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Studying the Spider Fauna of Pushkar Valley (Central Aravali) in Winter Season: A Biodiversity Assessment in Ajmer, Rajasthan

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Abstract: ***The Aravali is a mountain range that runs from northeast to southwest part of Rajasthan, India. The Pushkar Valley is the central part of Aravalli Range in Ajmer district of Rajasthan, is a serene blend of natural beauty and cultural heritage. This region is known for its sacred Pushkar Lake and vibrant camel fair, the valley showcases Rajasthan's rich traditions. Despite human pressures, it remains a cherished hub of biodiversity and spirituality. Spiders belong to the order Araneae and it's the biggest group of predaceous organisms in the animal kingdom. Spiders have ecological importance like insect population control, a food source for other animals, medical use of its venom, and pest control. This study shows high species evenness and many dominant species are present in the area. It also indicates the community is likely stable and healthy, with well-functioning ecological processes. It also suggests less anthropogenic impact or a well-preserved ecosystem.***

Keywords: Aravali, Aranea, Biodiversity, Pushkar Valley, Rajasthan, Spider fauna, Winter season.

1. Introduction

The central region of Aravali in Ajmer is commonly known as Naag Pahad because the shape of this mountain is snake-like. Among districts of Rajasthan, Ajmer has the highest number of spider families i.e. 24 and almost 69 spider species (Singh & Singh, 2022). In 2010, Naag Pahad was included in the Biodiversity Heritage Site(Govt of Rajasthan, 2010). So, it's important to assist its spider diversity.

The term biodiversity describes the range of life forms on Earth, including all living things, their genetic variations, and the ecosystems they create. Biodiversity includes three levels 1. Species diversity 2. Genetic diversity 3. Ecosystem diversity (Heydari Mehdi et al., 2020). The term "Spider Diversity" describes the wide range of spider species that may be found in almost any terrestrial habitat on Earth. More than 50,000 species of spiders are known, and they vary greatly in terms of size, shape, behavior, and ecological roles. They exhibit remarkable adaptations, including building webs to capture prey, provide habitats, or aid in reproduction. They also employ special hunting methods, such as imitation, pursuit, or ambush (Herberstein & Tso, 2011; Sawane, 2022). Additionally, they undergo physiological changes to withstand harsh conditions, such as those found in deserts or at high elevations. Spiders are classified in order Araneae. The members order Araneae have Bifurcated bodies, pedicel between the cephalothorax and abdomen, four pairs of legs on the cephalothorax, each leg differentiated into seven segments, spinnerets, which produce silk, and eight eyes (Chetia & Kalita, 2012).

Most animals, including spiders, are affected by low temperatures. However, they are not entirely defenceless in extreme cold. They employ various strategies to help them survive the winter. Naturally, spiders are cold-blooded animals. During the winter season, their body produces glycol compounds that function like the antifreeze substance. These compounds protect their tissues from freezing even when exposed to low temperatures. The spider also enters the diapause phase during cold seasons. Spiders are poikilothermic animals, so it's found very less in the winter season because they undergo in hibernation where their metabolic activity is very low.

2. Material and Methods

Study area: Aravali is commonly known as Naag Pahad in Ajmer. It is also known as Aadewala Mountain in Rajasthan. It is the oldest mountain range in the world, having formed in the Precambrian era (about 450 million years ago). Aravalli divides Rajasthan into 2 parts from north to south. It extends from Palanpur in Gujarat to Rashtrapati Bhavan in Delhi. The total length of the Aravali Mountain range is 692 km and in Rajasthan its length is 550 km almost 80% of the total Aravali Mountain range. The average height of Aravali is 930 m. Aravali is biodiversity-rich. The central Aravalli Mountain range extends into the Ajmer district of Rajasthan. Central Aravalli range is distributed in the Ajmer district of Rajasthan its average height is 550 to 650m. The highest peak of central Aravali is Taragarh. The distribution of the Aravali range is the lowest in Ajmer district in Rajasthan.

