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ECOLOGY OF SPIDERS AT QENA GOVERNORATE, EGYPT

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ABSTRACT

Spiders are one of the more diverse arthropod taxa, ranking seventh in global diversity, which makes them a fascinating group to study (Coddington, 1986). The Egyptian spider fauna still incompletely known due to scarcity of studies on this group especially in Upper Egypt. So, the present study was focused on Qena Governorate (15-26^0 N, 32-50^0 E) to make a survey of spiders in different habitats of this region and to study its abundance of this group as well as the effects of some physical factors on the abundance of the collected taxa. Samples were collected every 2 weeks during a period of one year (from February, 2012 till January, 2013) from six different sites covering Qena governorate. Sampling methods include hand picking, sweep net and pitfall trap. Also, physical factors (temperature, relative humidity, evaporation and wind velocity) were recorded during the period of study. Survey results revealed the occurrences of 1247 specimens belonging to 14 families that included 23 genera and 23species. Families recorded were: Agelenidae, Araneidae, Eutichuridae, Gnaphosidae, Linyphiidae, Lycosidae, Oecobiidae, Oxyopidae, Philodromidae, Pholcidae, Salticidae, Sparassidae, Theridiidae and Thomisidae. Family Salticidae was represented by the highest number of specimens during the whole period of study (22.29 % from the total number of collected taxa), while family Agelenidae was represented by the lowest number. The maximum number of spiders was collected during autumn (29.11 % from the total number) while the minimum number was collected during winter. By using statistical analysis, it could be concluded that the total relative abundance of all species was affected by temperature followed by relative humidity.

Keywords: Ecology, Egypt, Qena governorate, Spiders.

INTRODUCTION

Spiders (order Araneae) are among one of the most rich groups of terrestrial animals, with more than 45,000 spider's species belonging to 114 families described so far and many thousands still awaiting discovery and description (World Spider Catalog, 2015). In Egypt, there are 40 families belonging to 193 genera and 385 species (El-Hennawy, 2006). They are fascinating animals that appeared on the earth during the carboniferous geological era, about 300 million years ago. They live in different habitats, in arid regions and wet lands, in low lands and mountains, in cold tundra and in hot equatorial regions. Spiders are all predators. Their prey range from microscopic mites to vertebrates to the size of small birds.

They are mostly terrestrial but include one aquatic species and a few inhabitants of tidal zones, in addition to several species that visit water to hunt (El-Hennawy, 2010). Spiders are important in another way; they are a vital component of most terrestrial ecosystems, not least of agricultural systems. They strongly affect the density of insect populations and have been shown to limit insect pests in the agricultural environment (Wise, 1993). The world wide spider fauna still incompletely known. Furthermore, the scientific literature is very scattered, and new species can be found even with the most cursory surveys. Despite these problems there is fair taxonomic literature (Sewlal and Cutler, 2003). Ecological studies of this kind have been presented in the past, mainly concerning the relationships between taxonomically well-defined groups of spider species in regions in which problems on spider taxonomy are more or less resolved. Knowledge of species composition and distribution in eastern Mediterranean ecosystems is very limited, making ecological studies in this region very difficult. (Chatzaki *et.al.*, 1997). On reviewing literature that focused on the Egyptian spider fauna, it could be concluded that it still incompletely known due to scarcity of studies on this group especially in Upper Egypt. So, the present study was focused on Qena Governorate (15-26^0 N, 32-50^0 E) to make a survey of spiders in different habitats of this region and to study the abundance of this group as well as effects of some physical factors on the abundance of the collected taxa.

MATERIAL AND METHODS

In the present investigation, samples were collected every 2 weeks during a period of one year (from February, 2012 till January, 2013) from six different sites covering Qena governorate (Fig.1). These sites (Plate 1) were distributed as follows: (1st site was at Nag hammadi city, 2nd site was at El-Taramsa Village, 3rd site was at the faculty of Engineering, 4th site was at South valley University, 5th site was at El-Laqita region and the 6th site was at Qus city). Three sampling methods were used in this study which included hand picking, sweep net and pitfall traps. The collected specimens were preserved in 70% ethanol. Examination and counting of taxa were carried out with the aid of stereomicroscope. Statistical analysis was performed using SPSS software package (SYSTAT statistical program, version 17). The recorded data of the weather parameters (temperature (^{o} C), relative humidity (%), evaporation (mm) and wind velocity (Knots), which were labeled as (Tem, R.H., Evab. and W.V.) were obtained from South Valley University-meteorological research station (SVU-meteorological research station) as illustrated in (Table, 1). Data were converted into log (n+ 1) instead of log n to avoid zero number (Williams, 1937). The program Canoco for windows 4.5 was used for canonical corresponded analysis (CCA) as a

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unimodal method to analyze the response of the spider's species community composition to ecological factors. The identification of specimens was carried out using many keys, papers and catalogues. Finally, they were confirmed by Mr. H. K. El-Hennawy the expert in spider's identification of Egypt.

