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Correlation of Population Dynamics of Spiders with Abiotic Factors in Rajasthan

Vinod Kumari[1], *Kailash Saini*[1] *and N. P. Singh*[1]

Abstract: *A regular survey for the population density of spider faunal complex has been made in four major habitats namely, woodland, wetland, grassland and caves or crevices or rocky area of Jodhpur region in Rajasthan at fortnightly interval throughout the year 2014-15. Seasonal dynamics of spider population in different habitats during the study revealed that the spider population steadily increased from July and attained its peak in August/September. Maximum number of spiders were observed in woodland type of habitat while in caves or crevices or rocky habitat the lowest number of spider species were observed.*

The results when correlated with all the weather parameters viz., maximum temperature, minimum temperature, relative humidity (R. H) (morning), R. H (evening), wind velocity and rainfall through correlation matrix revealed that in woodland habitat temperature showed negative and significant effect on spider population as compared to that in marshy habitat. However, in pasture and caves or crevices or rocky habitat temperature showed negative but non significant effect on spider population.Relative humidity showed positve and significant effect on spider population in all the four habitats. Similarly, wind velocity had positive but non significant effect on spider population in all the four habitats. However, rainfall showed negative and significant effect on the spider population in pasture but negative and non significant in woodland and caves or crevices or rocky habitat.

Keywords: *spiders, population density, woodland, marshy, pasture, caves or crevices or rocky habitat, Rajasthan.*

INTRODUCTION

A central theme in community ecology is the understanding of what drives the variation in species diversity and composition [1,2]. Thus, the aim of present paper is not in knowing the exact number and identity of every species at a given site but rather how the diversity and composition vary among sites with different abiotic factors. Interannual variation in the density of spiders like those of other animals is influenced by a variety of biotic and abiotic factors including the architectural attributes of the habitat [3,4]. Spiders depend on the structure of the environment because: (1) they need attachment sites for their webs, (2) their sensory organs are based on the recognition of tactile vibrations of the substrate [5,6]. Therefore, web temperature is one abiotic factor that is known to affect prey availability [7], the web owner's metabolic rate and activity level [8,9] as well as web site selection in certain species [10,11]. In an environment where temperature is highly variable over time and space, adult females benefit if they can moderate their body temperature through web site selection. Likewise temperature, various other factors *viz.*, relative humidity (R. H), wind velocity and rainfall are also reported to affect the spider population [12,13,14]. Therefore, the present study was carreid out to study the correlation of population dynamics of spiders with abiotic factors in Jodhpur region of Rajasthan, India.

As most of the spiders are polyphagous predators, able to feed on various insect pests of agricultural crops [15,16,17,18,19], the present study will be useful for selecting most appropriate spider

[1] Department of Zoology, University of Rajasthan, Jaipur- 302004

species to use as a pest control agent in a particular seasonal crop, which can easily survive in a particular season. Moreover, spiders are good indicators of environmental health and play important roles in the dynamics of a specific habitat and are sensitive to habitat loss, climatic change and environmental upheavals [20]. So, the population dynamic study of spiders further will help to develop a data of spiders as bioindicators in Rajasthan.

MATERIALS AND METHODS

Present study was conducted in Jodhpur region of Rajasthan to determine the population dynamics and effect of abiotic factors from Feb. 2014 to Jan. 2015. In order to study the population density in four habitats namely woodland, marshy, pasture and caves/rocky/crevices, five plots of 11 m × 11 m (Quadrat sampling method) were selected randomly and the number of spiders present in the different habitats were recorded. The counts were made at fortnightly intervals throughout the year. Various climatic parameters *viz.* maximum temperature, minimum temperature, relative humidity (morning), relative humidity (evening), wind velocity and rainfall were recorded during the period of collection.

The data were subjected to statistical analysis and correlation between spider population and abiotic factors in each four habitat were derived. Correlation coefficients (r) was computed with a view to study combined quantitative impact of different abiotic factors *viz.* maximum temperature (X_1), minimum temperature (X_2), relative humidity for morning (X_3) and for evening (X_4), wind velocity (X_5) and total rainfall (X_6) on the spider population (Y).

