

## Seasonal Variation in Spider Population in the Semi Arid Area of North Gujarat

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Ecological study of spiders was done in Mehsana district (23° 02' to 24° 09' North latitudes and 71° 26' to 72° 51' East longitudes). Their collection was done from different habitat of four different sites for two years. Study area comes under semi arid climate. Its vegetation region has been classified as "Indian desert". Pit-fall trap methods as well as Sweeping method were applied for spider collection. Low species population was available during cold period (December-January) and high in Early Monsoon (June-July). Temperature effects highly and photoperiodism effects moderately on availability of spider species. More number of families also recorded during Monsoon. *Hippasa pisaurina*, Pocock was a predominant species in this area. Species richness was recorded highest during post Monsoon and Early Monsoon. Available different food source from farmland habitat during crop calendar was marked with its dominant role for diversity of spider fauna. But it was observed that use of insecticides in Ravi crops effect on population of spiders due to common agriculture practice. Public awareness about spiders as a bio controller is required.

**Key words:** Habitat, Monsoon, Agriculture, Species Richness, Temperature.

According to the latest estimates, approximately 37,300 species of spiders belonging to 3450 genera and 108 families are known from all over the world. Over 1000 species of them are so far known from the Indian sub continent (Smith 1982). Investigation on spider is very important because it is a best biological controller (Wheeler 1973; Turnbull 1973). It is a best adaptive creature to nature. They found extensively in fields, thick

forest floors, gardens, tree trunks, human habitation, mostly in deserted buildings, in creeks of wall, under stones, loges, ground, etc.

A new multidisciplinary science that has developed to deal with the crisis is conforming biological diversity or conservation biology. With respect to this we have selected the topic which is less attended by scientist and naturalists.

### Study Area

The state of Gujarat is situated on the West coast of India and lies between latitudes 10.1° N and 24.7°N and longitudes 68.4° E and 74.4° E (Fig. 1). The main land is almost flat plain made up of alluvial soil and some sandy soil in the North. The climate of north Gujarat is tropical in nature as the tropic of cancer passes through it. There is a large spatial and temporal variation in rain fall. Area Mehsana district (23° 02' to 24° 09' North latitudes and 71° 26' to 72° 51' East longitudes) of Gujarat

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was selected for study. Total different four sites were selected for collection with respect to different habitat: urban area, hilly forest area, crop field area, open westland area. Winter (November- January) is a period of cold and summer (February- June) is a hot period in the district. Monsoon starts during June and extends up to October. Average % relative humidity ranged 43.57 to 86.60 during study period (Table 1., Fig. 2). Average highest rainfall remained during Late Monsoon (321mm) and low during Post Monsoon (25mm). Moisture status was remained dry during Winter and Early Summer but varied during Late Summer and Post Monsoon (Table 2). Winter has very short photoperiod (average 11-19 hrs) and later on it increases. Highest photoperiodism remains during Early Monsoon (average 14-12 hrs). Vegetation of a district has been classified as "Indian desert" by Clarke (1898). Various types of crops grown. Sowing and harvesting seasons of cereals and pulses in a study area spread almost entire year, except April, May, June and September (Table 3).

Insect fauna was observed in luxurious number and variety during Monsoon. Some of them are the pest of cereals and pulses. Total 37 insectivorous bird species was seen during study period.

There are six seasons in this area. Summary of each season of a district is given in a (Table 4). It gives climatic condition and a specific remark of each season.

## METHOD

Spiders were collected mostly by hand. Searching was done by jerking the twigs of trees and bushes, keeping inverted open umbrella below to collect fallen spiders. They were kept in plastic tubes (5cm x 2cm) containing 70% ethanol and a slip indicating date and place etc. They were also collected by pit-fall trap method and sweeping method. Pit-fall trap method helps to capture non-weavers. Ditches (10 to 15 cm) were made and put the plastic dish (10 cm wide) filled with ethylene glycerol. Sweeping method was operated at early morning or at evening. The sweeping net (60 cm long and 24 cm wide) was operated at crop fields, farms, or ground and tall grasses. Spiders from net were collected and preserved in the containers. Identification key was adopted (Patel 1985).

