Diversity of spiders from Agro-ecosystem of Basra Province. south of Iraq

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Abstract:

The current study was conducted at agro-eycosystem of Basra province during the period 2013-2014, to evaluate the diversity of spiders community. 24 species, 23 genera belong to 10 families was recorded, the most relative abundance was registered for family Lycosidae 0.80 . the most divers month was November 2.88, the results of correlation revealed a negative correlation between number of spiders and wind speed, as well as air temperature degree, whereas the number of spiders correlated positively with rain quantity and relative humidity.

Key words: Iraq, spiders, diversity, arachnida, araneae

Introduction:

Spiders are a diverse collection of animals ,taxonomically they belong to the phylum Arthropoda; subphylum: chelicerata; class: Arachnida ; order: Araneae. This order in total contains 45,719 species belonging to 3935 genera belonging to,114 family (Platnick, 2015). Prior 1880, spiders classification was based on broad categories of lifestyles resulting in a praphyletic arrangement, today the monophylogeny of Araneae is supported by several complex and unique synapomorphies, the most important of these are abdominal appendages as spinnerets, silk gland and associated spigots, fang direction, male pedipalpal tarsi modified as sperm transfer organs , and loss of abdominal segmentation (Coddington and Levi ,1991).

The order Araneae is divided into two suborders : The Mesothelae which includes a single family Liphistiidae, distinguished from more evolved spiders by the presence of an abdominal plate. Members of Liphistiidae are found only in

China, Japan and South east Asia (Platnick,1995) .The second suborders of Opisthothelae is divided into two infraorders :The Mygalomorphae and the Araneomorphae .

In ancient literature ,Mygalomorphs are referred to as orthognatha and araneomorphs known as labidognatha .They are seperated by the direction of their fangs . Mygalomorph fangs open forward ,whereas araneomorph fangs open to the side (Kaston ,1978) .In addition the Araneomorphae has one pair of booklungs or absent but Mygalomorphae has two pairs of booklungs (Dippenear & Jocque ,1997).

without cribullum and calamistrum . Araneomorphae are usually referred to as "true spiders" , including all remaining spider taxa (Platnick, 2005).

Spiders live in a very wide variety of habitats, and different species reside at such diverse locations as in the freezing Arctic to the dry equatorial desert regions (Foelix,2011). While spiders are probably most abundant in areas of rich vegetation, certain species favour habitats far removed from this, such as tidal zones and sand dunes (Lamoral ,1968). The different habitats that spiders reside in , means different types of silk are required for optimal survival of the spider.

The diversity and ecology of spiders are important in any kind of attempt for the implementation of integrated pest management system (IPM).

They exhibit extremely high diversity and are the dominant insectivores in many terrestrial ecosystems. They feed exclusively on insects and are of economic value to man because of their ability to suppress pest abundance in agroecosystems. Species abundance of spider communities in agricultural fields can be as high as in natural ecosystem (Tanaka, 1989).

Materials and Methods

Study area:

Spiders were collected from 6 permanent stations of Basrah province . 1-AL-Mdaina 2-AL-Hwair 3-Shat-AL-Arab 4-Abu-Alkhaseeb 5-Zubair 6-Safwan. Description of each of these location was shown in table below: table 1.

Table 1: Description of habitats and locations of study area.

stations	Habitat	Location	Coordinates
1-AL-Mdaina	Wheat and barley , Date palms , natural plants,canes , vegetable crops, leaf vegetables, zuzyphus. ornamental trees, shrubs.	North of Basrah	N 30º56´ 43.5″ E47º 10´ 21.6″
2-AL-Hwair	Wheat and barley , canes, zuzyphus, shrubs, ornamental trees Date palms , natural plants ، vegetables crops.leaf vegetables	North of Basrah	N 30º59´ 38.4″ E47º 10´ 21. 6″
3- Shat-AL-Arab	Date palms orchards ,vegetables crops, fruit trees, Cane, ornamental trees .leaves	East of Basrah	N 30º 32´ 3″ E 47º 50´ 4″

	vegetables, wheat and barley, zuzyphus.		
4-Abu-Alkhaseeb	Date palms orchards , Shrubs, vine orchards , vegetables crops , cane , natural plants . leaves vegetables, wheat and barley, zuzyphus.	East of Basrah	N 30º 28´ 5″ E 47º 52´ 8.45″
5- Zubair	Green houses of vegetable crops ,natural plants ,	West of Basrah	N 30º 21´ 52.45″ E 47º 38´ 55.45″
6-Safwan	Green houses of vegetables crops , natural plants ,	West of Basrah	N 30º6´ 58.4″ E 47º 39´ 12″

Sampling design & techniques

Collection was carried out during the period from April 2013 to May 2014 . It was done between 7:00 am to 4:00 pm , environmental factors were recorded from Basra airline office . Coordination were registered at the field by GPS instrument.