RESULTS AND DISCUSSION

Seasonal dynamics of spider population in different habitats during the study revealed that the spider population steadily increased from July and attained its peak in the post monsoon season *i.e.*, August/ September (Figure 1). After the post monsoon season the density of spiders gradually decreased till December due to adverse climate conditions *e.g.* low temperature and R. H and also the sparse vegetation. Maximum number of spiders were observed in woodland type of habitat because of favourable conditions, food and site for web building, while in caves or crevices or rocky habitat the lowest number of spider species were observed due to the lack of favourable conditions. The results are partially in agreement with Brown *et al* [21], who found more spiders in August (37%) than earlier months, but the variation of spiders was in July. Similarly, Arango and Rico-Gray [22] found highest spider density in August (total 118, adults77) and lowest in may (total 7, adults 2). Foraging andfeeding were more intense between July and September, when their preys, flowe visitors were more abundant. However, when Flantz [23] observed seasonal dynamics, abundance and diversity of ground spiders in Montane meadows near Fenmsbuck, found a strong peak in May/July with two levels of abundance *viz.*, high in July/Aug and low in April to June.

The correlation coefficient (r) of the total spider population (Y) occurring in four habitats *viz.* woodland, marshy, pasture and caves/rocky area was computed with various abiotic factors *viz.* maximum temperature (X_1), minimum temperature (X_2), relative humidity for morning (X_3) and for evening (X_4), wind velocity (X_5) and total rainfall (X_6) and shown in Table 1. In woodland habitat, spider population showed negative but significant correlation with maximum temperature whereas, spider population showed positive and significant correlation with R.H factor (both morning and evening). Rest all factors *viz.*, Minimum temperature, wind velocity and rainfall showed no significant correlation with spider population. These results showed that in woodland habitat, minimum temperature, rainfall and wind velocity had least influence on the spider population, whereas RH affected the spider population markedly.

Dense vegetation found in this habitat provided more attachment for web building spider, relating them more abundant than other habitats. Present results are supported by Rypstra [24] and Halaj *et al* [25]. They found that web building spiders are directly linked to the configuration of the vegetations because of specific web attachment requirement. In pasture habitat, RH (Morning) and

