

Study On The Pattern And Architecture Of Spider's Web With Special Reference To Seasonal Abundance In Eastern Region Of Rajasthan, India

Krishna Kant Lawania¹ and Priyanka Mathur²

¹Research scholar, IIS University, Jaipur- 302020, Rajasthan

²Head department of Zoology, IIS University, Jaipur- 302020, Rajasthan
kklawania23@gmail.com

Abstract: Spiders attract special attention to the zoologist on account of their unique weaving capability of constructing webs with geometrical precision. Web weaving habit of spiders are unique because few of others insects like (silk worm) produce silk, yet the survival value of silk spinning or web weaving has never been discovered by any observers. According to their web building 'ability, generally the spiders are considered as weavers or non-weavers Present paper describes the web architecture and patterns of spiders with respect to their diversity and distribution in the habitat of Eastern Rajasthan. There are more than 30,000 documented species of spider in the world. These species can be broken in to two categories: web builders and ground dwellers. The type of web spider spins depends entirely on the spider's way of life. The pattern and architecture of webs varies family to family. During the study 6 types of web patterns Viz. Irregular web, Sheet webs, Funnel web, Orb web, Single-line web, Dome shaped horizontal webs were identified and analyzed between July 2012 to June 2015. These webs are thought to produce patterns that resemble patterns reflected by many flowers in U.V. light. Thus insect who are searching for their favorite type of flower see the decorated web in U.V. light and fly in to the trap. Spider web can take a variety of forms, but the most common type is the Orb web. The gradations of the web patterns can be written in the following order: Orb web > Sheet web > Irregular web > Funnel web > Single line snare web > Horizontal dome shape web. The orb web and Sheet web were very commonly observed during this study. The study focused on the spider's web behavior and their survival strategy, which will help in their conservation.

Key Words: Spiders (Araneae), web architecture and web patterns, conservation.

I. Introduction

Animals in various taxa build some kinds of nest. Nests are built to protect the owner from predators, moderate harsh environmental conditions, trap food for consumption or attract females to mate. Spiders also make a nest its called web. Spiders are the most diverse and abundant invertebrate predators in terrestrial ecosystems (Wise 1993; Sebastian 2009). They regulate the terrestrial arthropod population (Anonymous2000). The global list of spider fauna is approximately 39,882 species belonging to 3676 genera and 108 families (Platnick 2011). Tikader (1987) published the first comprehensive list of Indian spiders which included 1067 species belonging to 249 genera in 43 families.

The parental care is the most interesting event among spiders. The eggs never lay singly, but are laid in one or more clusters and each cluster is protected by a covering of silk and the egg sac or cocoon. All spiders are carnivorous, spider mainly feed on large population of Insects and also feed on other spider. The spiders daily construct a new web with the help of energy help accumulated from the food they get. The spiders specially orb weaving spiders make their webs at night time and usually take them down in the morning Blackledge et. al.(2001; 2004). They eat the silk, leaving only the base line to rebuild on. Constructing the web uses a lot of the spider's energy does to the large amount of protein required, in the form of silk and after a time the silk will lose its stickiness and becomes inefficient at capturing prey. Eating their web is a way for the spider to recoup some of the energy used in spinning, the silk protein are thus recycled.

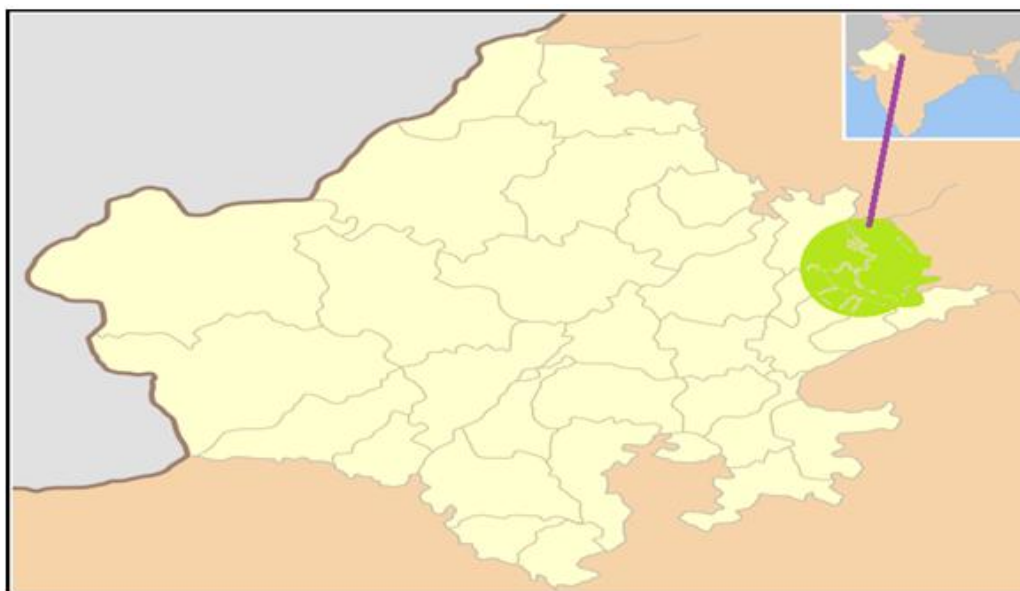
The survey was conducted at Eastern Region of Rajasthan. Present survey is an attempt to revise and standardize spider fauna and their web weaving behavior and web patterns and architecture.