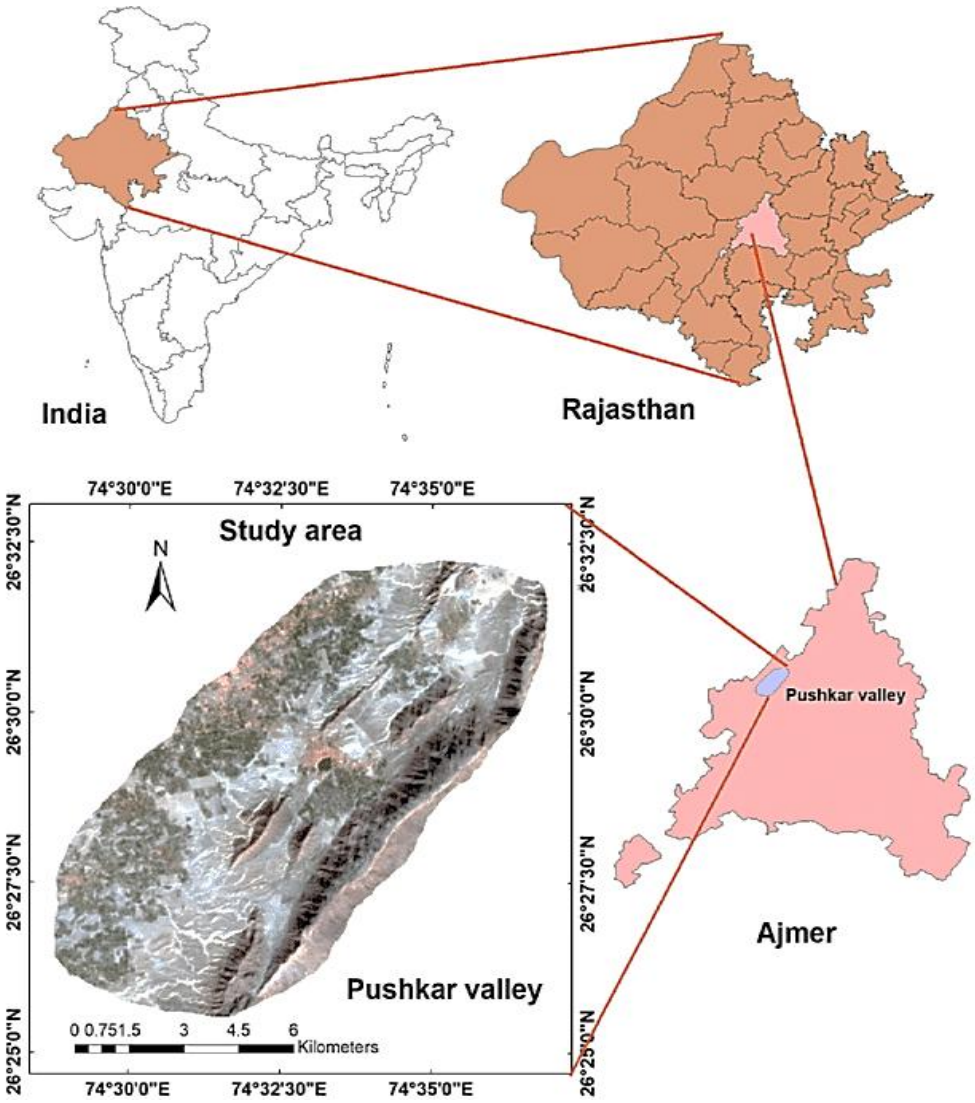

Figure 1: Pushkar Valley in Ajmer (Sharma et al., 2019)

Data collection methods: During the study, the spider samples were collected in the morning and evening times using the following methods.

Spider sampling was carried out in different locations in central Aravali in the winter season from November to December. Line transit method and quadrate methods was used to estimate the spider diversity. We put random transit in different mountains and estimated the diversity of spiders.

Also quadrates of 1m ×1m were made for spider count. We noted the total individuals and species of spiders in each quadrate and then applied various diversity indexes. For data collection, we used some methods listed below.

- **Inverted umbrella**- In this technique an inverted umbrella was placed under flowering shoots and bushes and then shaken some branches of the trees, spiders, and other insects fell to the inverted umbrella. After that spiders were transferred into collecting tubes(Quasin & Uniyal, 2010).
- **Vegetation beating**- In this method, a cloth sheet was spreaded under a bush or the low branches of a tree here after grab the branches and gave them a vigorous shaking, alternately strike them with a stick or stiff branch. Spiders were dislodged and fallen onto the sheet(Quasin & Uniyal, 2010).
- **Aerial hand collection**- Orb weavers and other aerial spiders were collected by this method by direct hands(Kostanjšek et al., 2015).
- **Ground hand collection**- Ground dwelling spiders were collected by direct hand(Sørensen et al., 2002).

