



## **Spider Diversity in Rice and Mix Vegetable Agro-ecosystem in Bhabar Region of Nainital District, Uttarakhand**

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### **ABSTRACT**

*Spiders play vital role in agro ecosystem as pest control agent. The present study was conducted in two different agro-ecosystems viz. rice and mix vegetable of Kaladhungi district Nainital, located in bhabar area of Kumaun region of Uttarakhand. The sample is obtained using hand picking method and sweep net method. The data analysis includes the Simpson Indices, Shannon-Weiner's diversity and Species Richness of species between two agro ecosystems. All diversity indices like Simpson Indices, Shannon-Weiner's diversity and Species Richness of spiders are found higher in mix vegetable field (0.96, 3.27, 4.98) and less in rice field (0.94, 2.96, 3.71) respectively. Most dominant species was Pardosa pseudoannulata comprises highest numbers of individuals (45) and most dominant family was Araneidae comprises 8 species. The major guild structure observed from study site were Orb weavers, branch dweller ground dwellers, space web dwellers, sheet web builders and foliage dwellers. The most dominant guild was an orb weaver comprises 45% of total species. The highest number of individuals was observed from mix vegetable crop field (414) and lowest from rice field (219). The results of the study revealed that the mix vegetable crop field is more favourable for spiders as compare to rice field.*

**Key words:** Spider, Mix vegetable, Rice, Bhabar, Guild structure

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### **INTRODUCTION**

Spiders or Araneae are members of the spider family Arachnida. They are the most common group of builders of spiral wheel-shaped webs often found in gardens, fields and forests. Araneids have eight similar eyes, hairy or spiny legs and no stridulating organs [12]. Spiders are ubiquitous in distribution, except for a few niches, such as Arctic and Antarctica. Almost every plant has its spider fauna, as do dead leaves, on the forest floor and on the tress during the winter [13]. There are about 45,700 recorded spider species and 114 families and they could achieve this level of diversity due to their higher adaptive value apart from morphological and behavioural uniqueness [1].

Spider is classified as generalist predator and has a great influence toward the structure of the community, especially the food chain and food web. Spiders play important role as the predator, especially the predator of insects and therefore they contribute to control the insect population [2,6]. Spiders are little studied in environments like agro-ecosystems and nearby lands. In Uttarakhand, there is no study on the spider fauna in rice and vegetable plantations even though forest ecosystem have been studied in small extensions of Garhwal region, Uttarakhand [9]. The present study was conducted in two different agro-ecosystems of Bhabar region of Kumaun, Uttarakhand.

### **MATERIAL AND METHODS**

#### **Study area**

The Kumaun region consists of a large Himalayan tract together with two submontane stripes called Terai and Bhabar. The present study was conducted in two different agro-ecosystems of Kaladhungi, district Nainital (longitude 79.3480°E, latitude 29.2854°N), which is located in Bhabar area of Kumaun region. Two different agro-ecosystems viz. rice and vegetable were chosen for study of spider diversity.

## Sampling

The sampling was carried out from July 2018 to December 2018 with an average sampling interval of 15 days, covering different stages of the crop development. Two environments were sampled rice and mixed vegetables (cabbage, ladies finger, pumpkin, bitter gourd, ridge gourd). Two methods were used for spider collection viz. sweeping nets and hand picking method. The sampling was random in both crops. Sampling was made between 8:00 A.M. and 11:00 A.M. to minimise spider migration to the lower vegetation stratum due to high temperature at noon [3]. Temperature, pH and moisture of soil were measured and photographs were taken from canon digital camera. The specimens were preserved in 70% alcohol. The identification was made as per "Spiders of India" [11].

## Data Analysis

The Shannon-wiener, Simpson Indices, Species Richness (Margalef) and Equitability (J) were used to calculate the spider's diversity in two sampling sites.

Shannon-Wiener equation:  $H' = -\sum P_i (\ln P_i)$  where,  $P_i$  is the proportion of each species in the sample (Shannon and Wiener, 1949).

Simpson's equation:  $D = \sum n(n-1)/N(N-1)$ . Where,  $D$  = Simpson's index of dominance;  $N$  = the total number of individuals of all species;  $n$  = number of individuals of specific species per sample.

Species richness was calculated by Margalef's formula  $SR = (S-1)/\log N$ , where  $S$  = total number of species and  $N$  = total number of individuals present in the sample.