II. Material And Methods

STUDY AREA- The present study was conducted in habitats of Eastern Rajasthan between July 2012 to May 2015. The region within the Golden Triangle of Delhi-Jaipur-Agra, covering an area of 5066 sq. kms. Its line covers mainly Bharatpur district and some area of Alwer, Dusa, Karoli and Dholpur district of Rajasthan. The forest and vegetation of Eastern Rajasthan has been broadly classified and categorized in to three types depending upon three major zones: Semi-arid type, Subtropical humid type, and Tropical savana (Summer-dry

type forest). These forests provide sufficient vegetation diversity and rich environment conditions for the spider fauna.

The study area has semi-arid and sub-tropical humid, climatic region. This area is a large biodiversity hotspot and it provides woodland, marshy area, pasture, caves/rock habitat conditions for spiders. The average rainfall varies from 70-150 cm. and the temperature varies from 1°C (min.) to 48°C (max.) in this study area. An ample amount of genetic diversity is found in this area.



Map-1. Location Map of Eastern region of Rajasthan

III. Methodology

Firstly the site identification is done, in this the site where the spiders and their webs are present are selected to do further study on their different web patterns.

1. Site identification - spider build webs in shrubs, trees, along rock walls, storage rooms and corners. Many spiders live in retreat area off the web. Burrowing spiders may be found under rocks, logs in debris or old litter under plants and under sheets of wood or cardboard.

2. Spider webs identification: - The different web patterns are then identified by taking their photographs and comparing them with photographs and reports on the spider's web pattern, which were done earlier.

3. Study of Spider activities and designing web patterns: - Different activities of spiders are studied which includes foraging, egg laying and ecology of the spiders, simultaneously different web patterns are also studied by taking their pictures and comparing and analyzing them with the of previous work has been done on the same and different web patterns of spiders are prepared.

4. Photography. To know each web pattern, photograph were taken by using super –macro lens of Canon camera.

IV. Results And Discussion

Architecture of Spider Webs - Spiders attract special attention to the zoologist on account of their unique weaving capability of constructing webs with geometrical precision. Web weaving habit of spiders are unique because few of others insects like (silk worm) produce silk, yet the survival value of silk spinning or web weaving has never been discovered by any observers.

According to their web building 'ability, generally the spiders are considered as weavers or non-weavers. The weavers make the snares to trap insects for food viz. Pholcidae family, while the non weavers hunt the prey by chasing viz. families' Lycosidae, Gnaphosidae, Salticidae, and Oxyopidae. The spiders wait at the center or at the corner of web for capture the prey. During the study 6 different web architectures were found in the study area. These are following types:-

(1) Irregular web/ Space web:-

The irregular webs, here threads are extending in all direction, are built by the spiders like *Pholcus*, these type of web are mostly found on ceiling the roof and corner of wall, these type of web were mostly found in this area.

Families like Pholcidae (*Artema Atlanta*, *Crossopryza lyoni*, *Pholcus phalangiodes*) and Therididae (*Tylorida ventralis*) show the irregular type of web pattern formation.

(2) Sheet web/ Tangle web: - A sheet web (sometimes called a triangular web) is flat with main lines running down the center. When any insect lands on sheet web, the spider shakes it, causing the insect to struggle and get caught in the strands.

Principal part of the web of a more or less closely woven sheet extended in a single plane and consisting of threads extending in all direction in that plane. These webs are found on two adjacent walls. Linyphiidae family shows the sheet type of web formation.