The specimens were collected by quadrate method ,five quadrate 10 × 10 m . Spiders were collected by adopting standard sampling .

Data analysis

To quantify the diversity of spider species for agro-ecosystem of Basra province, the diversity indices were done for each month of study area, from 1 April 2013- 1 April 2014 :

diversity index;) Shannon-Weiner index (H); Equitability Margalef , Beger-parker index with the help of software PAST, version 1.34 were used. For making -sure all calculation were repeated manually by using excel program.

Relative abundance for species was collected by using Excel program

Pi=ni/N Odum (1970)

whereas ni= no. of individuals of one species

N = no. of total individuals.

Results of correlation was done by PCA test (PAST program version 1,34).

Results:

Results show there are 24 species, belonging to 23 genera and 8 families were recorded from 6 stations of Basrah province agro-ecosystem. Figure 7.

1- Family: Araneidae Simon, 1895 (Orb web spiders)

Genus: Aculepeira Chamberlin and Levi, 1942.

Aculepeira armida (Audouin,1826).

Genus*: Argiope* Audouin, 1826.

Argiope trifasciata (Forskal, 1775) .

Genus:- *Neoscona* Simon, 1864.

Neoscona arabesca (Walckenaer).

2-Family: Clubionidae Wagner, 1887 (Sac spiders)

Genus : *Clubiona* Latreille, 1804

Clubiona subtilis Coch,1867.

3-Family: Dictynidae O.Pickard-Cambridge,1871. { Mesh web spiders{

Genus: - *Emblyna* Chamberlin ،

Emblyna brevidens Kulczynski.

4-Family: Gnaphosidae Pocock, 1898 .

Genus: *Nomisia* Dalmas, 1921

Nomisia exornata Dalmas, 1921.
5-Family: Salticidae Blackwall, 1841 (Jumping spiders)
Genus:- *Euphrys* Koch, 1834
Euophrys pseudogambosa Strand,1915*.
Genus: *Phlegra* Simon, 1876.
Phlegra fasciata Simon, 1876.
Genus:*Thyene* Simon,1885.
Thyene imperialis (Rossi,1846)
Genus:-*Neaetha* Simmon,1884.
Neaetha membrosa(Simon,1868).
Genus: Plexippus Koch, 1846
plexippus pykulli (Audoin,1826)
6-Family :Theridiosomatidae (Ray spiders)
Genus: *Theridiosoma* Cambridge, 1879
Theridiosoma gemmosum Simon, 1881.
7-Family: Thomisidae Sundevall, 1833 (Crab spiders)
Genus : *Monaeses* Thorell, 1869
Monaeses israeliensis Levy ,1973.
Genus: *Ozyptila* simon,1864
Ozyptila tricoloripes Strand,1913
Genus :Runcinia Simon, 1875
Runcinia grammica ((C. L. Koch, 1837).
8-Family: Oecobiidae Blackwall,1862.
Genus :*Uroctea* Dufour,1820.
Uroctea thaleri Rheims and Van,2007
9-Family: Scytodidae Blackwall, 1864 (Spitting spiders)
Genus: *Scytodes* Latreille, 1804
Scytodes thoracica (Latreille, 1802).
10-Family: Lycosidae Sundevall, 1833 (Wolf spiders)
Genus*: Acantholycosa* F. Dahl,1908
Acantholycosa lignaria Clerck,1833.
Genus: *Alopecosa*
Alopecosa albofasciata (BRÜLLE 1832)

Genus :- *Arctosa* c.l. Koch, 1847.
Arctosa tbilisiensis Mcheidze, 1947.
Arctosa leopardus (Sundevall,1833).
Genus: *Hippasa S*imon, 1885
Hippasa cinerea Simon, 1898.
Genus: *Wadicosa* Zyuzin, 1985
Wadicosa fidelis (O. P.-Cambridge, 1872).
Genus :- *Pardosa* Koch, 1847.
Pardosa bifasciata Simon ,1876.
A total of 2721 individuals belonging to 23 species, 22 genera and 10 families were sampled from 6 station of Basrah province during the study period (2013-2014). Table (2).