## Formulae used to study

$$\text{Percent Species Richness} = \frac{\text{number of species found in a particular sites or month}}{\text{Total number of species found}} \times 100$$

$$\text{Seasonal Index (SI)} = \frac{\text{monthly average}}{\text{Sum of monthly average}} \times 100$$

$$\text{Similarity (sim)} = \frac{2c}{A+B}$$

Where A= number of species in area "A", B=number of species in area "B", C= number of species Common to "A" and "B".

## RESULTS AND DISCUSSION

### Preference of habitat

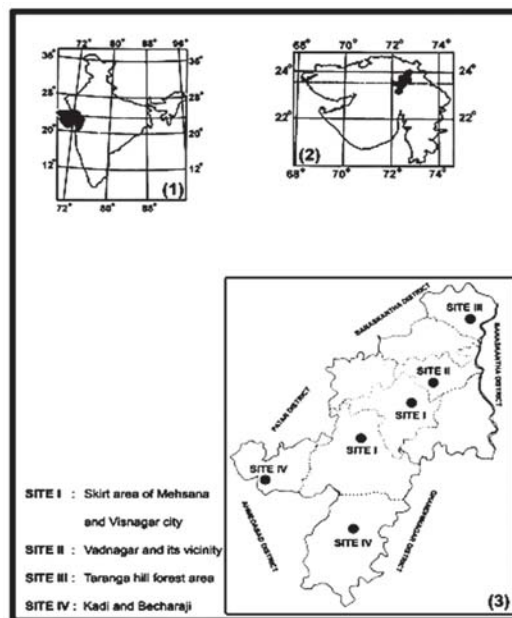


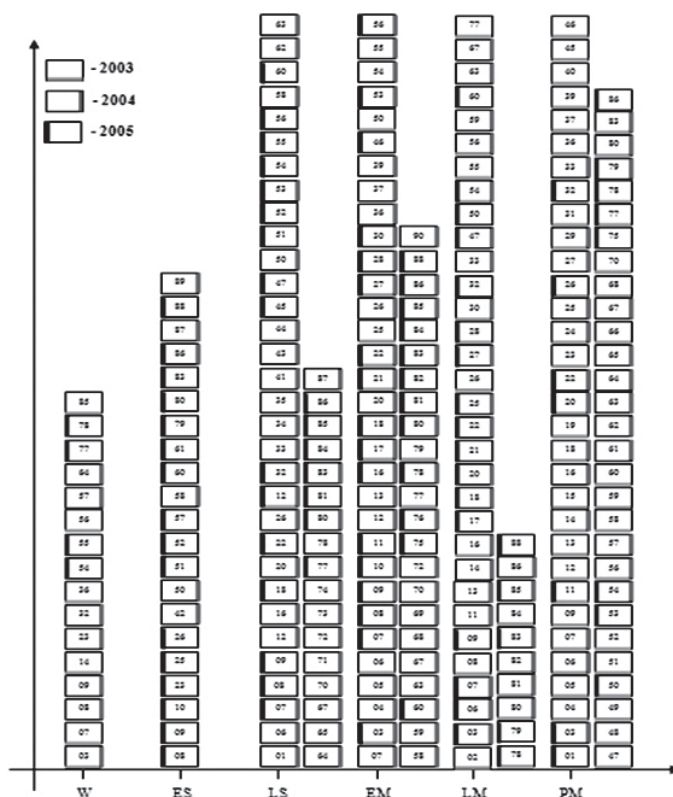
Fig. 1. Map of the study area.

