthropod communities (Brandt and Lubin, 1998; Heikkinen and MacMahon, 2004).

Community composition also differed inside and outside enclosures, suggesting that grazing regulation not only promotes higher richness but also stabilizes assemblages across habitats and seasons. These findings parallel results from other predator guilds in arid ecosystems, where grazing pressure simplified communities while exclusion restored microhabitats and functional diversity (Polis and Yamashita, 1991). In the context of the Thar Desert, where overgrazing is a major ecological challenge, grazing management stands out as an essential conservation tool for maintaining diverse and resilient spider assemblages.

5.5 Implications for Conservation

Our findings emphasize that primary habitats such as grasslands and shrublands are irreplaceable for maintaining the full spectrum of spider diversity in the Thar Desert. These habitats supported the richest and most balanced assemblages, underscoring their role as core sites for biodiversity conservation. At the same time, we observed that low-impact production landscapes such as agricultural fields can provide secondary refuge for spiders, echoing evidence from other taxa that strategically managed production land-uses can supplement protected areas (Dutta & Jhala, 2014). Thus, conservation strategies in arid regions should not be restricted to formally protected areas alone but should also consider the ecological value of mosaic landscapes where human use and biodiversity can co-exist.

In the Thar Desert, where overgrazing and land degradation pose serious threats, grazing regulation through enclosures emerged as a particularly effective management tool. Enclosures facilitated vegetation recovery, stabilized community composition, and enhanced species richness, suggesting that this approach can buffer biodiversity against the pressures of livestock grazing. These results endorse a more comprehensive landscape approach to conservation, where sustainably managed agro-pastoral mosaics complement protected grasslands (Dutta et al., 2011).

Finally, this study demonstrates that grazing regulation significantly influences spider assemblages in the Thar Desert, with reduced grazing enhancing species richness and functional diversity. Enclosures provided refuges for sensitive taxa, reflecting improved habitat quality. Spiders thus emerge as effective bioindicators of ecosystem recovery under managed grazing. Integrating traditional practices with science-based regulation can harmonize biodiversity conservation and pastoral needs. Such balanced management is vital for sustaining the ecological integrity of the Great Indian Bustard landscape.

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CHAPTER 6

SUMMARY & CONCLUSION



This study revealed that natural habitats, particularly grasslands, shrublands, and woodlands, are vital for sustaining high spider diversity and abundance in arid landscapes, while grazing enclosures enhance these communities by regulating disturbance across all seasons. A comprehensive survey was conducted across six habitat types (agriculture, barren land, grasslands, scrublands, shrublands, and woodlands) in different satellite enclosures and outside to assess patterns of spider diversity, abundance, and community structure, comparing areas inside and outside livestock exclusion enclosures. The analysis recorded 114 spider species from over 16,000 individuals, with grasslands contributing more than half of all records and showing the highest species richness and abundance. Shrubland and woodland maintained high species evenness, highlighting the importance of habitat complexity for balanced communities. Both diversity indices and rarefaction analyses emphasized the conservation value of structurally diverse habitats over more disturbed landscapes like agriculture and barren ground.

This thesis demonstrates that arid and semi-arid ecosystems, such as those of the Thar Desert, host a finely balanced mosaic of habitats where natural processes and management interventions jointly shape spider diversity and ecological stability. Spiders emerged as key components of the terrestrial arthropod fauna, responding sensitively to vegetation structure, land-use intensity, and seasonal shifts. A consistent pattern emerged across the study as we found that habitats with greater vegetation cover and structural complexity, particularly those within livestock exclusion enclosures, supported more diverse and abundant spider assemblages. By buffering against grazing pressure, these enclosures enabled the recovery of vegetation, which in turn facilitated essential microhabitats for spiders. Importantly, the positive effects

of enclosures persisted across all seasons, even during resource-scarce summer months, underscoring their long-term ecological value. While enclosures offer an effective tool for maintaining grassland habitats, their broader ecological impacts must be considered. For example, dung-dependent organisms such as scarab beetles may be adversely affected by the reduction or exclusion of grazers, with cascading effects on their populations and life cycles. Addressing these complexities will require future studies that should therefore integrate behavioural observations, population dynamics, and multi-trophic interactions to assess the full consequences of grazing regulation.

The work also highlights that spiders of the Thar Desert, especially the ground-dwelling taxa with low dispersal ability, remain poorly studied. This restricted mobility renders many of them endemic, and our findings include several remarkable records of species previously known only from the Middle East or westernmost Asia, now documented for the first time in India. Such discoveries point to the urgent need for more profound insights into the biogeography of desert spiders, alongside the description of numerous still-undescribed taxa. Beyond diversity patterns, the Thar Desert revealed unique lessons on spider survival strategies under extreme conditions, adaptations to both intense heat and cold, and persistence under minimal resource availability.