Table 2: number of individuals of spider species collecting from agro-ecosystem of Basra province during the study period.

species	Apr.	May	Jun	Jul	Aug	Sep	Oct	Nov.	Dec	Jan.	Feb	Mar	total
Argiope trifasciata	0	0	0	0	0	0	0	19	11	4	4	4	42
Neoscona_arabesca	22	10	1	0	0	0	0	12	10	10	9	13	87
Aculepeira_armida	3	2	0	0	0	0	0	0	0	0	0	0	5
Clubiona_subtilis	20	18	5	0	0	0	0	34	10	1	12	33	133
Emblyna_brevidens	30	20	18	1	0	30	25	20	15	12	10	9	190
Nomisia_exornata	17	23	10	0	0	0	0	35	25	4	4	10	128
Thyene_imperialis	12	10	7	4	3	3	5	18	12	2	3	14	93
Euphrys_pseudogambosa	2	2	7	12	15	13	0	1	0	0	0	0	52
Neaetha_membrosa	0	0	10	15	18	6	0	4	2	0	0	0	55
Phlegra_fasciata	21	20	23	25	27	23	23	24	28	6	8	18	246
plexippus pykulli	3	1	0	0	0	0	0	4	0	0	0	0	7
Theridiosoma_gamosum	10	0	0	0	0	0	1	11	24	17	13	10	86
Ozyptila_tricoloripes	0	0	0	0	0	0	0	5	3	3	2	0	13
Runcinia_grammica	10	8	4	0	1	1	9	10	12	14	15	20	104
Monaeses_israeliensis	27	29	2	0	0	0	1	22	19	5	5	13	123
Uroctea_thaleri	19	21	6	4	1	0	3	14	8	37	7	16	136
Pardosa_bifasciata	20	18	21	1	0	0	3	30	25	18	12	10	158

Wadicosa_fidelis	40	20	20	0	0	0	0	40	30	25	20	15	210
Arctosa_leopardus	18	10	0	0	0	0	0	50	40	30	20	18	186
Arctosa_tbilisiensis	17	12	0	0	0	0	1	30	20	10	11	15	116
Alopecosa_albofasciata	35	30	0	0	0	0	12	20	18	19	16	17	167
Acantholyosa_lignaria	20	13	8	0	0	0	0	4	10	11	12	22	100
Hippasa_cinerea	40	30	20	4	0	0	10	12	10	11	4	12	153
Scytodes_thoracica	20	18	7	2	1	0	1	10	10	11	20	30	130

Spider families relative abundance according to the number of individuals:

The major component of the spiders population found in agro-ecosystem of Basrah province was family Lycosidae 0.80, , Salticidae 0.33, Thomisidae 0.18, while Araneidae, Scytodidae,Clubionidae were constituted 0.10 , the lowest relative abundance was 0.06 for Theridiosomatidae .Figure 1.

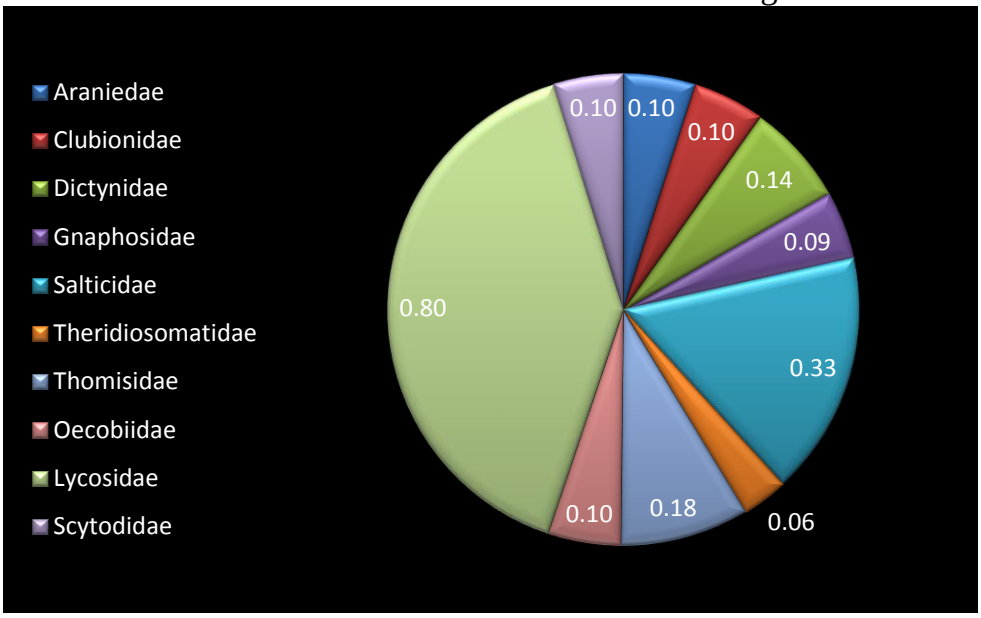


Figure 1: Spider families relative abundance in Basra province during the study period.

