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The Journal of Basic and Applied Zoology (2024) 85:14
https://doi.org/10.1186/s41936-024-00366-w

The Journal of Basic and Applied Zoology

RESEARCH

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Dominance structure and constancy of spiders in the Indian Thar desert

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Abstract

Background The knowledge about the species of a habitat (both resident and transient/dominant and rare) is a vital step to plan the conservation measures. Being generalist predators, spiders help controlling the population of their prey and maintain ecosystem stability. This makes spiders excellent bio-indicators for assessing the impact of anthropogenic disturbance factors on natural ecosystems (De, Siliwal, Uniyal and Hussain in Trop. Ecol. 63: 1–7, 2021). The aim of this study was to assess the dominance structure and constancy of spiders in three different habitats (Sand dunes, Riparian and Rocky) of the Thar desert. Study was conducted from March 2017 to February 2019 covering all seasons.

Results The eudominant species in sand dunes and rocky desert belonged to the family Thomisidae. These species were *Tmarus* sp. 1 and *Tmarus kotigeharus* Tikader, 1963, respectively. There were two eudominants in Riparian habitat (*Oecobius putus* O. Pickard-Cambridge, 1876 and *Menemerus bivittatus* (Dufour, 1831)). Through the analysis of constancy of all the species in the Thar desert, it was revealed that three species were constant in all the three habitats. The number of accessory and accidental species was far higher than constant species in all the habitats.

Conclusions The number of accessory and accidental spider species in all habitats was far higher than constants due to the unstability of spider population. Therefore, this study highlights the necessity for conservation of these habitats of the Thar desert.

Keywords Araneae, Ecology, Constancy, Dominance, Desert, Spiders

Background

The Thar desert represents one of the extremely fragile ecosystems in the Indian subcontinent. The biodiversity of the Thar is unique and adapted to its extreme climatic conditions. But the ecological scenario of the Thar desert is altering due to threats like climate change, invasion of exotic species, urbanization, unscientific sand dune stabilization methods, ecological consequences of the irrigation project, Indira Gandhi Nahar Pariyojana (IGNP)—like water logging, saline water intrusion, extinction of xeric biodiversity, etc. (Tembhurne et al., 2020). The fact that ecological studies in a changing ecosystem can forecast the reverberations in future, makes this study important for predicting the future of this desert ecosystem and planning conservation measures.

Spiders are appropriate for ecological studies as they are widely distributed across the world and inhabits vast range of niches (Marc, Canard and Ysnel, 1999). They are also the most profuse generalist predators which helps in pest suppression (Birkhoferet al., 2013; Michalko et al., 2018). Web weaving spiders can even check the pest population which they do not consume, using their sticky webs (Alderweireldt, 1994). Though the spiders reduce pollination success in plants, it can also reduce the seed damage caused by insects (Louda, 1982). They can also control insect vector borne diseases like Chikungunya, Filariasis, Dengue, Yellow Fever, Zika, Malaria, Japanese

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encephalitis, Tungiasis, Leishmaniasis and Trypanosomiasis (Ndava et al., 2018) by feeding those vectors. Another ecological benefit from spiders is that they indirectly assist in ecosystem services like litter decomposition and nutrient cycling (Lawrence & Wise, 2000). Published research works analysing the ecological aspects of spider assemblages in the Thar desert has been sparse till date. This study attempts to compare the dominance structure and constancy of occurrence of spiders in three different habitats of the Thar desert.