Families like Filistatidae (*Pritha sp.*) and Lyniphidae show the irregular type of web pattern formation.

(3) Funnel web: - A funnel web is built in the grassland areas. The spider hides at the small end and rushes out and grabs the insects as they come down the funnel. Funnel web spider, any of a group of spiders that make funnel-shaped webs, which the use to trap insects. They are among the most abundant and conspicuous spiders in temperate grassland area. They are also known as grass spiders. Worldwide there are about 700 known species of funnel web spiders. The principal part of a funnel web is sheet like in structure, but webs of this type different from sheet web in having a tube extending from one edge these found near water cooler. Families like Agelenidae and Lyniphidae show funnel type of web pattern formation.

(4) Orb webs: - An orb web is shaped like a circle. The characteristics feature of an orb-web is that the center portion, the part laying within the supporting frame work, consist of a series of radiating lines the web of Aranidae an excellent illustration of this kind of web.

The typical orb-weaver spiders (family Araneidae) are the most common group of builders of spiral wheel-shaped webs often found in gardens, fields and forests. Their common name is taken from the round shape of this typical web, and the taxon was formerly also referred to as the Orbiculariae.

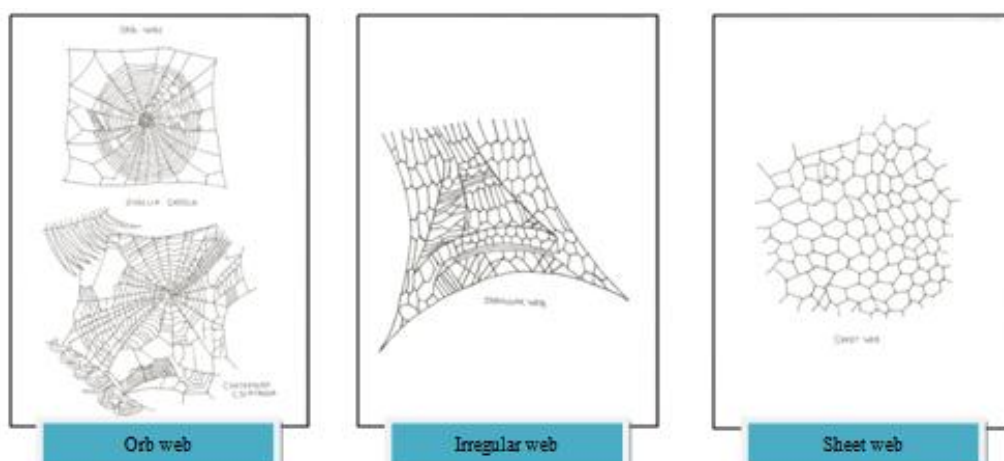
Orb-weavers have eight similar eyes, hairy or spiny legs, and no stridulating organs. The Araneidae family is cosmopolitan, including many well-known large or brightly colored garden spiders. The 3,006 species in 168 genera worldwide make Araneidae the third-largest family of spiders known (behind Salticidae and Linyphiidae). The orb-weavers include over 10,000 species and make up about 25% of spider diversity. Four different families were recorded in this type of web-

- (a) Family- Aranidae- Wheel-shaped orb webs
- (b) Family- Nephilidae- Large golden orb-web
- (c) Family- Tetragnathidae- long-jawed orb weavers
- (d) Family- Uloboridae- Cribellate or hackled orb-web

(5) The single - line snare:- There is a single horizontal line, attached at both ends to branches that stretch about four feet across open spaces in the forest. Some species of families like Theridiidae, Uloboridae shows single-line snare type of web pattern formation.

(6) Horizontal dome shaped web:- *Cyrtophora Cicatrosa* and *Cyrtophora cicatrosa* are garden spiders which weaves a horizontal dome shaped web with many radial and spiral and them raises its center to form a dome, under this dome spider builds a flat mesh. It was found on Cycas plant.

Lyniphidae and Aranidae families also build three-dimensional horizontal domb shpe webs which work differently from flat orb webs. Orb webs depend on sticky silk to entangle the prey which flies horizontally into the invisible trap. In three-dimensional webs, the silk is not sticky. Flying insects are knocked down by the vertical silk lines onto the horizontal platform. The spider then runs out of its hiding place to grab them. Different Tent Spiders have various ingenious hiding places. The horizontal platform is often dome shaped. Unlike orb-webs, they are not rebuilt regularly and can last a long longtime (several weeks). One experiment suggests that while orb webs are not waterproof (water droplets remain on the web), three-dimensional webs are, and may thus be more durable in wet habitats.