Annual relative abundance of each species of spiders collected from agro-ecosystem of Bsara province during the period from 1 April 2013- 1 April 2014 :

The results showed that the highest relative abundance 0.09 was for *Phlegra fasciata* from family Lycosidae, and the lowest relative abundance 0.002 was for *Aculepeira armida* .Figure 2.

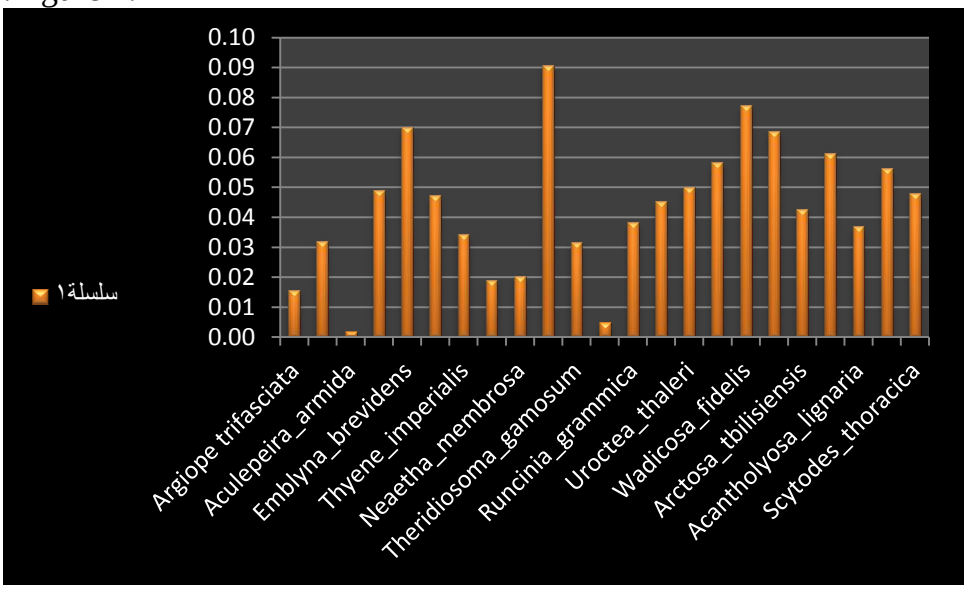


Figure 2: Annual relative abundance of each species of spiders.

Monthly relative abundance of spiders in Basra province during study period:

The results showed the highest relative abundance of spiders was registered in November and April,16% and 15% respectively ; the lowest relative abundance was in August , 2%.Figure 3.

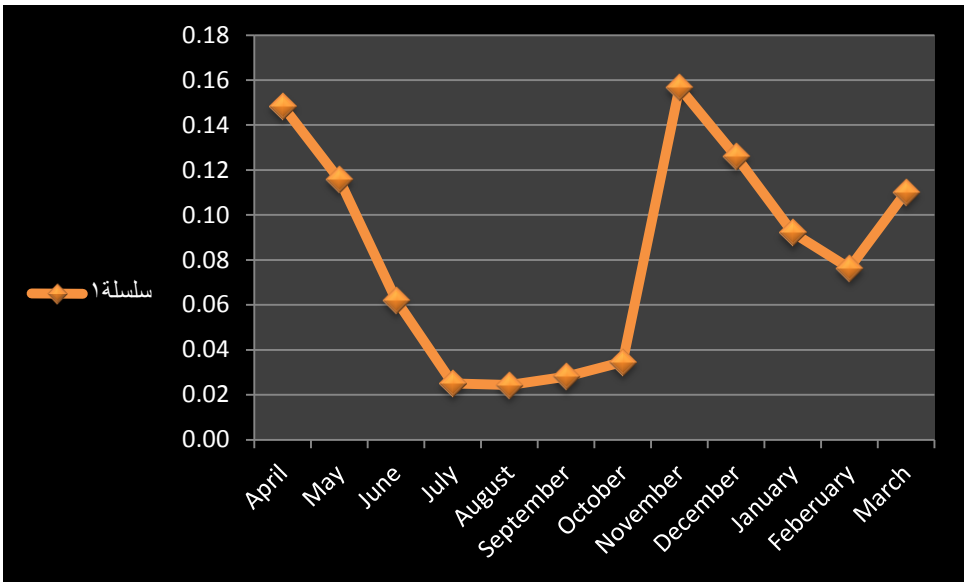


Figure 3: Monthly relative abundance of spiders in Basra province during study period.