Equitability was calculated by formula:  $Equitability = H/H_{max}$ , where  $H$  = sum of  $P_i (\ln P_i)$ ,  $H_{max} = \ln$  (total number of species)

## RESULTS

During the study period a total of 33 spider species belonging to 26 genera, grouped under 12 families were recorded in two different agro-ecosystems of Kaladhungi district Nainital (Table 1). It was observed that Araneidae was most dominant family comprised maximum number of species (8 species) followed by Salticidae (7 species), Tetragnathidae (5 species), Lycosidae, Oxyopidae (3 species) and Pholcidae, Linyphiidae, Nephilidae, Sparassidae, Theraphosidae, Therididae, Uloboridae comprise least number of species (1 Species). In terms of individuals, family Araneidae (29%) was dominant followed by Tetragnathidae (21%), Lycosidae (15%), Oxyoidae (10%), Salticidae (8%), Therididae (6%), Linyphiidae (4%), Sparassidae (3%), Uloboridae (1%), Pholcidae (1%), Nephilidae (1%) and Theraphosidae (0.3%) (Figure 2).

Abundance of spider was observed varied across two agro-ecosystems. The species richness and diversity of spiders was more in mixed vegetable and less in rice crop (Table 2). Maximum numbers of individuals were recorded in mixed vegetable (414) and less in rice crop (219) (Figure 1). In the present study the observation showed that the major guild structure was Orb weavers, branch dweller, ground dwellers, space web dwellers, sheet web builders and foliage dwellers. The highly dominant guild structure was orb weavers (45%) followed by branch dwellers (30%) and ground dwellers (12%). The rest are space web dwellers (6%), sheet web builders (3%) and foliage dwellers (3%) (Figure 3).

Table 1: Checklist of Spiders and their abundance in rice and mixed vegetable crop field (July 2018 to December 2018)

Family	Genera	Species	Rice	Mix Vegetable
Araneidae	<i>Araneus</i>	<i>Araneusmitificus</i>	-	+
	<i>Argiope</i>	<i>Argiopepulchella</i>	+	+
	<i>Cyclosa</i>	<i>Cyclosa bifida</i>	+	+
		<i>Cyclosagossypiata</i>	+	+
	<i>Cyrtophora</i>	<i>Cyrtophoracitricola</i>	-	+
	<i>Eriovixia</i>	<i>Eriovixialaglaizei</i>	-	+
	<i>Neoscona</i>	<i>Neosconanautical</i>	+	+
		<i>Neosconatheisi</i>	+	+
Pholcidae	<i>Crossopriza</i>	<i>Crossoprizalyoni</i>	-	+
Linyphiidae	<i>Nerienne</i>	<i>Nerienibirminica</i>	+	+
Lycosidae	<i>Lycosa</i>	<i>Lycosatista</i>	+	+
	<i>Pardosa</i>	<i>Pardosapseudoannulata</i>	+	+
		<i>Pardosasumatrana</i>	+	+
Nephilidae	<i>Nephila</i>	<i>Nephilapilipes</i>	-	+
Oxyopidae	<i>Oxyopes</i>	<i>Oxyopespankaji</i>	+	+
		<i>Oxyopes sp1</i>	+	+
		<i>Oxyopes sp2</i>	+	+

Salticidae	<i>Bianor</i>	<i>Bianorangulosus</i>	+	-
	<i>Evarcha</i>	<i>Evarcha sp1</i>	+	+
	<i>Hyllus</i>	<i>Hyllussemicupreus</i>	-	+
	<i>Menemerus</i>	<i>Menemerus sp.</i>	-	+
	<i>Plexippus</i>	<i>Plexippuspaykulli</i>	-	+
	<i>Stenaelurillus</i>	<i>Stenaelurillus sp.</i>	-	+
	<i>Telamonia</i>	<i>Telamoniadimidiate</i>	-	+
Sparassidae	<i>Heteropoda</i>	<i>Heteropodavenotoria</i>	+	+
Tetragnathidae	<i>Leucauge</i>	<i>Leucaugedecorate</i>	+	+
	<i>Tetragnatha</i>	<i>Tetragnathamandibulata</i>	+	+
		<i>Tetragnathajavana</i>	+	+
	<i>Tylorida</i>	<i>Tyloridastrata</i>	+	-
<i>Tyloridaventralis</i>		+	+	
Theraphosidae	<i>Lyrognathus</i>	<i>Lyrognathussaltator</i>	-	+
Therididae	<i>Argyrodes</i>	<i>Argyrodesargentatus</i>	+	+
Uloboridae	<i>Zosis</i>	<i>Zosisgeniculate</i>	-	+