In conclusion, this study establishes that interventions such as livestock exclusion, coupled with the conservation of structurally complex habitats, are pivotal for enhancing invertebrate diversity in dryland agroecosystems. Such management practices not only strengthen ecological resilience and natural pest regulation but also contribute to long-term biodiversity conservation. Realizing these benefits, however,

requires inclusive participation of local stakeholders and sustained commitment, as ecological gains often accumulate gradually over time. By illuminating the ecological roles of spiders in desert ecosystems, this thesis demonstrates how targeted local-scale actions can translate into landscape-level conservation outcomes. Moving forward, sustainable land management in arid zones must integrate habitat protection, adaptive grazing regulation, and community engagement to ensure that biodiversity and livelihoods coexist and thrive amidst the unique challenges of dryland environments.

CHAPTER 7

RECOMMENDATIONS



Although this study covers a broad spectrum of spider species in the Thar Desert, the natural world offers endless avenues for exploration, and many important ecological and biogeographical aspects remain to be investigated. The seasonal shifts in spider communities are striking and understudied, especially regarding how species emerge, dominate, and are replaced across seasons.

Several spider species exhibit unique adaptive behaviours for survival in harsh desert conditions, which provide intriguing opportunities for in-depth research. For example, *Mogrus* spiders use the flowers of the desert cotton plant to build pouches where they overwinter, and *Peucetia* spiders change their colouration from green in the wet season to brown during the dry season to blend with the environment. Exploring such adaptations in detail could yield valuable ecological and evolutionary insights. In terms of taxonomy, several spider groups, such as Philodromidae, Oxyopidae, and Araneidae, require further detailed examination to enhance our understanding of species diversity and systematics in the region.

This research also highlights the need to include arthropods, especially spiders, in ecological assessments and biodiversity monitoring frameworks. Since arthropods are highly responsive to landscape changes, they serve as sensitive indicators of habitat quality and ecosystem health. Unlike larger vertebrates, spiders provide a feasible and effective group for rapid ecological assessments.

Conservation implications: promote sustainable grazing practices by implementing rotational grazing, regulating herd sizes, and allowing pastures to rest seasonally to balance local livelihoods with conservation goals, while actively engaging local communities in enclosure management, habitat restoration, and awareness campaigns to build long-term support and ensure successful conservation outcomes.

APPENDICES

		Winter		Summer		Monsoon	
Enclosure	in/out	Avg	Std	Avg	Std	Avg	Std
Chauhani_PPC	in	4.400	2.824	4.275	1.840	5.075	1.526
Chauhani_TFC	in	3.783	2.179	3.675	1.509	4.200	1.454
Gajaimata	in	4.067	1.912	3.850	1.762	4.425	1.933
Guddi	in	4.225	1.860	3.950	1.300	4.050	1.449
Loharki	in	6.150	2.907	3.050	1.605	5.767	1.305
Manihari	in	4.575	2.986	2.150	1.075	4.125	1.285
Miajlar	in	5.150	2.845	3.650	1.231	3.900	1.837
Ramdeora_ABC	in	5.675	2.786	3.050	1.276	--	--
Ramdeora_RKVY	in	--	--	3.300	1.750	6.026	1.828
Rasla	in	3.717	2.108	3.525	1.467	5.525	1.585
Sipla	in	4.880	2.205	4.000	1.607	4.100	1.348
Sudasri_ACD	in	4.733	1.401	3.800	1.488	5.650	1.688
Chauhani_PPC	out	3.050	1.935	2.625	1.254	2.725	1.339
Chauhani_TFC	out	3.050	1.817	2.500	1.414	2.325	0.917
Gajaimata	out	2.917	1.942	2.850	1.406	3.025	1.291
Guddi	out	4.250	2.262	2.250	1.171	2.625	1.659
Loharki	out	4.550	2.856	2.300	1.380	4.167	1.289
Manihari	out	3.300	2.139	2.225	1.121	2.550	1.300
Miajlar	out	3.350	1.549	2.950	1.413	2.500	1.198
Ramdeora_ABC	out	4.300	2.186	1.767	1.006	--	--
Ramdeora_RKVY	out	--	--	1.900	1.287	2.902	1.221
Rasla	out	2.850	1.603	2.475	1.176	3.650	1.442
Sipla	out	4.120	1.691	2.760	1.128	3.133	1.137
Sudasri_ACD	out	3.109	1.781	2.400	1.215	2.975	1.291

Appendix 7.1: Average Spider Species Richness ($\pm$ SD) Across Enclosures and Seasons