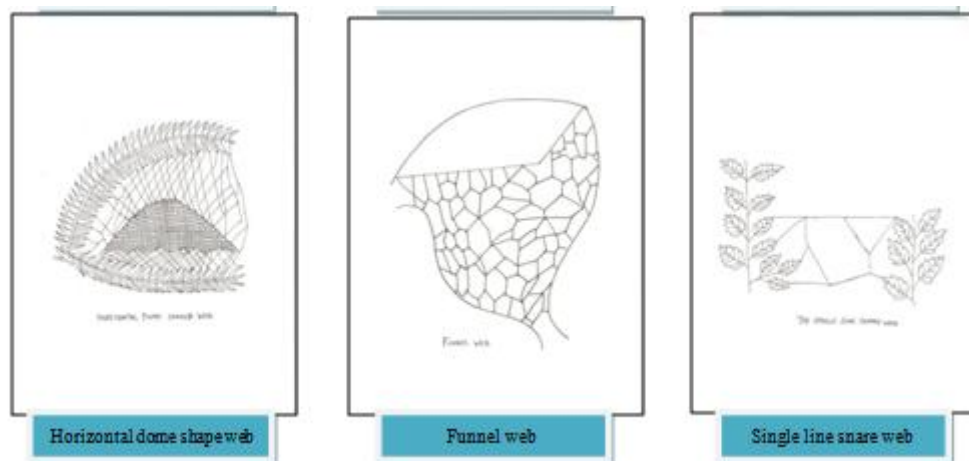
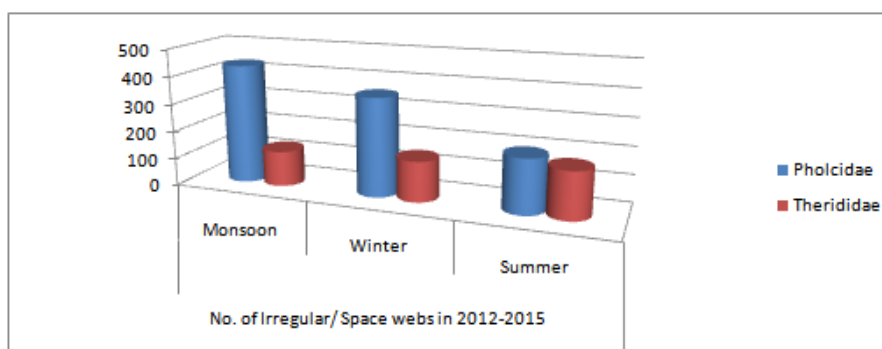
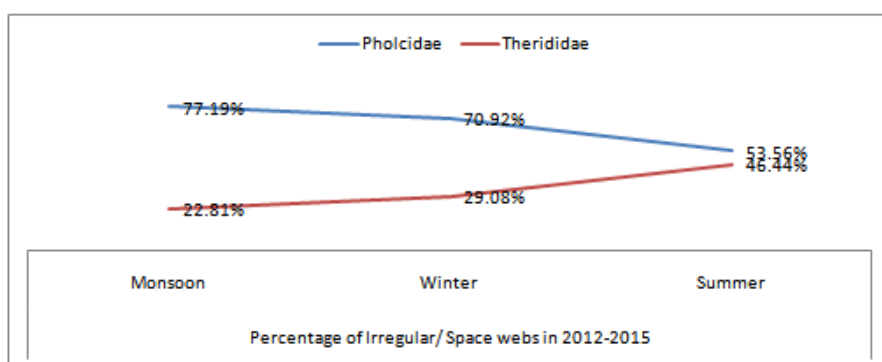


Table-1- Number and percentage of Irregular web of different families in different seasons of 2012-2015.