Ecological indices:

Shannon - Wiener index:

The diversity values of spiders were calculated by Shannon - Wiener index ,the highest values of diversity were in November and December reached 2.88, the lowest value was recorded in August 1.39.

Richness index for Margalef:

The richness value of spider species were calculated by Margalef index for richness ,the highest value was registered in November 3.47 , the lowest value of richness was recorded in September 1.16.

Equitability :

The high values of evenness were during March 0.97, we can say that the distribution of spiders individuals on the number

of species are nearly equal during this months, the lowest value of evenness was in August 0.71.

Berger-Parker index:

The value of dominance was calculated by Berger-Barker indices ,the highest value was in August 0.41, the lowest value was recorded in April, May and February 0.10. Figure 4.

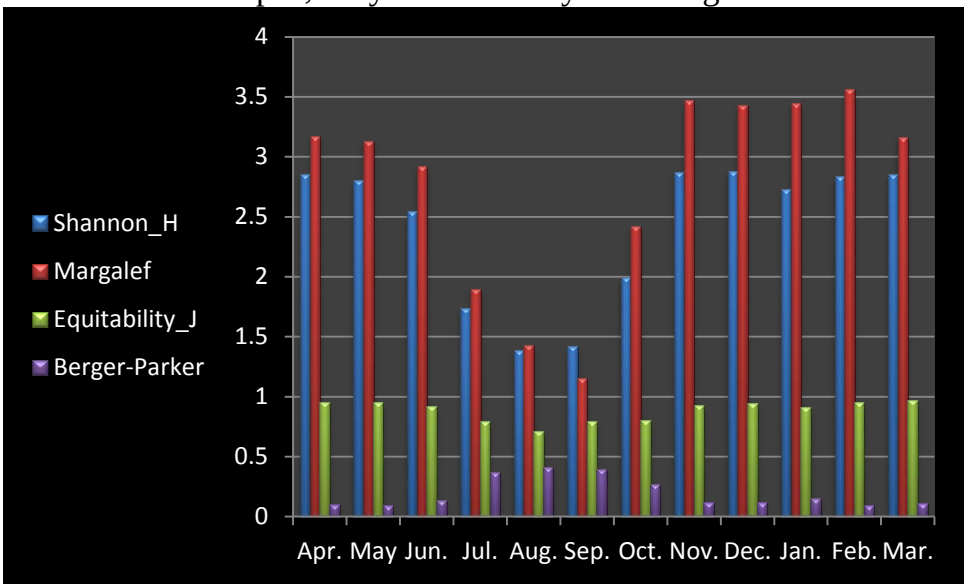


Figure 4 : Temporal ecological indices of spiders collected during the study period from Basra province.

Environmental factors:

The prevailing environmental conditions were recorded during the study period, with average temperatures ranging from 10º to 44º.

As for the relative humidity, it ranged between 20-70%, the wind speed ranged between 10-22 km/hr, and the rain quantity ranged between 0-70 mm. Figure 5.