Figure (1): A map of Qena governorate showing the sites of collections.

Plate (1): Photos showing different sites of collections.

Table (1): The monthly mean of weather factors for the study area during the period of investigation.

Months	T.(Min)	T.(Max)	Mean Temp.	R.H.(Min)	R.H.(Max)	Mean R.H.	Evap.	W.V.
February-2012	10.1	24.8	13.9	19.4	55.7	43.0	7.6	65.6
March-2012	11.8	27.1	19.6	15.8	51.4	30.8	9.5	53.3
April-2012	18.8	35.3	27.0	6.7	31.2	19.0	15.0	45.4
May-2012	23.4	38.8	31.1	7.6	29.2	18.4	17.8	56.1
June-2012	26.0	41.3	33.7	7.1	30.6	18.8	18.9	66.8
July-2012	27.0	41.0	34.0	11.5	35.4	23.5	19.6	93.0
August-2012	25.7	40.0	32.9	10.7	37.4	24.1	20.4	88.7
September-2012	23.2	37.6	30.4	15.5	47.2	31.4	17.1	102.3
October-2012	21.4	35.8	28.6	14.5	42.8	28.7	14.3	81.2
November-2012	16.3	29.6	22.9	23.5	57.4	40.5	10.4	86.3
December-2012	9.8	23.4	16.6	28.5	74.0	51.2	6.7	72.1
January-2013	5.8	20.7	13.2	28.3	69.7	49.0	5.7	57.2
Mean–2012/2013	18.28	32.95	25.32	15.76	46.83	31.52	13.6	72.33

T (Min) = Minimum of temperature °C, T (Max) = Maximum of temperature °C, R.H (Min) = Minimum of relative humidity (%), R.H (Max) = Maximum of relative humidity (%), Evap. = Evaporation (mm), W.V. = Wind Velocity (Knots).

RESULTS

The study revealed that the total number of specimens of different taxa of spiders collected through the year of investigation was 1247 specimens forming 23 taxa belonging to 23 genera that fall in 14 families; all of them belong to order: Araneae (Araneida).

These families were: Agelenidae, Araneidae, Eutichuridae, Gnaphosidae, Linyphiidae, Lycosidae, Oecobiidae, Oxyopidae, Philodromidae, Pholcidae, Salticidae, Sparassidae, Theridiidae and Thomisidae (Table 2). These families varied in their numbers and frequencies of occurrence according to the site, type of plants, methods of collection and the date of collections (climatic conditions). Family Salticidae was the most abundant family during the whole period of study (278 specimens, constituting 22.29 % from total number of collected taxa), but family Agelenidae was represented lowest number in the same period of study (4 specimens, constituting 0.32 % from the total number. Considering the number of each taxa of spiders collected from all sites, it was observed that the maximum number was collected from *Thanatus albini* (199 specimens, constituting 16.0 % of the total number), while *Halodromus barbarae* was the least species number since (2 specimens, consisting 0.16 % from the total number). Regarding sex ratio of collected spiders from all sites, it was clear that there were 213 adult male specimens, constituting 32.60% of the total number, whereas the adult females were represented by 440 specimens, constituting 67.40% of the total number). The most favorable locality was site (VI) since the maximum number of specimens was collected (262 specimens, constituting 21.01% of the overall total number), whereas site (III) was the least favorable one, since 169 specimens were collected and constituting 13.55% of the overall total number.

Table (2): The identified families and species from all sites during the period of investigation.