Methods

Study area

Major portions of the Thar desert lie extended in the states of Rajasthan, Punjab, Gujarat and Haryana of India and partially in Pakistan. It covers around twelve percentage of geographical area of India. Western part of the state of Rajasthan constitutes 61 percentage of the entire Thar desert. Hence, this study focus on desert area of Jodhpur district which lies in western part of Rajasthan. This region, like any other desert ecosystems, is known for extreme climatic conditions. Sometimes temperature during summer may raise up to 50 °C and may drop down to −10 °C during winter (Sharma et al., 2021). Droughts are frequent in this region due to high rainfall variability (Rao, 2009). The average annual precipitation of the Thar desert has been about 290 mm during 1901 to 2019. During winter wind direction is towards northeast and speed is 3-4 km/hr. During summer and rainy season wind blows in southwest direction. Wind speed is relatively higher in summer (8–20 km/hr). Wind speed reaches 60–80 km/hr during intense dust storms (Sharma et al., 2021). Three different types of habitat (Sand dunes, Riparian habitat and Rocky desert) in the Thar desert were studied in the present work from March 2017 to February 2019 (Figs. 1, 2, 3, 4, 5).

Fig. 2 *Cheiracanthium melanostomum* (Thorell, 1895)

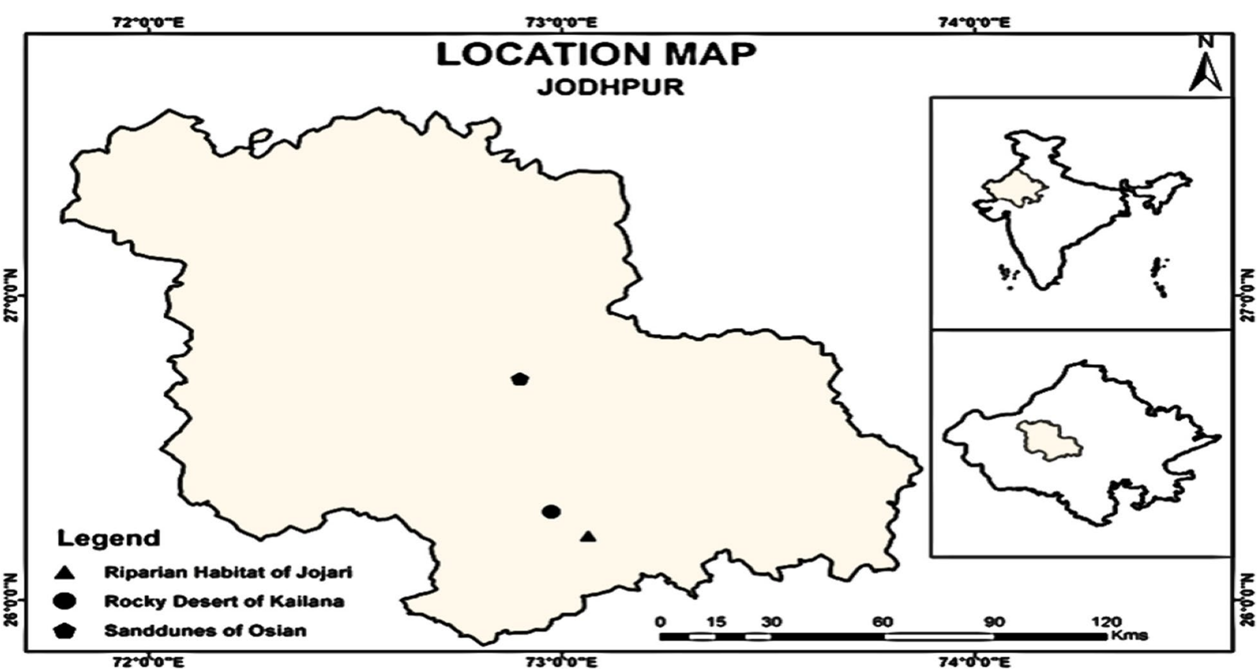

Fig. 1 Map of study area

Fig. 3 *Indoxysticus minutus* (Tikader, 1960)

Fig. 4 *Thomisus lobosus* Tikader, 1965

Fig. 5 *Neoscona theisi* (Walckenaer, 1841)