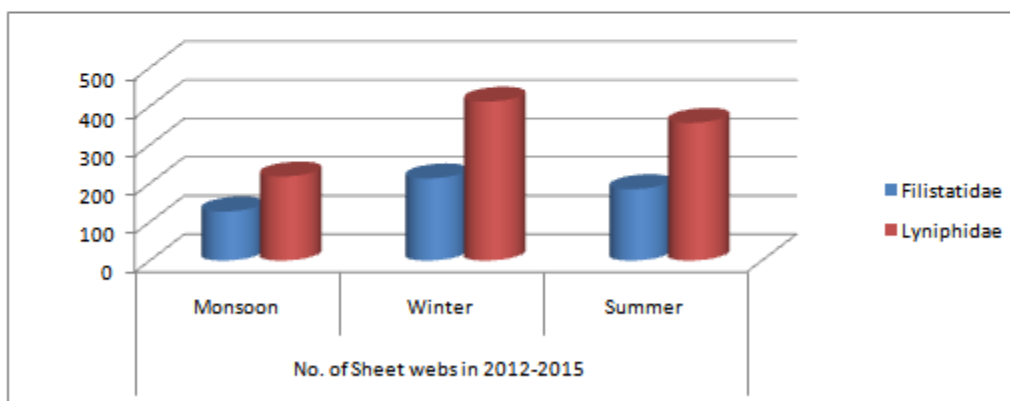
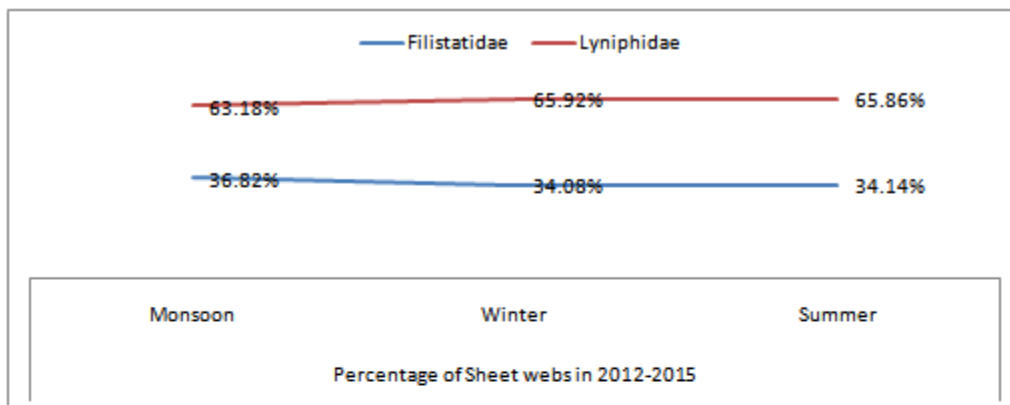
Family	No. of Irregular/ Space webs in 2012-2015			Percentage of Irregular/ Space webs in 2012-2015		
	Monsoon	Winter	Summer	Monsoon	Winter	Summer
Pholcidae	433	356	196	77.19%	70.92%	53.56%
Therididae	128	146	170	22.81%	29.08%	46.44%
Total	561	502	366	100%	100%	100%



Graphs Showing- Number and percentage of Irregular web of different families in different seasons of 2012-2015

Table-2- Number and percentage of Sheet web of different families in different seasons of 2012-2015.

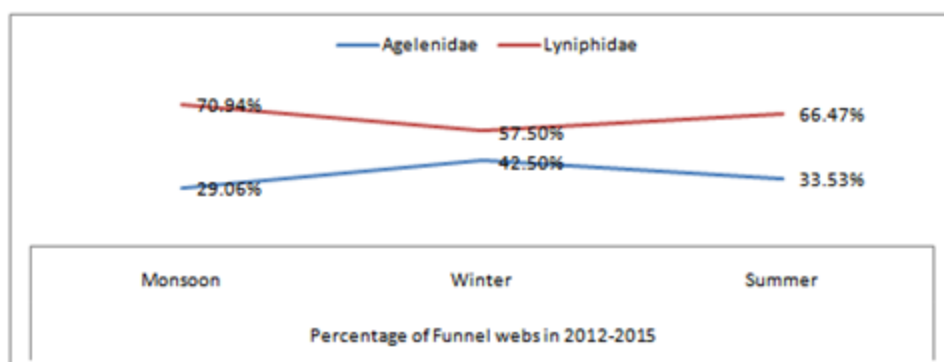
Family	No. of Sheet webs in 2012-2015			Percentage of Sheet webs in 2012-2015		
	Monsoon	Winter	Summer	Monsoon	Winter	Summer
Filistatidae	127	213	185	36.82%	34.08%	34.14%
Lyniphidae	218	412	357	63.18%	65.92%	65.86%
Total	345	625	542	100%	100%	100%



Graphs Showing - Number and percentage of Sheet web of different families in different seasons of 2012-2015

Table-3 - Number and percentage of Funnel webs of different families in different seasons of 2012-2015.