We also visually searched for spiders below the rocks, stones, and bark of trees. All spiders were observed via photographs and captured them for observation under the stereoscope microscope. All specimens of spider were identified through various catalogues and keys provided by Tikder and Biswas (1981), kaston (1971).

3. Observation

During this 1month survey, we found 25 species in the Pushkar Valley. Data was collected from 2 sites in Pushkar Valley.
Sampling sites –
1) Pushkar Valley left mountain.
2) Pushkar valley right mountain.

Table 1: Data collection of Spidersd

Name of Spider species	No. of quadrates employed in the study site. Spider no. in quadrates.										Total no. of spiders in a species	frequency
	1	2	3	4	5	6	7	8	9	10		
Lycosa tarantula	1	1	0	1	0	0	2	0	0	1	6	6/64 = 0.093
Anyphaena soricina	0	0	0	0	1	2	1	0	0	0	4	4/64 = 0.062
Galeodes indicus	1	0	1	0	1	0	0	0	1	0	4	4/64= 0.062
Rabidosa punctulata	0	0	0	0	0	0	1	1	0	0	2	2/64 = 0.031
Pholcus phalangioides	0	0	1	2	0	0	0	0	0	1	4	4/64= 0.062
Steatoda paykulliana	0	0	0	0	0	0	0	1	0	0	1	1/64= 0.015
Uloborous spider	0	0	0	0	1	1	0	0	0	1	3	3/64 = 0.046
Argiope aemula	0	0	0	0	0	0	1	0	1	0	2	2/64= 0.031
Araneus mitificus	0	1	1	1	0	1	0	0	0	0	4	4/64= 0.062
Cyclosa bifida	0	0	0	1	1	0	0	0	0	1	3	3/64= 0.046
Cyrtophora citricola	1	0	0	0	0	1	0	1	0	0	3	3/64= 0.046
Artema atlanta	0	1	0	1	2	0	0	0	1	0	5	5/64 = 0.078
Scytodes pallida	0	0	0	0	0	0	1		0	0	1	1/64= 0.015
Thomisus lobosus	1	1	0	0	0	0	0	1	0	0	3	3/64= 0.046
Guizygiella indica	0	0	0	0	0	0	1	0	0	1	2	2/64= 0.031
Zosis geniculata	0	0	1	0	0	0	0	1	0	0	2	2/64= 0.031
Evippa rajasthanea	0	1	0	1	1	0	0	0	1	1	5	5/64= 0.078
Vailimia ajmerensis	1	0	0	0	0	1	0	0	0	0	2	2/64= 0.031
Olios tener	0	0	0	0	1	0	0	0	0	0	1	1/64= 0.015
Plexippus paykulli	0	0	0	0	0	0	0	`1	0	0	1	1/64= 0.015
Leucauge decorate	0	1	0	0	0	0	0	0	0	0	1	1/64= 0.015
Olios millet	0	0	0	0	0	0	1	0	0	0	1	1/64= 0.015
Guizygiella melanocrania,	0	0	0	0	0	0	0	0	1	0	1	1/64= 0.015
Neoscona nautica	0	0	0	0	0	0	0	1	0	0	1	1/64 = 0.015
Curubis sipeki	0	0	0	1	0	1	0	0	0	0	2	2/64= 0.031
											Total = 64	