No.	Family	Species	No.	Family	Species
1	Agelenidae C.L. Koch, 1837	Benoitialepida	13	Oxyopidae Thorell, 1870	Peucetiasp.
2	Araneidae Simon, 1895	*Argiopetri fasciata*	14	Philodromidae Thorell, 1870	*Halodromus barbarae*
3		*Cyrtophora citricola*			
4		*Larinia* sp.	15		*Thanatus albini*
5	Eutichuridae Lehtinen,1967	*Cheiracanthium siwi*	16	Pholcidae C.L.Koch, 1851	*Artemaatlanta*
6	Gnaphosidae Pocock, 1898	*Trachyzelotes lyonneti*	17	Salticidae Blackwall, 1841	*Heliophanillus* sp.
7		*Zimirisdoriai*	18		*Plexippus paykulli*
19					*Thyene imperialis*
8	Linyphiidae Blackwall, 1859	*Erigone dentipalpis*	20	Sparassidae Bertkau, 1872	*Eusparassus walckenaeri*
9	Lycosidae Sundevall, 1833	*Pardosa* sp.	21	Theridiidae Sundevall, 1833	*Paidiscura dromedaria*
10		*Wadicosa fidelis*	22		*Theridion* sp.
11	Oecobiidae Blackwall, 1862	*Oecobius putus*	23	Thomisidae Sundevall, 1833	*Thomisusspinifer*
12	Oxyopidae Thorell, 1870	*Oxyopes* sp.			

Regarding monthly abundance of spiders, it was found that the maximal number was collected during June and October (128 specimens, consisting 10.26 % from the total number for each of them), while, the lowest number of the population was collected during January (59 specimens, consisting 4.73 % from the total number). The maximal number was collected during autumn (363 specimens, constituting 29.11 % from the total number), and the minimal number was collected during winter (215 specimens, constituting 17.24 % from the total number). The recorded spider's taxa were divided into constancy classes according to the system adopted by Weis-Fogh (1948), Hussein (1972), Obuid-Allah (2000), Abd El-Wakeil (2005), Al-Sanabani (2008) and Hussien (2011) as follows:- Constant species: Present in more than 50% of the samples. - Accessory species: Present in 20-50% of the samples. - Accidental species: Present in less than 20% of the samples.

The constant species included: *Cheiracanthium siwi* and *Thanatus albini*. The accessory species included: *Argiope trifasciata*, *Trachyzelotes lyonneti*, *Zimiris doriai*, *Pardosa* sp., *Heliophanellus* sp., *Plexippus paykulli*, *Thyene imperialis*, *Eusparassus walckenaeri* and *Thomisus spinifer*. The accidental species included: *Benoitia lepida*, *Cyrtophora citricola*, *Larinia* sp., *Erigone dentipalpis*, *Wadicosa fidelis*, *Oecobius putus*, *Oxyopes* sp., *Peucetia* sp., *Halodromus barbarae*, *Artema Atlanta*, *Paidiscura dromedaria* and *Theridion* sp. For studying the effects of environmental factors on the relative abundance of different taxa collected, stepwise multiple regressions was applied to select a model in which all variables are significant. It could be concluded that the total relative abundance of all species was affected by temperature. The model equation is: Relative abundance of all species = 4.202 + 0.163 temperature. Using canonical correspondence analyses (Fig. 2). It could be concluded that the first two CCA axes together account for 50% of the relations between the relative abundance of collected taxa and environmental variables. The results of CCA revealed that relative abundance of collected species mostly related to temperature followed by relative humidity; while the rest of the studied environmental variables have relatively small effects in collected species, especially evaporation. Temperature and wind velocity show positive correlation with the first canonical axis, while all of relative humidity and evaporation indicated negative correlation. Temperature has obvious effect on relative abundance of *Plexippus paykulli*. Relative humidity affects relative abundance of *Wadicosa fidelis*, while evaporation affects relative abundance of *Cheiracanthium siwi*. Wind velocity affects relative abundance of *Cyrtophora citricola*.