		Winter		Summer		Monsoon	
Enclosure	in/out	Avg	SD	Avg	SD	Avg	SD
Chauhani_PPC	in	6.100	2.093	6.100	2.104	7.775	0.479
Chauhani_TFC	in	5.856	2.759	5.000	1.309	5.850	0.819
Gajaimata	in	5.870	1.612	7.029	1.958	6.875	3.301
Guddi	in	5.275	0.126	5.425	0.591	6.325	0.960
Loharki	in	9.350	0.778	3.900	0.424	10.400	1.652
Manihari	in	7.325	1.295	2.725	0.892	5.950	0.995
Miajlar	in	6.775	1.851	4.857	1.628	5.175	0.585
Ramdeora_ABC	in	6.480	2.838	4.300	0.283	--	--
Rasla	in	5.675	1.385	4.700	0.583	9.000	0.762
Sipla	in	6.233	2.303	6.700	1.212	7.167	1.514
Sudasri_ACD	in	6.658	2.093	6.100	1.727	8.850	0.929
Chauhani_PPC	out	3.375	1.531	3.638	1.394	4.200	1.349
Chauhani_TFC	out	4.822	1.448	3.100	0.383	3.125	0.670
Gajaimata	out	4.163	2.124	3.829	0.955	4.275	0.556
Guddi	out	6.650	1.500	2.825	1.087	3.750	1.282
Loharki	out	7.500	0.990	3.000	0.141	6.800	1.572
Manihari	out	5.200	0.707	2.725	0.519	3.475	1.305
Miajlar	out	4.963	1.374	5.050	0.777	3.725	1.156
Ramdeora_ABC	out	5.450	1.962	1.800	0.766	--	--
Rasla	out	4.050	0.733	3.300	0.622	6.525	0.377
Sipla	out	5.733	3.421	4.040	0.669	4.233	0.451
Sudasri_ACD	out	6.386	1.509	3.100	0.944	4.150	0.915

Appendix 7.2: Average Spider Species Abundance ($\pm$ SD) Across Enclosures and Seasons

	PC 1	PC 2
Max of Barren	0.02094	0.83153
Max of Grassland	-0.0002	0.007947
Max of Scrubland	-0.00157	0.004618
Max of Shrubland	0.000216	0.004512
Max of Woodland	7.74E-05	0.004308
Max of Undulate	2.40E-05	0.00373
Max of Flat	8.55E-05	0.003622
Max of Soil	-0.0011	0.003526
Max of Sand	-0.0002	0.003502
Max of Gravel	-0.00017	0.003491
Max of Rocky	-0.00026	0.002901
Average of GHC0	-0.00014	0.001528
Average of GHC1	-0.00055	0.000621
Average of GHC2	-0.00035	0.000337
Average of GHC3	-0.00177	-0.00068
Average of GHC4	-0.00013	-0.00145
Average of GHC5	-4.04E-05	-0.00165
Average of GHC6	-0.00039	-0.00345
Average of GHC7	-0.00014	-0.00359
Average of GHC8	-0.00033	-0.00362
Max of Age	-6.95E-05	-0.00449
Max of Area_in_ha	0.99972	-0.0176

Appendix 7.3: PCA loadings of environmental variables inside enclosures, with highlighted values showing the strongest contributors to PC1 and PC2.

	PC 1	PC 2	PC 3	PC 4	PC 5
Max of Out	0.01525	0.04405	0.14612	0.074985	0.23724
Max of In	-0.00125	0.051834	0.11518	0.015287	0.13573
Max of Agriculture	-0.00721	0.045532	0.063598	-0.00662	0.090025
Max of Barren	0.008156	0.009359	0.023401	0.014475	0.036218
Max of Grassland	0.008635	0.006978	0.03662	-0.00433	0.034768
Max of Scrubland	-0.01035	3.61E-02	0.031163	-0.01924	0.027222
Max of Shrubland	0.005824	-2.64E-05	0.005106	0.010644	0.012913
Max of Woodland	0.003199	-0.00061	0.001909	0.003421	0.007725
Max of Flat	3.99E-05	0.015945	-0.00461	-0.00538	5.21E-03
Max of Undulate	-0.00027	0.012073	-0.00519	-0.00346	0.004719
Max of Soil	-0.00127	0.021546	-0.00227	-0.00918	0.004609
Max of Sand	0.003778	-0.00496	-0.00392	0.010012	0.004092
Max of Gravel	-0.00382	0.02628	0.007121	-0.0157	0.003474
Max of Rocky	0.003822	-0.00034	-8.45E-05	-0.00243	0.002435
Average of GHC0	0.001622	0.002133	-0.00715	0.018846	-0.00284

Average of GHC1	0.001162	0.026759	0.000888	-0.00103	-0.00488
Average of GHC2	0.002372	0.004442	-0.00696	-0.00074	-0.01
Average of GHC3	3.22E-03	0.015858	0.00425	0.013241	-0.01015
Average of GHC4	3.82E-03	0.011535	-0.00905	-0.00649	-0.01421
Average of GHC5	-0.00192	-0.01537	-0.01801	0.000679	-0.02018
Average of GHC6	0.001365	1.26E-02	-0.01048	-0.01036	-0.026
Average of GHC7	-0.00864	-0.00698	-0.03662	0.004328	-0.03477
Average of GHC8	-0.01294	-0.0393	-0.14633	-0.07068	-0.24348

Appendix 7.4: PCA loadings of environmental variables inside-outside enclosures, with highlighted values showing the strongest contributors to PC1-PC5.