Family	No. of Funnel webs in 2012-2015			Percentage of Funnel webs in 2012-2015		
	Monsoon	Winter	Summer	Monsoon	Winter	Summer
Agelenidae	68	201	118	29.06%	42.50%	33.53%
Lyniphidae	166	272	234	70.94%	57.50%	66.47%
Total	234	473	352	100%	100%	100%



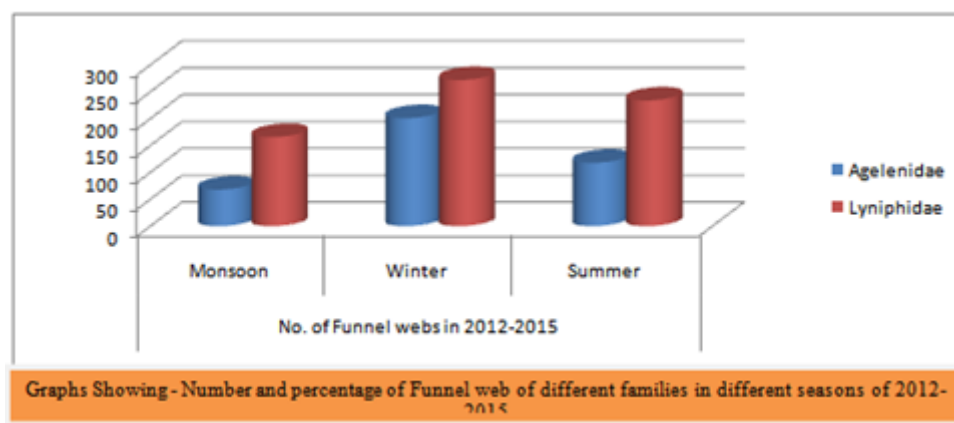
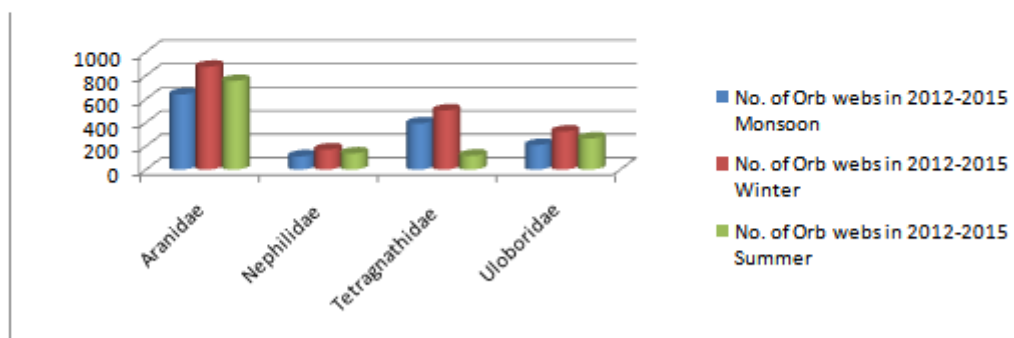
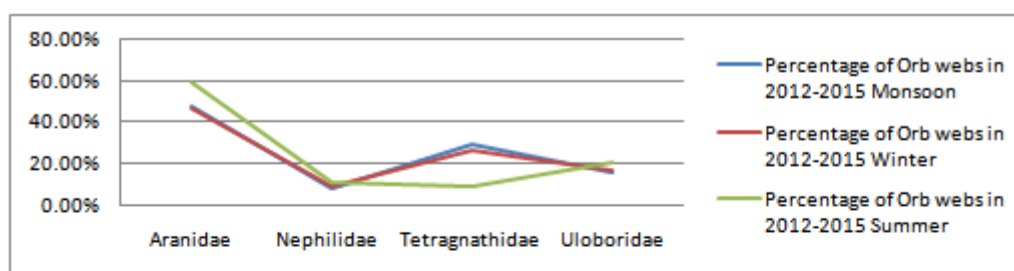


Table-4- Number and percentage of Orb webs of different families in different seasons of 2012-2015