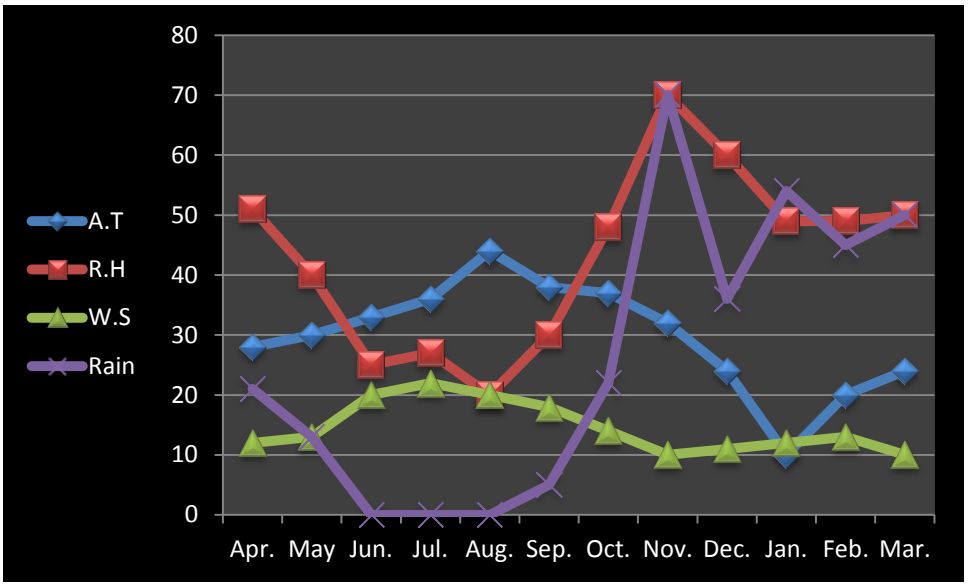
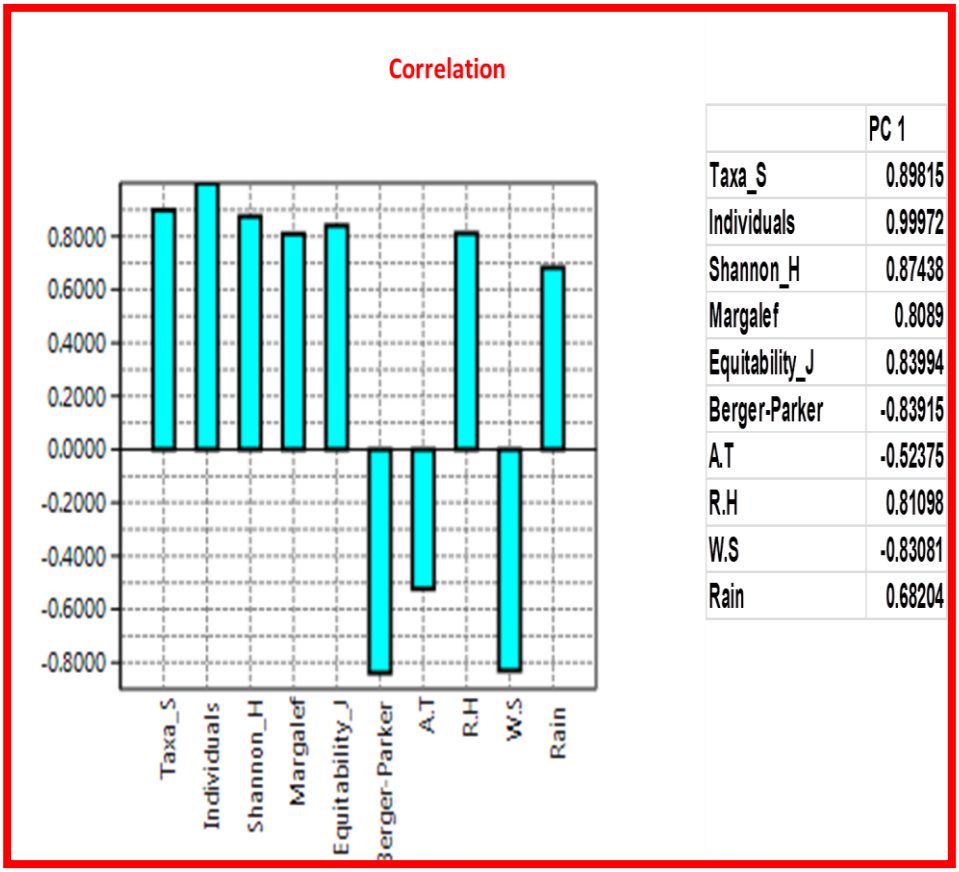


Figure 5: Environmental factors recorded during study period, A.T(air temperature) , R.H(relative humidity), W.S(wind speed).

PCA test for correlation:

The results of PCA test indicated a strong inverse correlation relationship available between wind velocity and number of individuals, number of taxa, diversity and richness index of spiders (pc=- 0.83), ,the same result obtained when we test the effect of temperature degrees on spiders population. The results show an inverse correlation(pc= -0.52), , on other hand both the rainfall and relative humidity show positive correlation relationship on number of spiders , diversity and richness index (pc= + 0.68 , pc= + 0.81) .Figure 6.



	PC 1
Taxa_S	0.89815
Individuals	0.99972
Shannon_H	0.87438
Margalef	0.8089
Equitability_J	0.83994
Berger-Parker	-0.83915
A.T	-0.52375
R.H	0.81098
W.S	-0.83081
Rain	0.68204

Figure 6: Correlation of number of individuals, number of taxa , diversity indices, richness indices, dominance indices, and evenness indices with environmental factors recorded during study period.