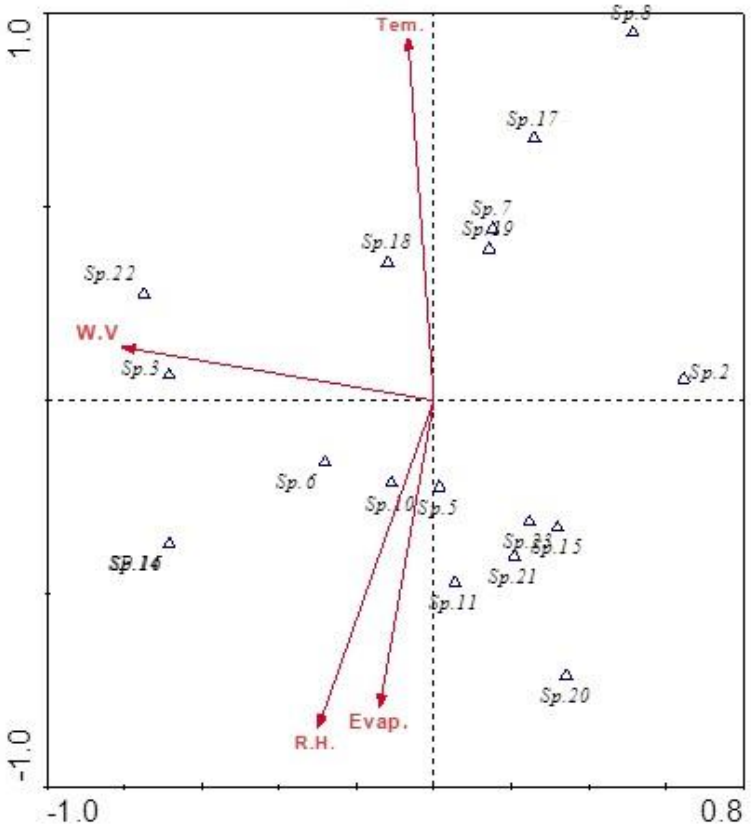

Figure (2): Ordination diagram of canonical correspondence analyses (CCA) of collected species and corresponding environmental factors sampled form all sites during the period of investigation.

DISCUSSION

To the best of the present authors' knowledge and as far as can be ascertained, the present study is the first of its kind carried out at Qena governorate and is one of the few studies on spider communities in Egypt indicating diversity of spider's fauna inhabiting plants. Spiders are one of the more diverse arthropod taxa, ranking seventh in global diversity (Coddington and Levi, 1991), which makes them a fascinating group to study. Concerning methods of collection of spiders, most studies used several methods, such as hand collecting, sweep nets or vacuum samples, are usually conducted during daylight hours (Young and Lockley 1990; Mason, 1992 and Breene *et al*., 1993a, b). Sweep samples can be conducted more quickly and with less material cost than for pitfall traps, barrier traps (Parmenter *et. al.*, 1991), pan traps (Evans and Bailey, 1993), or night traps (Evans *et al*., 1983).

In the present investigation, sweep net was the most effective method than other methods in the collection of spiders since most of species were sampled, and it was simple and inexpensive. The present study indicated that abundance of spiders varied during different seasons due to variation of weathers (363 specimens in autumn, 336 specimens in spring, 333 specimens in summer and 215 specimens in winter). The community of spiders reached high numbers in autumn as the suitable of weather and the high population of resource available during these periods. This result agrees with Mukherjee *et al.* (2010), who indicated that the populations of spiders showed stable numbers throughout summer and a smaller increase in the autumn as a general trend.

On the other hand, populations of spiders in the present study were lowest in winter, this result agrees with the results obtained by Gibson (1947) who studied the ecology of the spiders of a river-terrace forest in western Tennessee and indicated that physical factors were the dominant forces in the activities of the spiders during winter and the habitat is essentially reduced to a single layer, the ground-leaf stratum. Activity is reduced to a minimum during hibernation except on warm days when certain species move about on the dead leaves and herbs but even then evidence of predatory activity is lacking. Moreover hibernation is a general downward migration of the spiders (Weese, 1924). Also Mukherjee *et al.* (2010) indicated that winter and early spring had lower numbers of spiders than late spring, summer and autumn. Previous studies demonstrated that a correlation exists between the structural complexity of habitat and species diversity (Uetz, 1979, Andow, 1991). Uetz (1991) suggested that structurally more complex plants can support a more diverse spider community. The spiders are extremely sensitive to small changes in the habitat structure; including habitat complexity and microclimate characteristics (Downie *et al*., 1999 and New, 1999). Some studies like Duffey (1962), Almquist (1973), Hatley and MacMahon (1980), Robinson (1981), Greenstone (1984), Fraser and Frankie (1986) and Rypstra (1986) have shown that architectural features of vegetation, prey availability, and microclimatic conditions all are important in determining the abundance and distribution of spiders. The present study agrees with all of the above results where the most favorable locality was site (VI, 262 specimens), which is probably due to the high abundance and diversity of plants. This site is a fertile environment to attract insects and thus the diversity of spider's food is high. The less favorable locality was site (III, 169 specimens), which is mostly due to drought and small number of plants.