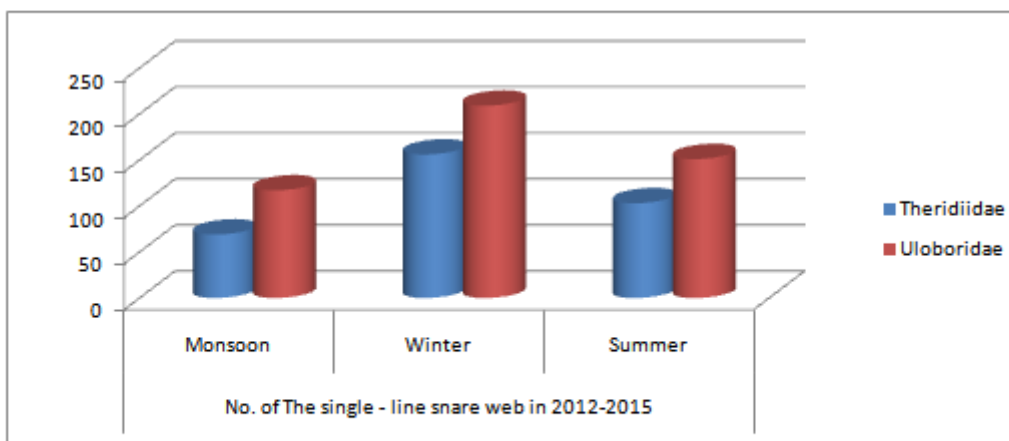
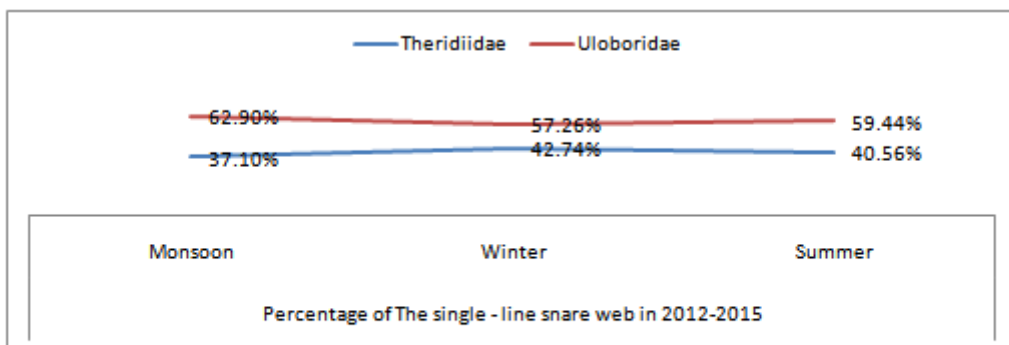
Family	No. of Orb webs in 2012-2015			Percentage of Orb webs in 2012-2015		
	Monsoon	Winter	Summer	Monsoon	Winter	Summer
Aranidae	639	875	754	47.26%	46.77%	59.23%
Nephilidae	112	170	137	8.29%	9.09%	10.77%
Tetragnathidae	392	503	118	29.00%	26.88%	9.27%
Uloboridae	209	323	264	15.45%	17.26%	20.73%
Total	1352	1871	1273	100%	100%	100%



Graphs Showing - Number and percentage of Orb web of different families in different seasons of 2012-2015

Table-5- Number and percentage of Single line- snare webs of different families in different seasons of 2012-2015.

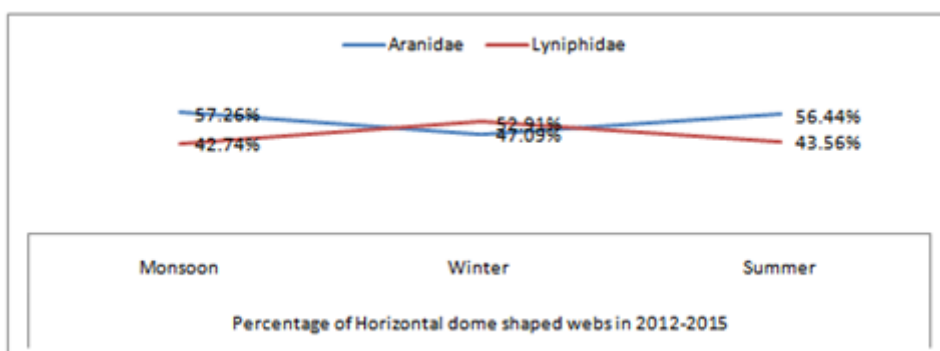
Family	No. of The single - line snare web in 2012-2015			Percentage of The single - line snare web in 2012-2015		
	Monsoon	Winter	Summer	Monsoon	Winter	Summer
Theridiidae	69	156	103	37.10%	42.74%	40.56%
Uloboridae	117	209	151	62.90%	57.26%	59.44%
Total	186	365	254	100%	100%	100%