(a) Sand dunes

Sand dunes with height varying from 9 to 30 m surrounding Osian village of Jodhpur (lat. 26°72′ 68″ N latitude and long.72° 89′ 85″ E) was one of the study area. Vegetation found here includes *Acacia senegal*, *A. jacquemontii, Aerva javanica, Calligonum polygonoides, Capparis decidua, Cenchrus biflorus, Crotalaria burhia, Prosopis juliflora Tephrosia petrosa* and *T. purpurea.*

(b)Riparian habitat

Riparian habitat on the banks of Luni river, the only natural river that flows through the Thar desert of western Rajasthan was selected as second study site (lat. 26° 21′ 06″ N and long. 73° 06′ 39″ E). Natural vegetation present here includes *Acacia senegal, Azadirachta indica, Calotropis procera, Prosopis cineraria, Prosopis juliflora* and *Salvadora oleoides.*

(c) Rocky desert

Igneous rock formations surrounding the Kailana lake of Jodhpur, Rajasthan was the third study area (lat. 26° 28′ 91″ N and long. 72° 97′ 48″ E). Vegetation prevalent in this area includes *Euphorbia caducifolia, Anogeissus pendula Barleria* sp., *Tephrosia purpurea, Prosopis juliflora, Cleome viscosa, Indigofera cordifolia* and *Grewia tenax.*

Methods of collection

Spiders were collected from the study areas using the following methods. Some collection methods using sweep net and pitfall traps were avoided due to limitations of the landscape like thorny vegetation and sand storms.

(a) Hand collection

Collection of specimens from ground level to knee height and knee level to as high as collector can reach was done using this method. Specimens were gathered using aspirator or forceps or brush (Sørensen, et al., 2002).

(b)Beating

Vegetation present in the study areas was beaten using a wooden rod while keeping a collection tray below (Tikader, 1987).

Fig. 6 *Thyene imperialis* (Rossi, 1846)

Fig. 8 *Plexippus paykulli* (Audouin, 1826)

Fig. 7 *Langona albolinea* Caleb & Mathai, 2015

Fig. 9 *Oecobius putus* O. Pickard-Cambridge, 1876

(c) Litter sampling

Litter procured from the study area were collected in a plastic bag, sealed and carried to the lab. Spiders were sorted out from the litter by placing it on white canvas sheet or paper (Coddington et al., 1996).

Fig. 10 *Cyrba ocellata* (Kroneberg, 1875)

Preservation and identification

Specimens collected were placed directly in 70% Ethyl Alcohol. Then it was properly labelled and sorted. Leica—M205C Stereozoom microscope was used to identify the specimens. The literature referred for identification process include works of Tikader and Malhotra (1980), Tikader (1982), Barrion and Litsinger (1995), Jocqué and Dippenaar –Schoeman (2006), Murphy (2007), Sebastian and Peter (2009), Prószyński (2017), Metzner (2020) and World Spider Catalog (2022) (Figs. 6, 7, 8, 9, 10).

Data analysis

Class of dominance and constancy of occurrence of spiders were found using the methods described by Górny and Grüm (1993) and Silveira Neto et al. (1976).

(a) Class of dominance (*D*)

Class of dominance of spiders in different habitats were determined by calculating the percentage of specimens of a given species in total number of specimens collected from the habitat studied. The species with $D > 10\%$ were considered as eudominants (D_5), with $5.1\% < D < 10\%$ as dominants (D_4), with $2.1\% < D < 5\%$ as subdominants ($D_{3)}$, with $1.1\% < D < 2\%$ as recedents (D_2) and $D < 1\%$ as subrecedents (D1).

(b)Constancy of occurrence

To identify the resident species in this study, constancy of occurrence was measured using the formula given by Silveira-Neto et al. (1976) and based on that they were grouped into three classes (Table 1).

$$C = \frac{P \times 100}{n}$$

P = Number of samples in which the given species were present and n = Total number of sampling performed.