The anthropogenic effect during study caused rapid change in this site by cutting vegetation (as it happened during the period of collection in this site i.e. cutting down trees and plants to create buildings) caused adverse effect on the abundance and diversity of spiders. Different levels of grass, thinning of vegetation, also the time and the way of vegetation cut may affect the abundance, diversity, distribution and life cycles of spider species (Hendeson, 2007). From the present results, it was clear that the maximal number for monthly fluctuations of spiders was collected during June and October (128 specimens), constituting 10.26% of the total number for each of them. Negm *et al.* (1976) mentioned that although population size of spiders varied greatly throughout the growing seasons of clover, there was gradual increase until late May when a peak activity was reached, also Mukherjee *et al.* (2010) indicated that during April a distinct peak in fluctuation numbers of spiders occurs. The present results concerning the effects of studied environmental factors on the relative abundance of different species collected using stepwise multiple regressions to select a model in which all variables are significant; it was clear that the total relative abundance of all taxa was affected by temperature. Moreover using canonical correspondence analyses (CCA) indicates that relative abundance of the collected species mostly related to temperature followed by relative humidity; while the rest of the studied environmental variables have relatively small effects on the collected species, especially evaporation. The results cleared that temperature has obvious effect on the relative abundance of different species such as *Plexippus paykulli*, while the relative humidity affects relative abundance of other species like *Wadicosa fidelis*. Rosenzweig (1995) indicated that there were many environmental factors that affect species diversity. Riechert and Gillespie (1986) reported that spiders generally have humidity and temperature preferences that limit them to areas within the range of their "physiological tolerances" which make them ideal candidates for land conservation studies. The above mentioned results may account for the slight differences between the six investigated sites in the diversity of species (taxa) collected during the period of investigation (18, 20, 15, 20, 19, and 16). The relative abundance of 18 taxa among the 23 recorded taxa in the four seasons was non-significantly different and the other 5 taxa were slightly significantly different, this

may be attributed to similar environmental factors that prevailed in all sites. The present results indicated that the total catch of spiders varies from one location to another in the six investigated sites. Where, *Argiope trifasciata, Pardosa* sp., *Cherichanthium siwi, Thanatus albine, Heliophanellus* sp., *Plexipus paykaulli, Thyene imperialis,* and *Thomisus spinifer* were distributed in all sites during the period of investigation, which agree with Gibson (1947), who reported that when spiders were divided according to their functional group there was a significant effect of habitat on the diversity of these groups.

Some of the spiders are apparently tolerant for a wide variety of conditions and can be found virtually in all situations in substantial numbers. It often happens that a species characteristic of one habitat is numerically dominant in another. Based on the present results and compared with other results carried out in other different governorates of Egypt like: El-Mehalawy (1988); Rahil (1988); Sallam (1996, 2002); Hussien (1999); El-Erksousy (2000); Mohafez (2000); Ahmed (2003); Hamada (2003); Ibrahim (2003, 2008); Shaban *et, al.* (2008); Hussien (2011); Medany (2013) and Elnamrouty (2014), it is clear that there were differences in the diversity and in the relative abundance of taxa between the above studies and the present study. These differences may be attributed to the effect of one or more of the following variables like: environmental factors of the collected sites, habitat type, methods of collection, natural enemies, types and nature of crops, abundance of prey and human effects.

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بيئية العناكب فى محافظة قنا_مصر

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الملخص العربي

تلعب العناكب دورا هاما في بنيه المجتمعات والشبكات الغزائية والتوازن البيئي نتيجة تاثيرها وتاثرها بالبيئة المحيطة مما يجعلها من المجموعات الرائعة في الدراسة ،ولهذه الاسباب كان الهدف الاساسي من هذه الدراسة هو القاء المزيد من الضوء علي العناكب التي تعيش في محافظة قنا ،ومدي تاثير العوامل البيئية علي الوفر النسبية للانواع.
ولدراسةالانواع كميا ،جمعت العينات مرتان شهريا لمدة عام (في الفترة من فبراير2012 حتي يناير 2013)من ستة مواقع مختلفة داخل محافظةقنا (15 -26 شمالا و 50 32 شرقا)،والتي اختيرت لتغطي جميع انحاء المحافظة ،وقد تم استخدام الشبكة اليدوية لتجميع الحشرات والمصائد الارضية وكذلك التجميع اليدوي ،بعد ذلك حفظت العينات في كحول ايثيلي 70% وتم فحصها وعدها تحت الميكروسكوب ذي العدستين العينيتين .ولقد اظهرت الدراسة وجود 23 مرتبة تصنيفية من العناكب الارضية تنتمي الي 23 جنس متمثلة في 14 عائلة كما اظهرت نتائج الدراسة العدد الكلى للأنواع التى جمعت كميا خلال عام كانت 1247 عينة من داخل محافظة قنا،وقد تم دراسة والتخليلات الإحصائية أن درجه الحرارة والرطوبة كانتا اهم عاملين يؤثران فى الوفرة النسبية للعناكب محل الدراسة.