Predictor	Estimate	95% CI	p-value
Intercept	1.31	1.19 – 1.44	<0.001
Season [Summer]	-0.20	-0.26 – -0.15	<0.001
Season [Winter]	-0.02	-0.07 – 0.03	0.454
Landcover [Grassland]	0.29	0.17 – 0.41	<0.001
Landcover [Scrubland]	0.25	0.10 – 0.39	0.001
Landcover [Shrubland]	0.24	0.11 – 0.38	<0.001
Landcover [Woodland]	0.44	0.30 – 0.58	<0.001
Ground vegetation cover	0.03	0.02 – 0.03	<0.001

Appendix 7.5: Fixed effects estimates for spider richness inside enclosures (model 3), showing predictors with estimates, 95% CI, and significance levels.

Random Effect	Variance	Std. Dev.
Intercept (enc)	0.005	0.073
Residual	0.149	0.387

Appendix 7.5: Random effects and model fit for spider richness inside enclosures, showing variance and standard deviation of random components.

Model Information	Value
Observations	1430
Groups (enc)	13
ICC	0.03
Marginal R ²	0.100
Conditional R ²	0.131

Appendix 7.6: Model information for spider richness inside enclosures, including sample size, group structure, ICC, and R² values.

Predictor	Estimate	95% CI	p-value
Intercept	1.64	1.48 – 1.79	<0.001
Season [Summer]	-0.27	-0.33 – -0.20	<0.001
Season [Winter]	-0.04	-0.10 – 0.02	0.202
Landcover [Grassland]	0.46	0.33 – 0.60	<0.001
Landcover [Scrubland]	0.37	0.20 – 0.54	<0.001
Landcover [Shrubland]	0.37	0.21 – 0.52	<0.001
Landcover [Woodland]	0.59	0.43 – 0.76	<0.001

Appendix 7.7: Fixed effects estimates for spider abundance inside enclosures (model 2), showing predictors with estimates, 95% CI, and significance levels.

Random Effect	Variance	Std. Dev.
Intercept (enc)	0.016	0.127
Residual	0.206	0.454

Appendix 7.8: Random effects and model fit for spider abundance inside enclosures, showing variance and standard deviation of random components.

Model Information	Value
Observations	1430
Groups (enc)	13
ICC	0.07
Marginal R ²	0.092
Conditional R ²	0.158

Appendix 7.9: Model information for spider abundance inside enclosures, including sample size, group structure, ICC, and R² values.

Predictor	Estimate	95% CI	p-value
Intercept	1.48	1.41 – 1.56	<0.001
In/Out [Out]	-0.27	-0.31 – -0.23	<0.001
Landcover [Barren]	-0.11	-0.19 – -0.04	0.002
Landcover [Grassland]	0.07	0.01 – 0.14	0.019
Landcover [Scrubland]	0.09	0.03 – 0.16	0.007
Landcover [Shrubland]	-0.02	-0.08 – 0.05	0.613
Landcover [Woodland]	0.19	0.11 – 0.26	<0.001
Ground vegetation	0.02	0.02 – 0.03	<0.001
Season [Summer]	-0.13	-0.18 – -0.09	<0.001
Season [Winter]	0.08	0.04 – 0.12	<0.001

Appendix 7.10: Fixed effects estimates for spider richness inside-outside enclosures (model 4), showing predictors with estimates, 95% CI, and significance levels.

Random Effect	Variance	Std. Dev.
Intercept (enc)	0.003	0.056
Residual	0.180	0.424

Appendix 7.11: Random effects and model fit for spider richness inside-outside enclosures, showing variance and standard deviation of random components.

Model Information	Value
Observations	2852
Groups (enc)	13
ICC	0.02
Marginal R ²	0.205
Conditional R ²	0.218

Appendix 7.12: Model information for spider richness inside-outside enclosures, including sample size, group structure, ICC, and R² values.