1. The Gujrat State within India.
2. The Mahsana region within Gujrat.
3. The Mahsana District indicate Sites.

**Table 1.** Available spider species and their relation with climatic condition in a study area with r value \*.

Season	Available Species	Average Temp. °C	% Humidity	Rainfall in mm	Photo periodHrs
Winter	18	20.51	50.58	0	11 19
Early Summer	23	22.41	50.19	0	12 10
Late Summer	49	31.69	43.57	140	13 11
Early Monsoon	58	31.64	77.66	271	14 12
Late Monsoon	46	28.79	86.60	321	13 14
Post Monsoon	61	27.13	63.10	025	12 15

\*Calculative Values based on species population of spiders Vrs. different factors  
 Factors r Value Conclusion  
 Available Sps. Vrs. Average temp. + 0.85 Fairly Correlated  
 Available Sps. Vrs. % Humidity + 0.48 Low Correlated  
 Available Sps. Vrs. Rainfall + 0.52 Moderate Correlated  
 Available Sps. Vrs. Photo Periodism + 0.70 Moderate Correlated



**Fig. 3.** Season wise available coded Species in the area (2003-2005) (Summary)

**Table 2.** Moisture status during different years\*.

Season	Climatic Condition Years		
	2003	2004	2005
Winter	Dry	Dry	Dry
Early summer	Dry	Dry	Dry
Late summer	Dry	Humid	Dry
Early monsoon	Humid	Per humid	Humid
Late monsoon	Humid	Humid	Humid
Post monsoon	Dry	Semi dry	Dry

\*Note: The moisture status for a month is categorized by the following formula,

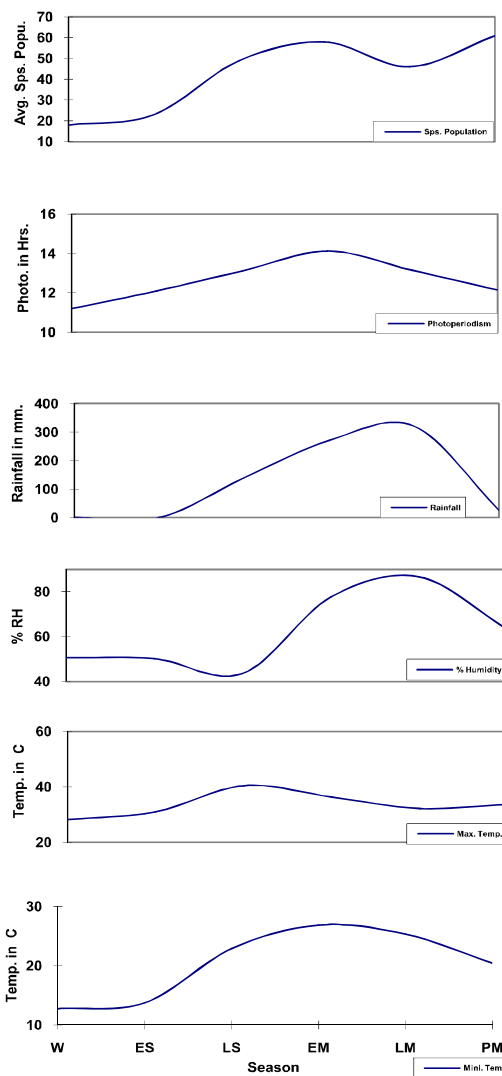
Dry –  $P \leq 2T$   
 Semi dry –  $P > 2T$  or  $\leq 3T$   
 Sub humid –  $P > 3T$  or  $\leq 4T$   
 Per humid –  $P > 4T$  or  $\leq 5T$   
 Humid –  $P > 5T$

Where P stands for the monthly precipitation in mm and T stands for the monthly mean temperature in degree centigrade.

**Table 3.** Crop calendar (Related to spider fauna).

Name of the crop	Month of Sowing	Month of Harvesting
Bajari	Jul.	Oct.
Castor	Aug.	Jan.
Cotton	Jul.	Feb.
Jowar	Aug.	Dec.
Mustard	Oct.	Jan. – Feb.
Paddy	Jul.	Oct. – Nov.
Rape	Oct.	Jan. – Feb.
Tobacco	Aug.	Feb. – Mar.
Tur	Jul.	Nov. – Dec.
Wheat	Nov.	Mar.