Results

(a)Dominance structure of spiders in the Thar desert

Total 127 species of spiders under 61 genera and 17 families were recorded from the study area. Number of species collected from Sand dunes, Riparian area and Rocky desert were 76, 54 and 67, respectively. Nineteen species were common to all the three habitats. They are *Neoscona mukerjei, Oxyopes gujaratensis, Neoscona odites, Afraflacilla* sp.1, *Menemerus bivittatus, Thyene imperialis, Neoscona theisi, Clubiona* sp.1, *Philodromus* sp.1, *Peucetia viridana, Langona albolinea, Indoxysticus minutus, Oxyopes chittrae, Thomisus onustus, Oxyopes javanus, Tmarus* sp.2, *Rudakius ludhianaensis, Cheiracanthium melanostomum, Neoscona nautica.* The most abundant spider family in sand dune and rocky desert was Thomisidae with 139 and 302 individuals, respectively. In riparian area, Oecobiidae was the family with more number of individuals (151). Eudominant and Dominant species in Sand dunes constituted 5.26% of total species collected from there. 9.25% of total species collected were eudominants or dominants in the Riparian area. Only 2.98% of the total species collected constituted this *category* in rocky desert area. The dominance structure of spiders present in all the three habitats are given in (Table 2,3 and 4).

Table 1 Criteria for classification of constancy

Sl. no	Percentage of constancy (%)	Class of constancy
1	> 50	Constant
2	25–50	Accessory
3	< 25	Accidental

(b)Constancy of spiders in different habitats of the Thar desert

There were a total of 1725 individuals belonging to 127 species in the spider collection made from Sand dunes, Riparian and Rocky habitats of the Thar desert. The number of constant species was three in all the habitats studied. *Mogrus rajasthanensis* showed constancy in both sand dune and rocky habitat. *Peucetia viridana* and *Tmarus* sp.1 were the remaining constant species in sand dunes. Besides *Mogrus rajasthanensis*, *Oxyopes chittrae* and *Tmarus kotigeharus* were the constant species in rocky area. In riparian habitat *Oecobius putus*, *Menemerus bivittatus* and *Menemerus brachygnathus* constituted the constant species. Highest number of accessory species was reported from Sand dunes (11 species). The number of accessory species in riparian and rocky habitats was 7 and 4, respectively. Accidental species number were also higher in Sand dunes (62 species). It was followed by rocky (60 species) and riparian (44 species) habitats. At sand dune habitat, 14.47% of the species were accessory, 81.57% were accidental and 3.94% were constant. In Riparian area, 12.9% of the total species were classified as accessory, 81.48% as accidental and 5.55% as constant. Accessory species were 5.9% in Rocky desert. Besides that, accidental species were 89.55% and remaining 4.47% were constant.

Discussion

Analysis of data showed that 19 species were common to all the three habitats. However, each habitat had its own unique species more than common species (Sand dunes—29 species, Rocky desert—28 species and Riparian habitat—19 species). This may be due to the uniqueness of vegetation of each habitat. Schaffers et al. (2008) explored the arthropod assemblages including epigeic spiders at 47 sites in Netherland with different plant species composition and demonstrated a link between them.