	
Aculepeira armada (dorsal view)	**Aculepeira armida (ventral view)**
	
Argiope trifasciata (male)	**Argiope trifasciata (female)**

Acantholycosa lignaria (female)

Arctosa tbilisensis (female)

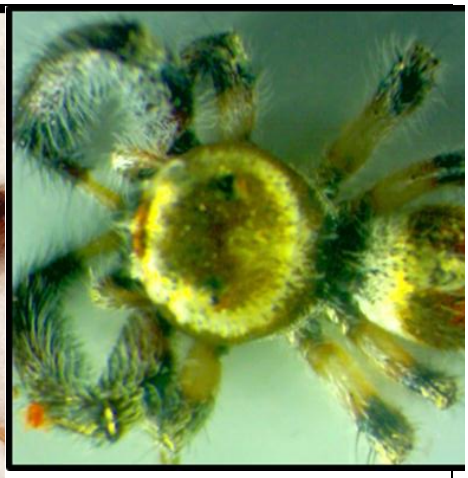
Hippasa cineria (female)

Pardosa bifasciata

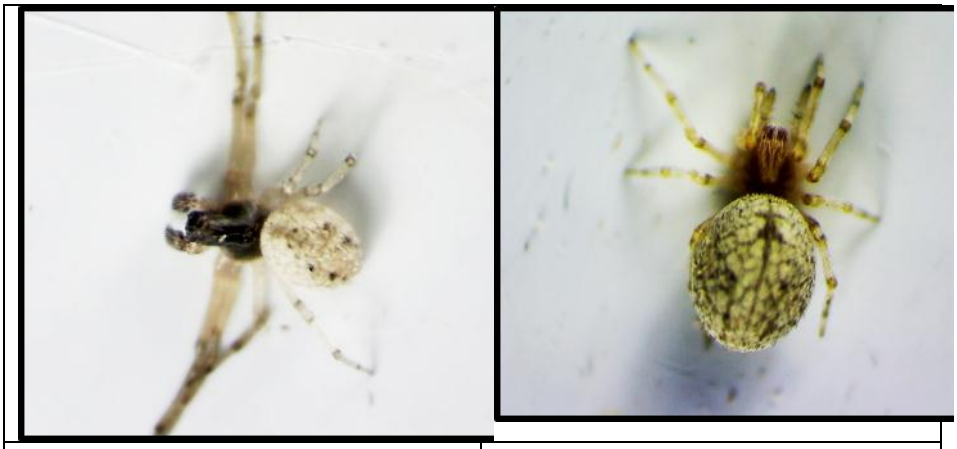
	
Wadicosa fediles (male)	**Wadicosa fediles (female)**
	
Clubiona subtilis (male	**Clubiona subtilis (female**

	
Nomisia exornata (female)	**Alopecosa albofasciata**
	
Monaeses israeliensis (male)	**Monaeses israeliensis (female)**

	
Ozyptila tricoloripes (male	**Ozyptila tricoloripes (female**
	
Runcinia grammica	**Euphrys pseudogambosa(female)**

	
Thyene imperialis (female)	**Thyene imperialis (male)**
	
Phlegra fasciata (male)	**b- Neaetha membrosa, female**

	
a-Uroctea thaleri (female)	**Uroctea thaleri (male)**
	
Scytodes thoracica	**Theridiosoma gammosum**



Emblyna brevidens (Male)	**Emblyna brevidens (Female)**

***Plexippus pykulli* (male)**	***Plexippus pykulli* (female)**

Figure 7: species of spiders collected from agro-ecosystem of Basra province during the study period>

Discussion:

A biodiversity index seeks to characterize the diversity of a sample or community by a single number (Magurran, 1988). The concept of "species diversity" involves two components: the number of species or richness and the distribution of individuals among species. The Shannon-Wiener diversity index considers the richness and proportion of each species, while the evenness and dominance indices represent the relative number of individuals in the sample and the fraction of common species, respectively .

There are many environmental factors that affect species diversity, some of these factors includes, seasonality, spatial heterogeneity, competition, predation, habitat type, productivity (Rosenzweig, 1995).

A diversity index of spider species during study period at six station, was high from November to April this due to high number of species, the concept of species diversity involves the number of species richness.