Predictor	Estimate	95% CI	p-value
Intercept	2.00	1.89 – 2.12	<0.001
In/Out [Out]	-0.28	-0.33 – -0.23	<0.001
Landcover [Barren]	-0.14	-0.22 – -0.05	0.003
Landcover [Grassland]	0.10	0.02 – 0.18	0.011
Landcover [Scrubland]	0.07	-0.02 – 0.15	0.122
Landcover [Shrubland]	-0.07	-0.15 – 0.01	0.093
Landcover [Woodland]	0.20	0.11 – 0.30	<0.001
Barren (continuous)	-0.02	-0.03 – -0.01	<0.001
Season [Summer]	-0.21	-0.27 – -0.16	<0.001
Season [Winter]	0.07	0.02 – 0.12	0.011

Appendix 7.13: Fixed effects estimates for spider abundance inside-outside enclosures (model 4), showing predictors with estimates, 95% CI, and significance levels.

Random Effect	Variance	Std. Dev.
Intercept (enc)	0.009	0.095
Residual	0.262	0.512

Appendix 7.14: Random effects and model fit for spider abundance inside-outside enclosures, showing variance and standard deviation of random components.

Model Information	Value
Observations	2852
Groups (enc)	13
ICC	0.03
Marginal R ²	0.197
Conditional R ²	0.224

Appendix 7.15: Model information for spider abundance inside-outside enclosures, including sample size, group structure, ICC, and R² values.

Datasheet for Spider survey, Desert National Park

Enclosure ID _____ Grid ID _____ Observers _____

Date _____ Time _____ Season _____

Point	Lat (DD)	Long (DD)	Point Count	Specimen			Pitfall Count	Habitat Data (20m)			Vegetation composition								
				Family	Genus	Species		Land-cover	Terrain	Substrate	0	1- 25	26- 50	51- 75	76- 100	101- 125	126- 150	151- 175	176- 200
								B/A/G/W/S/s	F/U	R/G/S/s									
								B/A/G/W/S/s	F/U	R/G/S/s									
								B/A/G/W/S/s	F/U	R/G/S/s									
								B/A/G/W/S/s	F/U	R/G/S/s									
								B/A/G/W/S/s	F/U	R/G/S/s									
								B/A/G/W/S/s	F/U	R/G/S/s									
								B/A/G/W/S/s	F/U	R/G/S/s									
								B/A/G/W/S/s	F/U	R/G/S/s									
								B/A/G/W/S/s	F/U	R/G/S/s									

Abbreviations: Landcover- **B** (barren)/ **A** (agriculture)/ **G** (grassland)/ **W** (woodland)/ **S** (shrubland)/ **s** (scrubland); Terrain- **F** (flat)/ **U** (undulate); Substrate-**R** (rock)/ **G** (gravel)/ **S** (sand)/ **s** (soil);
Vegetation Composition classes (in cm): 0/ 1-25/ 26-50/ 51-75/ 76-100/ 101-125/ 126-150/ 151-175/ 176-200.

Additional notes:

Appendix 7.16: Datasheet for habitat characterization and spider count.

PUBLICATIONS

2020

- **Tripathi, R.**, Jangid, A. K., Siliwal, M., & Dutta, S. (2020). The first report of matrophagy in *Stegodyphus pacificus* Pocock, 1900. *Acta Arachnologica*, 69(1), 17–21.

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- Kadam, G., **Tripathi, R.**, Jangid, A. K., Sudhikumar, A. V., & Hill, D. E. (2021). First records of the jumping spider genus *Irura* Peckham & Peckham 1901 (Araneae: Salticidae: Simaethina) from India. *Peckhamia*, 243(1), 1–9.

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- Logunov, D. V., **Tripathi, R.** & Jangid, A. K. (2022). First record of *Pseudomogrus* Simon, 1937 (Araneae: Salticidae) from India, with description of a new species. *Arachnology* **19**(1): 72-76. [doi:10.13156/arac.2022.19.1.72](https://doi.org/10.13156/arac.2022.19.1.72)
- Caleb, J. T. D., Sanap, R. V., **Tripathi, R.**, Sampathkumar, M., Dharmara, J. & Packiam, S. M. (2022a). Taxonomic notes on some South and Southeast Asian members of the genus *Rhene* Thorell, 1869 (Aranei, Salticidae, Dendryphantini). *Zootaxa* **5125**(4): 389-407. [doi:10.11646/zootaxa.5125.4.3](https://doi.org/10.11646/zootaxa.5125.4.3)
- Kadam, G., Sudhikumar, A. V., & **Tripathi, R.** (2022). New records of the jumping spider *Dexippus pengi* Wang & Li, 2020 (Araneae: Salticidae: Plexippina) in India. *Peckhamia*, 266(1), 1–4.
- Sudhin, P. P., Nafin, K. S., **Tripathi, R.**, Jangid, A. K., Prajapati, D. A., Siliwal, M. & Sudhikumar, A. V. (2022a). Description of two new species of the genus *Afraflacilla* Berland et Millot, 1941 (Araneae: Salticidae) from India. *Arthropoda Selecta* **31**(3): 326-334. [doi:10.15298/arthscl.31.3.09](https://doi.org/10.15298/arthscl.31.3.09)