Table 2 Dominance structure of spiders present in Sand dunes

Family	Genus/Species	Class of Dominance
Araneidae	*Araneus panchganiensis* Tikader & Bal, 1981	SR
	Araneus sp.1	SR
	Araneus sp.3	SR
	Chorizopes sp.1	SR
	Eriovixia excelsa (Simon, 1889)	R
	Eriovixia poonaensis (Tikader & Bal, 1981)	SR
	Gibbaranea bituberculata (Walckenaer, 1802)	R
	Larinia chloris (Audouin, 1826)	SD
	Larinia phthisica (L. Koch, 1871)	D
	Larinioides sclopetarius (Clerck, 1757)	R
	Neoscona mukerjei Tikader, 1980	SD
	Neoscona nautica (L. Koch, 1875)	SR
	Neoscona odites (Simon, 1906)	SR
	Neoscona pavida (Simon, 1906)	SR
	Neoscona theisi (Walckenaer, 1841)	SD
	Parawixia dehaani (Doleschall, 1859)	SR
	Zilla diodia (Walckenaer, 1802)	SR
Cheiracanthiidae	*Cheiracanthium melanostomum* (Thorell, 1895)	SR
	Cheiracanthium sp.1	SR
Clubionidae	*Clubiona drassodes* O. Pickard-Cambridge, 1874	SR
	Clubiona sp.1	SR
Gnaphosidae	*Drassodes luridus* (O. Pickard-Cambridge, 1874)	SR
	Drassodes sp.1	SD
	Gnaphosa kailana Tikader, 1966	SR
Lycosidae	*Hippasa agelenoides* (Simon, 1884)	SR
	Hippasa pisaurina Pocock, 1900	SR
	Lycosa tista Tikader, 1970	SR
	Pardosa birmanica Simon, 1884	R
	Pardosa pseudoannulata (Bösenberg & Strand, 1906)	SR
Oecobiidae	*Oecobius navus* Blackwall, 1859	SR
Oxyopidae	*Hamataliwa incompta* (Thorell, 1895)	SR
	Oxyopes chittrae Tikader, 1965	D
	Oxyopes gujaratensis Gajbe, 1999	D
	Oxyopes javanus Thorell, 1887	SR
	Oxyopes ratnae Tikader, 1970	R
	Peucetia viridana (Stoliczka, 1869)	SD
	Peucetia yogeshi Gajbe, 1999	SR
	Philodromus devhutai Tikader, 1966	SR
	Philodromus durvei Tikader, 1980	SR
	Philodromus sp.1	SR
	Tibellus pateli Tikader, 1980	SR

Table 2 (continued)

Family	Genus/Species	Class of Dominance
Salticidae	*Aelurillus improvisus* Azarkina, 2002	R
	Aelurillus sp.1	R
	Afraflacilla sp.1	SD
	Bianor albobimaculatus (Lucas, 1846)	SR
	Cyrba sp.1	SR
	Heliophanus sp.1	SD
	Hyllus semicupreus (Simon, 1885)	SR
	Hyllus sp.1	SR
	Langona albolinea Caleb & Mathai, 2015	SR
	Langona alfensis Hęciak & Prószyński, 1983	SR
	Langona sp.1	SR
	Marpissa dayapurensis Majumder, 2004	SR
	Menemerus albocinctus Keyserling, 1890	SR
	Menemerus bivittatus (Dufour, 1831)	SR
	Mogrus rajasthanensis Caleb, Chatterjee, Tyagi, Kundu & Kumar, 2017	SD
	Myrmarachne melanocephala MacLeay, 1839	SR
	Phlegra sp.1	SR
	Plexippus paykulli (Audouin, 1826)	SR
	Rudakius ludhianaensis (Tikader, 1974)	SR
	Thyene imperialis (Rossi, 1846)	R
Sparassidae	*Olios gravelyi* Sethi & Tikader, 1988	SR
Tetragnathidae	*Guizygiella melanocrania* (Thorell, 1887)	SR
	Indoxysticus minutus (Tikader, 1960)	SR
	Mecaphesa celer (Hentz, 1847)	SD
	Thomisus italongus Barrion & Litsinger, 1995	SR
	Thomisus lobosus Tikader, 1965	SR
	Thomisus onustus Walckenaer, 1805	R
	Thomisus pugilis Stoliczka, 1869	SR
	Thomisus sp.1	R
	Tmarus sp.1	ED
	Tmarus sp.2	SD
	Tmarus sp.3	SR
Uloboridae	*Uloborus danolius* Tikader, 1969	SR
	Uloborus krishnae Tikader, 1970	SR
	Uloborus plumipes Lucas, 1846	SR