The highest species number were recorded from November to April, these months also show the maximum Marglef richness value while the lowest number of species and the minimum value were Observed at July to October. Inverse relationship between Berger-Parker index and Evenness Index was observed for every month, due to the absence of even distribution of individuals on species.

There were clear differences in temporal diversity this differences are correlated to the climatic changes occurred through different seasons of the study period.

The results show monthly trends in number of individuals and species of spiders, there was a sharp decrease from June to October and two population peaks in April and November, most species occurred in low number during the hot and dry seasons, but increased when the temperature decreased and humidity

increased, so it is clear that climatic changes during season would influence the diversity of spiders.

The current study shows the strong positive correlation between the number of species and total number of individuals with the rainfall increase , this increase in rainfall may influence the density of vegetation cover which used by numerous spiders as shelters and source of food. The rain may also destroy the webs and the shelters of some species. The spiders have been collected by hand picking and pitfull traps in large number as result of the disturbance of retreats which makes the spiders exposed.

Results also show there was negative correlation between spider abundance and wind velocity, the spider avoids effects of the wind, such as the desiccating, or may be the wind play a role in drifting or eliminating of some plants results in the disappearance of the particular amount of shade required by many spiders; in addition the strong wind cause in transport of the spiders from place to another by ballooning method .

There was a negative correlation between the spiders abundance and increase of temperature degree. During dry and hot seasons most of trees lose their leaves, most of grasses disappear which affect vegetation cover density, so the Araneidae, Thomisidae, Cludionidae, Dictynidae which are plant dweller spiders need the foliage or flower of plant, had not been seen during this period. Also there have been differences in diversity, evenness and richness indices between hot and cold seasons indicate that the seasons show different species composition. It might be expected that climatic changes during seasons would influence the abundance of spiders. In addition different species have various humidity and temperature preferences and are limited to those seasons which offer a microclimate within the range of their physiological tolerances,

Therefore, the difference in species diversity among seasons is possibly due to the difference in the amount of rainfall and temperature in the cold and hot seasons .

The spiders have thermoregulation in their body, temperature is certainly important for determining the activity of spiders when the body temperature increases to above 40°C, the spider withdraws into the shade (Blanke, 1972); such high temperatures cause an anesthesialike state in the spider. Although spiders belong to the poikilothermic animals, it would be incorrect to believe that their body temperature simply reflects the ambient air temperature. Spiders can adjust their behavior to keep their body temperature higher or lower than the temperature of the environment (Lubin and Henschel, 1990).

There are many families active in Winter ,Therdiosomatidae, Araneidae, some species of Lycosidae, juvenile of Theridiidae. In general, spiders living in cooler climates have a lower super-cooling point than those that prefer warmer regions. (Murphy et al., 2008).

In current study, there was positive correlation between the humidity and spider abundance, a higher body temperature also means a higher transpiration rate and a correspondingly greater loss of water. If a spider loses more than 20% of its body weight because of transpiration, it will die (Cloudsley- hompson, 1957). It seems, however, that most spiders can take up water from moist soil, provided that the humidity of the substrate is more than 12 %. Normally, early morning dew is quite sufficient for that purpose. Lubin (1986) suggested that the observed temporal abundance variation might result from seasonal changes in humidity and prey availability.

The differences in diversity and abundance of spiders from season to another, may be also due to another limiting factor, which had been observed is the crop growth stage. In current study, the value of diversity increased at the final stage of

crops this reflect the increase in number of species in the spider community as crop growth advanced, the final stage of the results in habitat that is more complex and can support higher diversity, an increase in the spider population according to the plant growth tends to depend on preys availability, if the density of prey becomes higher, spiders are expected to increase proportionally to some extent. As noticed in this study, Dictynidae were most abundant in the final stages, in which the vegetation provided good support for mesh webs, as well as Thomisidae, Clubionidae members increased at last stage of plants .

It has already been pointed out by Kobayashi (1961) that the values of correlation coefficients between the population density of insect pests and that of spiders tend to increase from negative to positive form as crop growth advanced .

The families activity varied during seasons in which some families active in Summer or Autumn , others in Winter or Spring, depending on the productivity period and hibernation which effect the spider seasonal availability. In the temperate zones, poikilothermic animals have to adjust to the harsh cycles of the seasons. Spiders have developed several adaptations to survive such adverse conditions as cold, dampness, flooding, and naturally lack of food. Spiders meet these challenges by colonizing the appropriate microhabitats, by increasing their resistance to cold, and by reducing their metabolic rate. They are thus well prepared for overwintering, and, as a consequence, mortality during the cold winter months is surprisingly low .

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