- Sankaran, P. M., Kadam, G., Sudhikumar, A. V. & **Tripathi, R.** (2022). First record of *Siamspinops* Dankittipakul & Corronca, 2009 from India, first description of the female of *Makdiops shevaroyensis* (Gravely, 1931), and a catalogue of Indian selenopid fauna (Araneae, Selenopidae). *Zootaxa* 5194(1): 109-121. [doi:10.11646/zootaxa.5194.1.6](https://doi.org/10.11646/zootaxa.5194.1.6)
- Jäger, P., Sudhikumar, A. V. & **Tripathi, R.** (2022). Three species of Sparassidae from India, with the first description of the males of *Olios kiranae* Sethi & Tikader, 1988 and *Thelcticopis moolampilliensis* Sunil Jose & Sebastian, 2007 (Araneae: Sparassidae). *Arachnology* 19(3): 621-627. [doi:10.13156/arac.2022.19.3.621](https://doi.org/10.13156/arac.2022.19.3.621)

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- **Tripathi, R.**, Jose, A., Nafin, K. S., Babu, N. & Sudhikumar, A. V. (2023a). The first description of the female of *Myrmarachne uniseriata* Narayan, 1915 and the first report of *Myrmarachne spissa* (G. W. Peckham & E. G. Peckham, 1892) from India. *Peckhamia* **289.1**: 1-10. [doi:10.5281/zenodo.7542028](https://doi.org/10.5281/zenodo.7542028)
- Kadam, G., **Tripathi, R.** & Sudhikumar, A. V. (2023). Three new jumping spiders from northeastern India (Araneae: Salticidae: Hasariini: *Habrocestum*). *Peckhamia* **295.1**: 1-10.
- **Tripathi, R.**, Jangid, A. K., Sudhikumar, A. V., Siliwal, M. & Dutta, S. (2023b). *Steatoda albomaculata* (De Geer, 1778) (Araneae: Theridiidae): an addition to the spider fauna of India. *Journal of the Bombay Natural History Society* **119**(3, 2022): 266-272. [publ. in April 2023] [doi:10.17087/jbnhs/2022/v119/160688](https://doi.org/10.17087/jbnhs/2022/v119/160688)
- **Tripathi, R.**, Jangid, A. K., Bhagirathan, U. & Sudhikumar, A. V. (2023c). First record of the genus *Bassaniodes* Pocock, 1903 (Araneae, Thomisidae) from India. *Natura Somogyiensis* **40**: 47-50. [doi:10.24394/NatSom.2023.40.4](https://doi.org/10.24394/NatSom.2023.40.4)
- **Tripathi, R.**, Jangid, A. K., Bhagirathan, U. & Sudhikumar, A. V. (2023d). First record of the cobweb spider (*Steatoda erigoniformis*) from India. *Taprobanica* **12**(1): 26-27, pl. 15-17. [doi:10.47605/tapro.v12i1.299](https://doi.org/10.47605/tapro.v12i1.299)
- Jose, A., **Tripathi, R.** & Sudhikumar, A. V. (2023). First records of the genera *Anarrhotus* Simon, 1902 and *Gelotia* Thorell, 1890 from India (Araneae: Salticidae). *Peckhamia* **299.1**: 1-7.
- **Tripathi, R.**, Joshi, P., Kasambe, R. & Sudhikumar, A. V. (2023e). A new species of *Hasarius* Simon, 1871 (Araneae: Salticidae) from Mumbai, India.

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- **Tripathi, R.**, Sankaran, P. M., Kuni, N. & Sudhikumar, A. V. (2023f). New species of *Palpimanus* Dufour, 1820 from India (Araneae: Palpimanidae, Palpimaninae), with a catalogue of the Indian palpimanid fauna. *European Journal of Taxonomy* **891**: 26-50. [doi:10.5852/ejt.2023.891.2265](https://doi.org/10.5852/ejt.2023.891.2265)
- **Tripathi, R.**, Kadam, G., Asha, T. J. & Sudhikumar, A. V. (2023g). First record of *Sparbambus* Zhang, Woon & Li, 2006 from India, with description of a new species (Araneae: Salticidae). *Zootaxa* **5352**(3): 447-450. [doi:10.11646/zootaxa.5352.3.10](https://doi.org/10.11646/zootaxa.5352.3.10)
- Babu, N., **Tripathi, R.**, Sampathkumar, M., Caleb, J. T. D., Prasad, G., Mohanasundaram, M., Mahendiran, G. & Sudhikumar, A. V. (2023). Two new species of *Afraflacilla* Berland et Millot, 1941 (Araneae: Salticidae: Chrysillini) from India. *Arthropoda Selecta* **32**(4): 459-465. [doi:10.15298/arthsel.32.4.10](https://doi.org/10.15298/arthsel.32.4.10)
- **Tripathi, R.**, Sudhikumar, A. V. & Sherwood, D. (2023). A new species of *Oecobius* Lucas, 1846 from the Thar Desert, India (Araneae: Oecobiidae). *Zootaxa* **5389**(4): 483-490. [doi:10.11646/zootaxa.5389.4.6](https://doi.org/10.11646/zootaxa.5389.4.6)
- Sankaran, P. M. & **Tripathi, R.** (2023). First record of the genus *Hongkongia* Song & Zhu, 1998 from India, with the description of a new species (Araneae, Gnaphosidae). *Zootaxa* **5389**(4): 497-500. [doi:10.11646/zootaxa.5389.4.8](https://doi.org/10.11646/zootaxa.5389.4.8)