Plant species composition can affect the insect diversity and thereby indirectly affect the insect feeding spider community structure (Beals, 2006). Dennis et al. (2001) observed increased epigeal spider species composition in ungrazed grass land compared to grazed ones and related this to the presence of more plant litter below leaf stratum in ungrazed grass lands. Besides that, difference in environmental parameters like temperature and relative humidity might also have influenced the dominance structure. Range of temperature and relative humidity during the study was 18.8 to 40 °C and 12 to 54% for Sand dunes, 16.4 to 36.7 °C and 17 to 70% for Rocky desert and

Table 3 Dominance structure of spiders present in Riparian habitat

Family	Genus/Species	Class of dominance
Araneidae	*Araneus diadematus* Clerck, 1757	SR
	Araniella nympha (Simon, 1889)	SR
	Eriovixia excelsa (Simon, 1889)	SR
	Neoscona bengalensis Tikader & Bal, 1981	SR
	Neoscona mukerjei Tikader, 1980	R
	Neoscona nautica (L. Koch, 1875)	R
	Neoscona odites (Simon, 1906)	SD
	Neoscona pavida (Simon, 1906)	SR
	Neoscona sinhagadensis (Tikader, 1975)	SR
	Neoscona subfusca (C. L. Koch, 1837)	SR
	Neoscona theisi (Walckenaer, 1841) (Fig. 5)	SD
	Neoscona sp.1	SR
	Parawixia dehaani (Doleschall, 1859)	SR
Cheiracanthiidae	*Cheiracanthium danieli* Tikader, 1975	SR
	Cheiracanthium melanostomum (Thorell, 1895)(Fig. 2)	SR
Clubionidae	*Clubiona bifurcata* Zhang, Yu & Zhong, 2018	SR
	Clubiona sp.1	SR
Eresidae	*Stegodyphus pacificus* Pocock, 1900	SR
Gnaphosidae	*Drassodes* sp.1	SR
	Megamyrmaekion jodhpurense Gajbe, 1993	SR
Lycosidae	*Hippasa* sp. 1	SR
	Pardosa songosa Tikader & Malhotra, 1976	SR
Oecobiidae	*Oecobius navus* Blackwall, 1859	D
	Oecobius putus O. Pickard-Cambridge, 1876 (Fig. 9)	ED
	Uroctea sp. 1	SR
Oxyopidae	*Oxyopes chittrae* Tikader, 1965	D
	Oxyopes gujaratensis Gajbe, 1999	SR
	Oxyopes javanus Thorell, 1887	SR
	Peucetia latikae Tikader, 1970	SR
	Peucetia viridana (Stoliczka, 1869)	SR
Philodromidae	*Philodromus* sp.1	SR
Pholcidae	*Crossopriza lyoni* (Blackwall, 1867)	SR
Salticidae	*Afraflacilla* sp.1	SR
	Cyrba ocellata (Kroneberg, 1875)(Fig. 10)	SR
	Epocilla sirohi Caleb, Chatterjee, Tyagi, Kundu & Kumar, 2017	SR
	Hyllus semicupreus (Simon, 1885)	SR
	Langona albolinea Caleb & Mathai, 2015 (Fig. 7)	SR
	Menemerus bivittatus (Dufour, 1831)	ED
	Menemerus brachygnathus (Thorell, 1887)	D
	Menemerus fulvus (L. Koch, 1878)	SR
	Phlegra sp.1	R
	Plexippus paykulli (Audouin, 1826) (Fig. 8)	SD
	Plexippus petersi (Karsch, 1878)	SR
	Rudakius ludhianaensis (Tikader, 1974)	SD
	Thyene imperialis (Rossi, 1846) (Fig. 6)	SR
Sparassidae	*Olios gravelyi* Sethi & Tikader, 1988	SR
Tetragnathidae	*Guizygiella indica* (Tikader & Bal, 1980)	R
	Guizygiella melanocrania (Thorell, 1887)	R
	Indoxysticus minutus (Tikader, 1960) (Fig. 3)	SR

Table 3 (continued)