Table 2: Diversity Indices of Spider species in rice and mix vegetable field of the study area (July 2018 to December 2018)

Diversity Index	Rice Field	Mix Vegetable Field
<b>Simpson Indies</b>	0.94	0.96
<b>Shannon-Weiner's Diversity (H)</b>	2.96	3.27
<b>Margalef</b>	3.71	4.98
<b>Species numbers</b>	21	31
<b>Total Individuals</b>	219	414

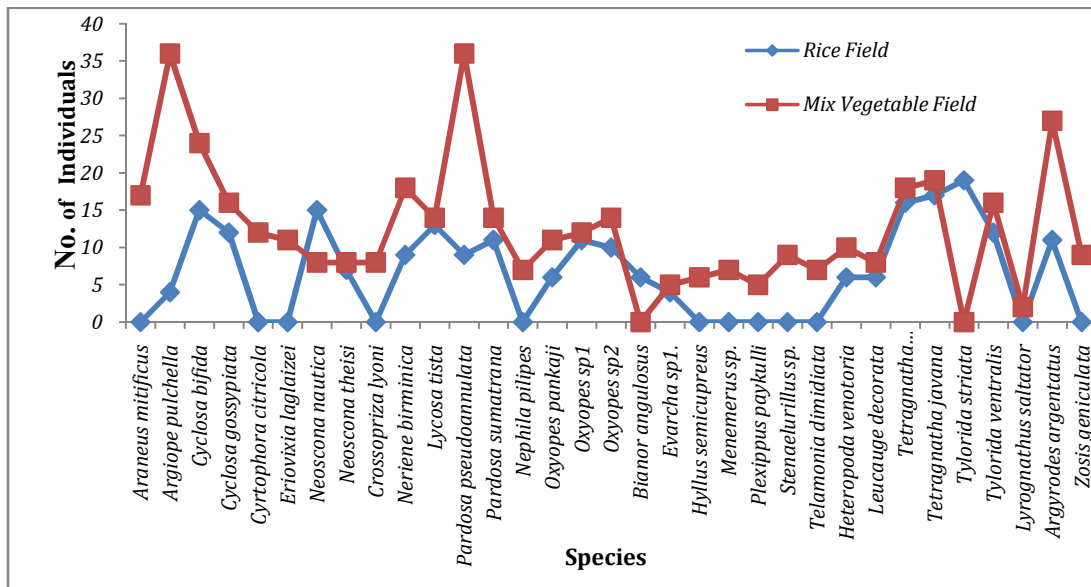


Fig. 1 Species diversity of spiders in rice and mix vegetable field (July 2018 to December 2018)

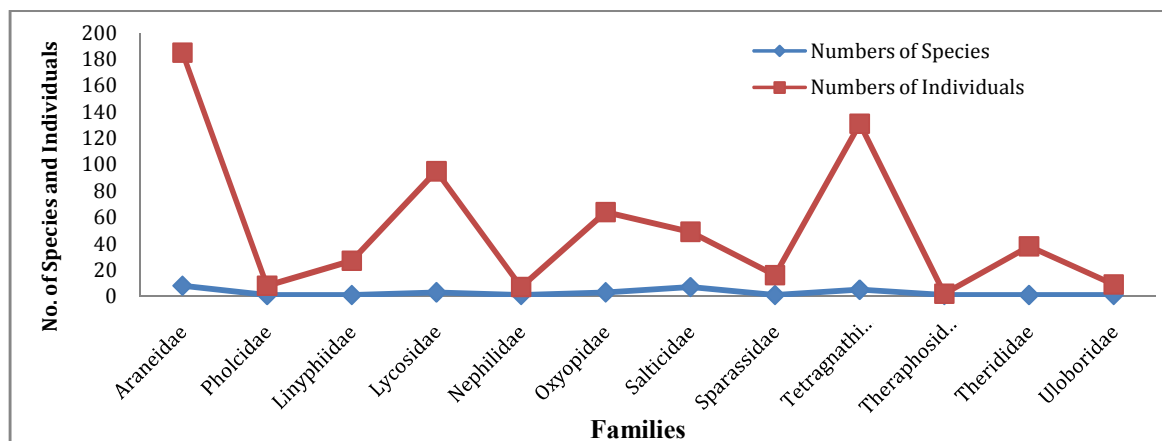


Fig. 2 Family wise diversity of spider in rice and vegetable field (July 2018 to December 2018)