Total 1200 specimens were collected. Out of total collected samples 551 samples were from Farmland, 321 from Wetland, 216 from Wasteland and 120 samples from houses (Table 5). Collected samples belong to 18 families (Table 6). Family Lycosidae and Therididae prefer wetland. Arenidae family is restricted to farmland only, other members of family Oxyopidae and Thomidae were also found in Farmland habitat. Members of families Heteropidae and Eresidae

**Fig. 2.** Average climatic factors and species population in a study area

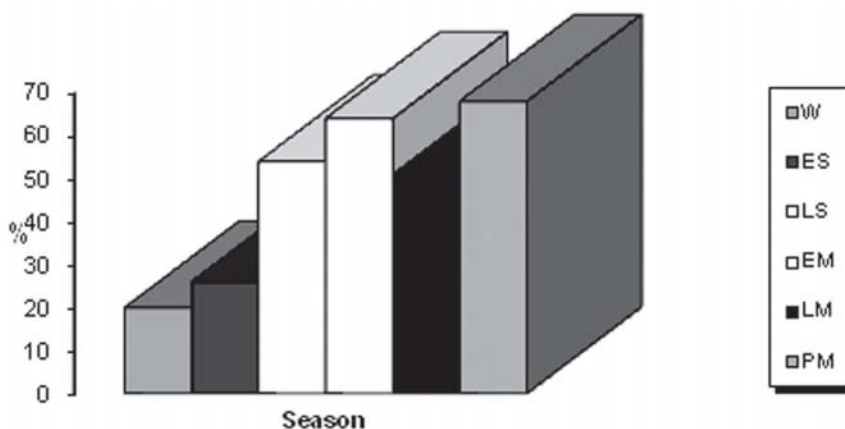
prefer Wasteland ecosystem. But members of Pholicidae were marked in a human habitation, especially at the corner side of the houses (Table 6). *Nescona theis*, *Oxyops ratna* and *Tibellus pateli* prefer vegetative farmland habitat near wasteland area. Similarity index shows that there was a high degree similarity between farmland and wetland species, but no similarity among habitat between farmland and westland due to variation in vegetation (Table 7).

#### Season variation

Fig. 2. shows season wise available samples within three years (2003-2005) in a study

**Table 4.** Summary of each season in a Mehsana District.

Season & Month	Climatic condition	Remarks
1. Winter Dec. to Jan.	Period of cold weather The sky remains clear Precipitation of rainfall is rare	Highly available Avian Fauna
2. Early Summer Feb. to Mar.	Starting period of warm weather Summer starts from late Feb. Transitional period between Winter and Summer Nights remain cool & days warm Usually sky remains clear but some time clouds were seen Dry period Rainfall was hardly recorded	Harvesting Period for Ravi crop
3. Late Summer Apr. to May	Period of warm and dry weather Temperature did not drop bellow 17 <sup>o</sup> C Dry period	Very hot season, Open farmlands
4. Early Monsoon Jun. to Jul.	The South-West Monsoon starts from late Jun. Climate was humid but it was per humid in 2004	Availability of insects (larval stage) was high
5. Late Monsoon Aug. to Sep.	Climate was more variable, humid to dry number of	High insect fauna
6. Post Monsoon Oct. to Nov.	A transitional period between the Monsoon & Winter Dry period but it was semidry in 2004	Sowing period for Kharif crops



**Fig. 4.** Season wise Species Richness (SR) in spider's population of the study area.

**Table 5.** Spiders available from different habitat within the study area.

Habitat	No. of samples	% Selection
Farmland	552	46
Wetland	312	26
Wasteland	216	18
Houses	120	10
Total	1200	100

area. Year wise as well as in toto of three years indicate that very low species population was available during cold and dry period. i.e. during Winter and Early Summer. Maximum numbers are found during Early Monsoon (412 out of 1200).