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- Kadam, G., Sudhikumar, A. V. & **Tripathi, R.** (2024). A new *Indopadilla* Caleb & Sankaran, 2019 (Araneae: Salticidae) from the Western Ghats, Tamil Nadu, India. *Arachnology* **19**(7): 1025-1028. [doi:10.13156/arac.2024.19.7.1025](https://doi.org/10.13156/arac.2024.19.7.1025)
- Gawas, V. U., **Tripathi, R.**, Sudhikumar, A. V. & Sawant, N. S. (2024). A new species of *Afraflacilla* Berland & Millot, 1941 (Araneae, Salticidae) from India. *Journal of Insect Biodiversity and Systematics* **10**(1): 125-132. [doi:10.61186/jibs.10.1.125](https://doi.org/10.61186/jibs.10.1.125)
- **Tripathi, R.**, Kuni, N., Kadam, G., Kumaran, K. P. & Sudhikumar, A. V. (2024). Four new species and five new distribution records of the jumping spider genus *Stenaelurillus* Simon, 1886 (Salticidae: Aelurillines) from India. *European Journal of Taxonomy* **930**: 124-156. [doi:10.5852/ejt.2024.930.2485](https://doi.org/10.5852/ejt.2024.930.2485)

- Sankaran, P. M., Kadam, G. & **Tripathi, R.** (2024). First records of *Medmassa* Simon, 1887 from India, with the description of two new species (Araneae: Corinnidae). *Zootaxa* **5433**(1): 133-143. [doi:10.11646/zootaxa.5433.1.6](https://doi.org/10.11646/zootaxa.5433.1.6)
- Marathe, K., **Tripathi, R.**, Sudhikumar, A. V. & Maddison, W. P. (2024a). Phylogenomic placement and revision of *Iranattus* Prószyński, 1992 jumping spiders (Salticidae, Plexippini, Plexippina). *Zoosystematics and Evolution* **100**(2): 531-542. [doi:10.3897/zse.100.122034](https://doi.org/10.3897/zse.100.122034)
- Sankaran, P. M., **Tripathi, R.** & Kadam, G. (2024). A new species of *Steriphopus* Simon, 1887 from India (Araneae: Palpimanidae, Chediminae), with the proposal of a new combination. *Zootaxa* **5474**(1): 97-100. [doi:10.11646/zootaxa.5474.1.10](https://doi.org/10.11646/zootaxa.5474.1.10)
- **Tripathi, R.**, Sherwood, D., & Sudhikumar, A. V. (2024). Ocular and appendage anomalies in *Thomisus* from India (Araneae: Thomisidae). *Revista Ibérica de Aracnología*, 44, 148–149.
- Sherwood, D. & **Tripathi, R.** (2024). Notes on a type specimen of *Poecilotheria* Simon, 1885 from India (Araneae: Theraphosidae). *Newsletter of the British Arachnological Society* **160**: 13.
- Kulkarni, A., **Tripathi, R.**, Koparde, P. & Sudhikumar, A. V. (2024). A new species of *Okinawicius* Prószyński, 2016 (Araneae: Salticidae: Chrysillini) from the Deccan Plateau, Maharashtra, India. *Arachnology* **19**(9): 1172-1176. [doi:10.13156/arac.2024.19.9.1172](https://doi.org/10.13156/arac.2024.19.9.1172)
- **Tripathi, R.**, Kadam, G. & Sudhikumar, A. V. (2024). Taxonomic and distributional notes on four recently described *Stenaelurillus* species from India (Araneae: Salticidae). *Journal of Asia-Pacific Biodiversity* **17**(4): 617-623. [doi:10.1016/j.japb.2024.04.010](https://doi.org/10.1016/j.japb.2024.04.010)