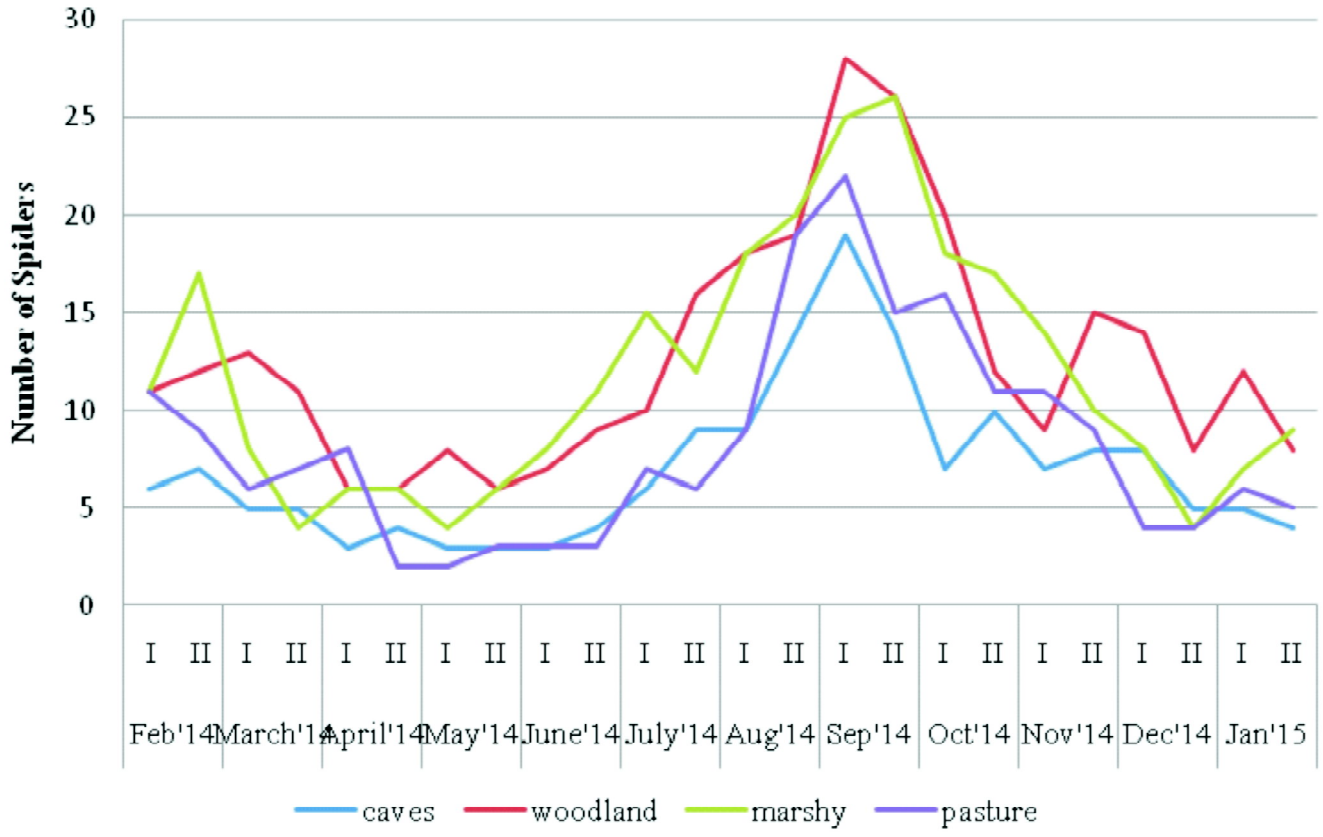

Figure 1: Spider population during 2014-15 with respect to fortnight interval of every month

Table 1
Correlation of spider population of four habitats with Abiotic Factors.

		Correlation coefficient (r)			
S. No.	Abiotic Factors	Woodland	Marshy	Pasture	Caves
1.	Max. Temp.(ÚC)	–0.55811**	0.53329**	–0.0778^{NS}	–0.02266 ^{NS}
2.	Min. Temp.(ÚC)	0.15688^{NS}	0.2884^{NS}	0.09801^{NS}	0.15482^{NS}
3.	R.H (morning) (%)	0.56279***	0.49008**	0.36117*	0.51457**
4.	R.H (evening) (%)	0.50606**	0.53012**	0.28502^{NS}	0.50396**
5.	Wind Velocity (km/h)	0.16611^{NS}	0.18411^{NS}	0.0705^{NS}	0.03798^{NS}
6.	Rainfall (mm)	-0.16445^{NS}	0.04010^{NS}	-0.43588**	–0.14887^{NS}

* Significant at P < 0.01
** Significant at P < 0.05 and P < 0.10
*** Significant at P < 0.01, P< 0.05 and P < 0.10
NS Non Significant

rainfall had significant correlation with spider population. But unlike RH (Morning) rainfall had negative correlation. However, RH (evening), maximum temperature, minimum temperature and wind velocity showed no significant correlation with spider population. In contrast to other three habitats, maximum temperature and rainfall showed negative but no significant correlation with spider population in caves/rocky habitat. Thus, temperature had least influence on spider population in this habitat whereas RH had significant and positive correlation with spider population. The results are in consonance with Khuhro *et al.*, [13].

In contrast to other three habitats, various environmental factors affected the spider population to a great extent in marshy habitat. All the factors had positive correlation with the spider population. As marshy habitats are temperate habitat, it totally depends on rainfall. Therefore, maximum temperature, RH (morning) and RH (evening) showed significant correlation as compared to minimum temperature, rainfall and wind velocity, which had no significant correlation with the spider population. The results are also in accordance with the findings of Elliot [26] who observed the seasonal succession of spider species while studying the ecology of the spiders of beech maple forest and associated spider species with particular strata, seasons and habitat.

The results showed that wind velocity had positive effect on the population of spider in all the four habitats whereas rain had negative effect on the population of spider in all the habitats except marshy habitat which was statistically non significant. Similarly, Costa [12] and Costa and Conti [14] reported that rain and wind affected the population of Lycosid spider-*Allocosa* and Namibian spider *Ariadna* sp. in their respective study. It is well known that many terrestrial arthropods are able to withstand prolonged submersion in water [27]. Likewise, *Ariadna bicolor* was shown to survive long periods of experimental submersion, especially when maintained in their silk-lined burrows by Rovner [28]. Researchers have also pointed out [29] that rain events act as ''resource pulses''.

The results of the present study showed that how the population density of spider vary with different abiotic factors which in future can be used as a base for selecting spider as biocontrol agent in a paticular sesonal crop.

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