Shannon diversity index

Table 2: Shannon wiener index

Name of Spider species	Total no. of individuals	Pi	ln pi	Pi*lnPi
Lycosa tarantula	6	0.09375	-2.36712361	-0.22192
Anyphaena soricina	4	0.0625	-2.77258872	-0.17329
Galeodes indicus	4	0.0625	-2.77258872	-0.17329
Rabidosa punctulata	2	0.03125	-3.4657359	-0.1083
Pholcus phalangioides	4	0.0625	-2.77258872	-0.17329
Steatoda paykulliana	1	0.015625	-4.15888308	-0.06498
Uloborous spider	3	0.046875	-3.06027079	-0.14345
Argiope aemula	2	0.03125	-3.4657359	-0.1083
Araneus mitificus	4	0.0625	-2.77258872	-0.17329
Cyclosa bifida	3	0.046875	-3.06027079	-0.14345
Cyrtophora citricola	3	0.046875	-3.06027079	-0.14345
Artema atlanta	5	0.078125	-2.54944517	-0.19918
Scytodes pallida	1	0.015625	-4.15888308	-0.06498
Thomisus lobosus	3	0.046875	-3.06027079	-0.14345
Guizygiella indica	2	0.03125	-3.4657359	-0.1083
Zosis geniculata	2	0.03125	-3.4657359	-0.1083
Evippa rajasthanea	5	0.078125	-2.54944517	-0.19918
Vailimia ajmerensis	2	0.03125	-3.4657359	-0.1083
Olios tener	1	0.015625	-4.15888308	-0.06498
Plexippus paykulli	1	0.015625	-4.15888308	-0.06498
Leucauge decorate	1	0.015625	-4.15888308	-0.06498
Olios millet	1	0.015625	-4.15888308	-0.06498
Guizygiella melanocrania,	1	0.015625	-4.15888308	-0.06498
Neoscona nautica	1	0.015625	-4.15888308	-0.06498
Curubis sipeki	2	0.03125	-3.4657359	-0.1083
	64			-3.0569
			H`=	3.056902

Shannon diversity index of this area is 3.056902

Simpson index of diversity:

Table 2: Simpson index of diversity

Name of Spider species	Total no. of individuals	n(n-1)	N(N-1)	∑n(n-1)/N(N-1)
Lycosa tarantula	6	30	4032	0.038194444
Anyphaena soricina	4	12		
Galeodes indicus	4	12		
Rabidosa punctulata	2	2		
Pholcus phalangioides	4	12		
Steatoda paykulliana	1	0		
Uloborous spider	3	6		
Argiope aemula	2	2		
Araneus mitificus	4	12		
Cyclosa bifida	3	6		
Cyrtophora citricola	3	6		
Artema atlanta	5	20		
Scytodes pallida	1	0		
Thomisus lobosus	3	6		
Guizygiella indica	2	2		
Zosis geniculata	2	2		
Evippa rajasthanea	5	20		
Vailimia ajmerensis	2	2		
Olios tener	1	0		
Plexippus paykulli	1	0		
Leucauge decorate	1	0		
Olios millet	1	0		
Guizygiella melanocrania,	1	0		
Neoscona nautica	1	0		
Curubis sipeki	2	2		
	64	154		

Simpson diversity index of this area
1-D= 1- 0.038194444 = 0.96180556

Species evenness (E) = H`/lnS
S = total no. of species
H`= Shannon wiener index
E = 3.05/26 = 0.949680148

4. Result and Discussion

From the above study area the Shannon wiener diversity index, Simpson diversity index, and species evenness are as follows-
Shannon Wiener diversity index(H`) = 3.056902
Simpson diversity index is (1 - D) = 0.96180556
Species evenness(E) = 0.949680148

Table 3: Results

S. No.	Diversity index	Calculated value	result
1	Shannon Wiener diversity index(H`)	3.056902	High diversity
2	Simpson's diversity index is (1 - D)	0.96180556	High diversity
3	Species evenness(E)	0.949680148	High evenness

The high value of the Shannon wiener diversity index like 3.056902 indicates that the community has more species that are evenly distributed which means high species evenness.

H` = 3.056902 reflects a relatively diverse and balanced community. It also indicates the community is likely stable and healthy, with well-functioning ecological processes. It also suggests less anthropogenic impact or a well-preserved ecosystem.

1 - D=0.96180556 indicates a diverse community and many species are present in the area.

Species evenness value varies from 0 to 1 where 1 indicates complete evenness so in this study area there is no complete species evenness but there is high species evenness.

5. Conclusion

Spiders are cold-blooded animals and theoretically diversity of cold-blooded animals is found low in winter. However, the findings of this study indicate that spider diversity in Pushkar Valley is significantly higher during the winter season. This could be because of ecological factors such as reduced predation pressure, and the availability of suitable microhabitats that offer stable thermal conditions. Anthropogenic activity is also very low in this area which is also a reason for higher spider diversity in this area.

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