Family	Genus/Species	Class of dominance
Thomisidae	*Thomisus andamanensis* Tikader, 1980	SR
	Thomisus lobosus Tikader, 1965 (Fig. 4)	SR
	Thomisus onustus Walckenaer, 1805	SR
	Tmarus sp.2	SD
Uloboridae	*Uloborus danolius* Tikader, 1969	R

18.6 to 36.5 °C and 27 to 77% for Riparian habitat. Jones (1941) studied the effect of temperature and humidity on the life history of spider *Agelena naevia* and concluded that mortality increases in low humidity—high temperature conditions but decreases slightly in high humidity condition with increase of temperature. It was also observed that relative humidity over 50% allowed growth of the spider. Almquist (1970) studied tolerance range for temperature in different dune dwelling spider species of Sweden in laboratory conditions and established that

Table 4 Dominance structure of spiders present in Rocky desert

Family	Genus/Species	Class of Dominance
Araneidae	*Araneus panchganiensis* Tikader & Bal, 1981	SR
	Araneus sp.1	SR
	Araneus sp.2	SR
	Araneus sp.3	SR
	Cyrtophora cicatrosa (Stoliczka, 1869)	SR
	Cyrtophora citricola (Forsskål, 1775)	SR
	Gibbaranea bituberculata (Walckenaer, 1802)	SR
	Herennia sp.1	R
	Larinia phthisica (L. Koch, 1871)	SR
	Neoscona biswasi Bhandari & Gajbe, 2001	SR
	Neoscona mukerjei Tikader, 1980	SR
	Neoscona nautica (L. Koch, 1875)	SR
	Neoscona odites (Simon, 1906)	SD
	Neoscona sinhagadensis (Tikader, 1975)	SD
	Neoscona theisi (Walckenaer, 1841)	R
	Neoscona sp.1	SR
Cheiracanthiidae	*Cheiracanthium melanostomum* (Thorell, 1895)	SR
Clubionidae	*Clubiona drassodes* O. Pickard-Cambridge, 1874	SR
	Clubiona filicata O. Pickard-Cambridge, 1874	SR
	Clubiona sp.1	SR
Ctenidae	*Ctenus* sp.1	SR
Eresidae	*Stegodyphus pacificus* Pocock, 1900	SR
	Stegodyphus sarasinorum Karsch, 1892	SR
Gnaphosidae	*Gnaphosa kailana* Tikader, 1966	SR
	Gnaphosa sp.1	SR
Lycosidae	*Draposa atropalpis* (Gravely, 1924)	SR
	Evippa banarensis Tikader & Malhotra, 1980	SR
	Lycosa madani Pocock, 1901	SR
	Lycosa sp.1	SR
	Pardosa pusiola (Thorell, 1891)	SR

Table 4 (continued)

Family	Genus/Species	Class of Dominance
Oxyopidae	*Hamataliwa subhadrae* (Tikader, 1970)	R
	Oxyopes chittrae Tikader, 1965	D
	Oxyopes gujaratensis Gajbe, 1999	R
	Oxyopes javanus Thorell, 1887	SR
	Oxyopes ratnae Tikader, 1970	SR
	Oxyopes sunandae Tikader, 1970	SR
	Oxyopes sp.1	SR
	Oxyopes sp.2	SR
	Peucetia sp.1	SR
	Peucetia viridana (Stoliczka, 1869)	SR
	Peucetia yogeshi Gajbe, 1999	SR
Philodromidae	*Philodromus assamensis* Tikader, 1962	SR
	Philodromus devhutai Tikader, 1966	SR
	Philodromus sp.1	SR
Salticidae	*Aelurillus improvisus* Azarkina, 2002	R
	Aelurillus sp.1	R
	Afraflacilla sp.1	SR
	Heliophanus sp.1	SR
	Langona albolinea Caleb & Mathai, 2015	R
	Langona sp.1	SD
	Menemerus bivittatus (Dufour, 1831)	SR
	Mogrus rajasthanensis Caleb, Chatterjee, Tyagi, Kundu & Kumar, 2017	SD
	Mogrus sp. 1	SR
	Pellenes sp.1	SR
	Rudakius ludhianaensis (Tikader, 1974)	R
	Thyene imperialis (Rossi, 1846)	SD
Scytodidae	*Scytodes* sp.1	SR
Tetragnathidae	*Leucauge* sp.1	SR
Thomisidae	*Bomis* sp.1	SR
	Indoxysticus minutus (Tikader, 1960)	SR
	Ozyptila sp.1	SR
	Thomisus andamanensis Tikader, 1980	SR
	Tmarus kotigeharus Tikader, 1963	ED
	Tmarus sp.2	SR
	Tmarus sp.3	SD
Uloboridae	*Miagrammopes* sp.1	SR