There is an influence of average temperature on available species ( $r=+0.85$ ). It is fairly correlated relative percent humidity dose not effect ( $r=+0.48$ ). Rain fall is not a direct effective factor but during raining insect fauna and vegetative growth found maximum, so food is the ultimate factor. Very little research has been conducted on the feeding ecology of spiders, perhaps due to

difficulty of observing predation by these vagrant spiders in the field (Bredy 1964). Photoperiodism moderately effects ( $r=+0.70$ ) because spider groups show both types of activities i.e diurnal and nocturnal. Even web preparation take place at night. Subramanyam(1940) studied on Indian spider and reported that the members of families Argiopidae, Sparassidae, Clubionidae, Psecridae, Lycosidae and Oxyopidae become active at the onset of Monsoon. Scott et al (1983) reported that the population of a family Oxyopidae remained low on cotton before the rain fall but there number increased with the onset of Monsoon. In our collection also it is seen as same as they observed. Barghusen et al (1997) had suggested that temperature has influence on web-building behavior in common house spider *Achaearanea tepidariorum*. They have concluded that spiders are ectothermic in both their metabolic rate and their activity levels vary with temperature. In tropical region effects of temperature was studied by patel and Kareemallah(1989) on two species of pseudo scorpion and observed that the number of hibernation chambers significantly increased the

**Table 6.** Family wise habitat selection within the study area

Family	(Number of samples)			
	Farmland	Wetland	Wasteland	Houses
Amaurobiidae	00	00	026	00
Araneidae	144	00	00	00
Clubionidae	041	00	00	00
Eresidae	00	00	059	00
Gnaphosidae	031	00	00	00
Heteropoidae	00	00	071	00
Lycosidae	031	222	00	001
Oeicobidae	00	00	00	020
Oxyopidae	084	00	00	00
Pholicidae	00	00	00	058
Pisauridae	00	00	009	001
Salticidae	028	00	006	014
Scytodiidae	00	010	00	00
Selenopidae	00	00	00	005
Theridiidae	00	063	00	00
Thomisidae	082	00	00	00
Uloboridae	037	00	00	00
Urocteridae	00	010	027	00
Dried samples*	070	007	018	021
Very small sized sample *	004	00	00	00
Total	552	312	216	120

**Table 7.** Degree of similarity of habitat preferred by spiders in a study area

Sites	Similarity Index	Degree of Similarity
Site I & II	0.25	High
Site III & IV	0.21	High
Site I & IV	0.13	Moderate
Site II & III	0.12	Moderate
Site II & IV	0.11	Moderate
Site I & III	0.08	Low

time in culture by factor of low temperature. In the district the daily average minimum temperature during Winter remains below (12.77°C) and maximum temperature (28.25°C) during study period. (Table 1). Average % relative humidity ranged 43.57 to 86.60 (Table 1).

Thus it is concluded that in a semi arid zone of north Gujarat, Monsoon is very favourable to spider population due to its variable climatic factors and 'insects' availability. As a biological controller specific species can be helpful to monsoon crops (Kharif crops) to farmers. But use of insecticides to crop may harm to this important population.

### CONCLUSION

Spider is the best biological controller and adaptive creature to nature. Its population ecology is less studied in the past. Study was conducted in a Mehsana district which has semi-arid climatic condition but agricultural ecosystem is well settled. There are six seasons i.e. Winter, Early Summer, Late Summer, Early Monsoon, Late Monsoon, and Post Monsoon. Its moisture status remains dry except Monsoon. Farmland, Wetland, Westland and Human habitation are the most preferable habitat of spiders. Maximum population is found

in farmland. Families also show preference. e.g. Family Lycosidae and Therididae prefer Wetland.

Maximum number of specimens is available during Monsoon due to available variable climate, food and vegetation for shelter. Food is the ultimate factor. Temperature has also effect on population of spiders. Rain fall has no direct effect. Relative humidity has no significant effect.

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