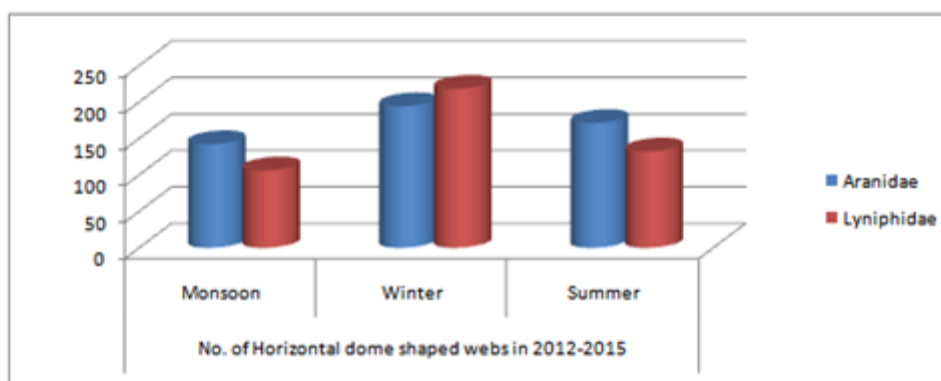


Graphs Showing - Number and percentage of Single line snare web of different families in different seasons of 2012-2015

Table-6- Number and percentage of Horizontal dome shaped webs of different families in different seasons of 2012-2015.

Family	No. of Horizontal dome shaped webs in 2012-2015			Percentage of Horizontal dome shaped webs in 2012-2015		
	Monsoon	Winter	Summer	Monsoon	Winter	Summer
Aranidae	142	194	171	57.26%	47.09%	56.44%
Lyniphidae	106	218	132	42.74%	52.91%	43.56%
Total	248	412	303	100%	100%	100%





Graphs Showing - Number and percentage of Dome shape horizontal web of different families in different seasons of 2012-2015

Table- 7- Showing total web counts of webs in spiders families

Family	Irregular web			Sheet web			Funnel web			Orb web			Single-line web			Horizontal dome shaped web		
	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S	M	W	S
Agelenidae							68	201	118									
Aranidae										639	875	754				142	194	171
Filistatidae				127	213	185												
Linyphidae				218	412	357	166	272	234							106	218	132
Nephilidae										112	170	137						
Tetragnathidae										392	503	118						
Pholsidae	433	356	196															
Therididae	128	146	170										69	156	103			
Uloboridae										209	323	264	117	209	151			
Season wise total count of web	561	502	366	345	625	542	234	473	352	1352	1871	1273	186	365	254	248	412	303
Total	1429			1512			1059			4496			805			963		

Dominance of web-

Orb web > Sheet web > Irregular web > Funnel web > Single line snare web > Horizontal dome shape web.

V. Conclusion

The spider constitutes a very interesting group of primitive animal. Which are cosmopolitan in nature. Spiders attract special attention to the zoologist on account of their unique weaving capability of constructing webs with geometrical precision. They are best friends of mankind as they feed on insects, which are generally harmful to mankind. In the present study the seasonal abundance of spider's web was studied. We studied web pattern and architecture of 9 families in the study area. During the study six types of web pattern formation are identified and analyzed by comparing with the studies and reports related to the same topic. Web formation by the spiders was also been studied during this study. The gradations of the web patterns can be written in the following order: Orb web > Sheet web > Irregular web > Funnel web > Single line snare web > Horizontal dome shape web. The orb web and Sheet web were very commonly observed during this study.

These results indicated that web's diversity in Eastern Region of Rajasthan is mostly dependant on the presence of food and paste species in the said area. Due to presence of ample food and paste diversity the Monsoon season represented high diversity of spider's web in this region. In the present investigation, the important observation is hunters or and ground dweller spiders dominated the study area over the web builders irrespective of the said area. This could possibly be due to the agricultural practices used in different crop fields. During the crop season, workers work in the field and their movements disturb the webs. Therefore, only those web constructing spiders were reported, which could construct their webs in a limited space and secondly most of them are nocturnal. During evening, they construct the web, prey whole the night on the pests caught in the web and by dawn, they eat their webs (*Neoscona*). Among web builder, *Argiope* and *Cyclosa* dominated all the three seasons. *Cyclosa* is thus the most successful web builder as they require a small space to construct mostly the basal webs.

The webs built by the spiders are used mainly for three purposes: for capturing the prey, for egg laying and their development, and for defense. It was concluded that a long-term study is needed to know more about spiders and their webs. This helps in their conservation.

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