spiders collected during winter showed greater tolerance to low temperature. During winter, the spiders which are juveniles during the previous summer season increased their tolerance more than adults.

Results show that in all the habitats studied the number of accessory and accidental species was higher than constant species. This indicates that these habitats does not favour stable population of spiders in it. Adverse environmental factors like high temperature, low humidity, etc., may have forced the spiders to migrate frequently. In a study on the influence of diversity of flora on coleoptera population, Tahvanainen and Root (1972) mentioned that the presence of high number of accessory and accidental species indicates low complexity of environment which offers only few resources, thereby hampering the establishment of those species.

Due to the obstacles like unfavourable climate and vegetation type the collection methods, sweep netting and pitfall trapping were not done in this study. The prevalent thorny vegetation in the study site prevented the use of sweep net as it gets torned by the thorns. Also the frequent wind in the study site blows sand to the pitfall traps.

While estimating spider species richness in southern Appalachian cove hardwood forest, Coddington et al. (1996) found aerial and ground collecting yielded more productive result than beating and litter sampling. Although they also reported that number of species collected were unique to each method. Conducting nocturnal and diurnal collection by utilizing a combination of sampling methods in future may yield more acceptable result. There is also a need to conduct studies comparing the effect of different collection methods and time of collection on the spider catches. The effects of plant species composition and environmental parameters during different seasons on spider community structure of each habitat also have to be explored in detail.

Conclusion

Through the study of dominance structure of the spiders of the Thar desert, it is apparent that there was only one eudominant species in both sand dunes (*Tmarus* sp. 1) and rocky desert (*Tmarus kotigeharus*). Riparian habitat consisted of two eudominant species (*Oecobius putus* and *Menemerus bivittatus*). Analysis of constancy of spiders revealed three constant species in all the three habitats. The constant species in sand dunes were *Mogrus rajasthanensis, Peucetia viridana* and *Tmarus* sp.1. The most constant species in riparian habitat was *Menemerus bivittatus* followed by *Oecobius putus* and *Menemerus brachygnathus.* In descending order of constancy, the most constant spiders of the Rocky desert can be arranged as follows: *Tmarus kotigeharus, Mogrus rajasthanensis* and *Oxyopes chittrae.* The number of accessory and accidental spider species in all habitats was far higher than constants. This is due to the unstability of spider population. So, this study highlights the necessity of conservation of these habitats as they have unstable population of spiders.

Abbreviations

ED Eudominants
D Dominants
SD Subdominants
R Recedents
SR Subrecedents

Acknowledgements
Authors extend sincere thanks and regards to the Principal of Christ College, Irinjalakuda, for providing necessary facilities and to lab mates for support and encouragement. First author is grateful to the Director, Zoological Survey of India for the permission granted to complete the research work.

Author contributions
N. A. carried out all the field work, analysed and interpreted the data. A. V. contributed the study design and reviewed the results. All authors read and approved the final manuscript.

Funding
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Availability of data and materials
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Received: 29 September 2022 Accepted: 7 May 2024
Published online: 27 May 2024

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