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- Sankaran, P. M., Haddad, C. R. & **Tripathi, R.** (2025). A review of the ground spider genus *Trichothyse* Tucker, 1923 (Araneae, Gnaphosidae). *Zootaxa* **5583**(1): 39-70. [doi:10.11646/zootaxa.5583.1.2](https://doi.org/10.11646/zootaxa.5583.1.2)
- Sanap, R., Kadam, G., **Tripathi, R.** & Caleb, J. T. D. (2025). The unknown male of *Habrocestum mookambikaense* (Araneae: Salticidae: Hasariini) from the Western Ghats, India. *Arachnology* **20**(1): 146-149. [doi:10.13156/arac.2024.20.1.146](https://doi.org/10.13156/arac.2024.20.1.146)

- **Tripathi, R.**, Kadam, G. & Sudhikumar, A. V. (2025). A new species of *Conothele* Thorell, 1878 (Araneae: Halonoproctidae) from the western Himalayas, India. *Arachnology* **20**(1): 76-79. [doi:10.13156/arac.2024.20.1.76](https://doi.org/10.13156/arac.2024.20.1.76)
- **Tripathi, R.**, Kadam, G., Sherwood, D. & Sudhikumar, A. V. (2025). Revision of Indian Ischnothelidae (Arachnida: Araneae) and descriptions of two new species of *Indothele* Coyle, 1995. *European Journal of Taxonomy* **981**: 189-212. [doi:10.5852/ejt.2025.981.2827](https://doi.org/10.5852/ejt.2025.981.2827)
- Sankaran, P. M., Tripathy, A. & **Tripathi, R.** (2025). On the identity of *Plator indicus* Simon, 1897, and a catalogue of Indian trochanteriid fauna (Araneae: Trochanteriidae). *Zootaxa* 5686(3): 447-450. [doi:10.11646/zootaxa.5686.3.8](https://doi.org/10.11646/zootaxa.5686.3.8)

In Press

- **Tripathi, R.**, Kadam, G., Asha, T. J., Kulkarni, A., Jangid, A. K., Prajapati, D. A., & Sudhikumar, A. V. (In press). Revision of *Mogrus* from India (Araneae: Salticidae): Two new Species, Male Description of *M. rajasthanensis*, and First Record of *M. larisae* from India. *European Journal of Taxonomy*.

PRESENTATIONS

International

- Assessment of spider assemblages and their responses to grazing regulation in the Great Indian Bustard habitat of Desert National Park, Rajasthan—*34th European Congress of Arachnology (ECA), University of Rennes, France* (August 2024).

National

- Assessment of spider assemblages and their responses to grazing regulation in the Great Indian Bustard habitat of Desert National Park, Rajasthan—*The Rufford India Conference: Fostering Grass-Roots Conservation in India—A Rufford Initiative, organised by FERAL and The Rufford Foundation, Udaipur, Rajasthan* (March 2022).

ACADEMIC ENGAGEMENTS

Guest Lectures & Academic Talks

- Basics of Spider Taxonomy—*Abasaheb Garware College, Pune* (August 2025).
- Decoding Diversity: Introduction to Spider Taxonomy—Webinar, *Ashoka University, Delhi* (April 2025).
- World of Spider—*Seminar, Wilson College, Mumbai* (January 2024).
- The Fascinating World of Spider—Webinar, *Wildlife Division Udaipur & Green Peepal Society, MLSU* (October 2021).
- Basics of Spider Taxonomy and Identification—Webinar, *Team Saaliga, Karnataka* (June 2020).
- The World of Spider—Webinar, *K. J. Somaiya College, Mumbai* (December 2020).
- Marvels of the Minuscule World Spider—Seminar, *Guru Nanak Khalsa College, Mumbai* (January 2019).

Public Outreach & Citizen Engagement

- Spinning Wonders: The Secret World of Spiders—Public lecture at *Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS), Mumbai* (August 2025)
- Spiders of Maharashtra: From Floor to Fame—Webinar, *Paryavaran Dakshita Mandal, Thane* (July 2025).
- Spider Walk—Talegaon Lake with *Prakriti Nature Club* (July 2025).

- Spider Walk—*Sanjay Gandhi National Park, Mumbai* (December 2024).
- Adaptations in Desert Spiders—Webinar, *NGO Murshidabad Wildlife Federation, Kolkata* (September 2021).

GRANTS

1. Anusandhan National Research Foundation—International Travel Scheme (2024)
2. American Arachnological Society—Travel Grant (2024)
3. BIOPAT Grant (2025)
4. IdeaWild Equipment Grant (2025)
5. WNE Start-Up Grant (2025)
6. International Society of Arachnology Grant (2025)
7. Mohamed bin Zayed Species Conservation Fund (2025)