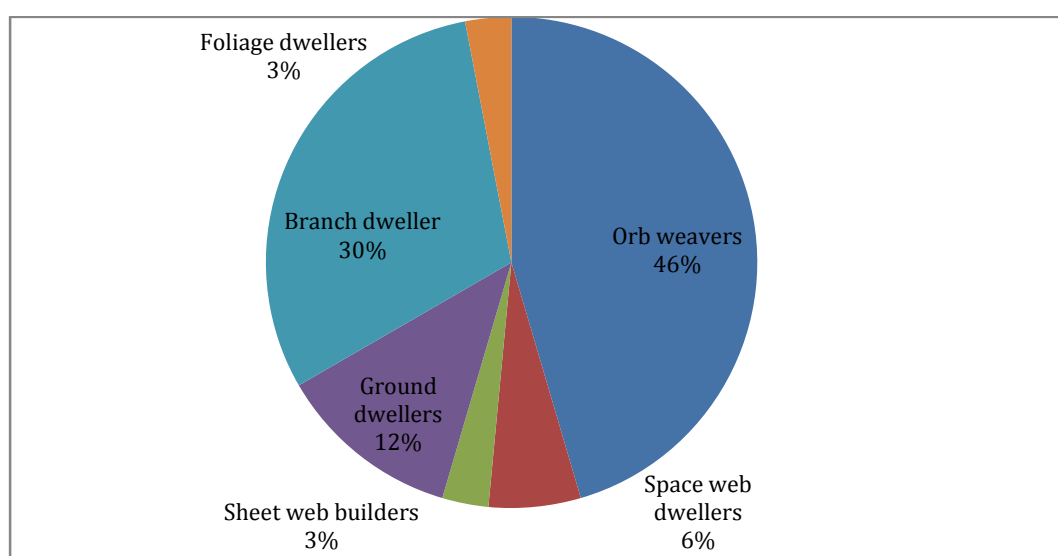


Fig. 3 Guild structure of spiders in rice and mix vegetable field (July 2018 to December 2018)

## DISCUSSION

The Bhabar area of Kumaun Region of Uttarakhand is commonly endowed different agricultural and horticultural crops. The major crops in Kaladhungi are rice, wheat, sugarcane, mustard, millets and mix vegetables etc. Research on spider diversity in agro ecosystems is highly valuable; both to observe the effect of such predators have on herbivorous pest [7] and to understand how profound changes on the environment affect spider colonisation [8]. Thus, it is relevant to evaluate the spider fauna in the agro ecosystem surroundings as done in a few cases for the agriculture. Another potentially important factor is agro ecosystem change along plant development, since environmental heterogeneity may be increased by plant growth. Rypstra *et al.* [10] stated that spider assemblage density and diversity are intimately related to environmental structural complexity which may be increasing as plants become larger and more complex. Observations of present study indicate that the diversity of spiders was higher in mixed vegetable crop and lowest in rice field. This is probably due to vegetation type and disturbing factors as rice field experiences flood annually which may changes areas of earlier successional stages by removing organisms, organic matter and existing substrate and by depositing sediments [5].

Vegetation organization is one of the most important factors for spiders. In the study area, mixed vegetable field have dense vegetation and weeds. The growth of weeds promotes the migration of spiders from nearby habitat [14]. Dense and compact vegetation provide shadow and moisture, suitable environment for small spiders, especially of the families Theridiidae and Linyphiidae. These spiders find places for hiding in many small places of such habitats as they are exposed to water loss more than that of larger ones [4]. According to Root [10], guilds are groups of ecological organisms which utilizes similar or a single resource in a similar style. The present study showed orb weavers were dominant guild structure.

**CONCLUSION**

The present study indicates that Bhabaragro-systems of Kumaun, Uttarakhand are an ideal habitat for spiders. The study concludes that the species richness of spider higher in mix vegetable crops and less in rice crop. Thus, this work aims to evaluate spider diversity between the rice agro-ecosystems and mixed vegetable system.

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