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Full Length Research Paper

Diversity and abundance of spider fauna at different habitats of University of Pune, M. S. (India)

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The objectives of the present study were to explore the diversity and abundance of spider fauna at different habitats. The study was conducted at different places of University of Pune, Pune, MS India. In this study we observed the diversity of Spiders (Class Insecta, phylum Arthopoda) and efforts were made to evaluate the status of ecosystems in University of Pune. In total 32 species of spiders belonging to 7 families were observed. Thus family Araneidae was the most dominant family exploring 35% of species. The high species diversity of spiders in University of Pune can be attributed to the high diversity of plants and insects. This could be an important centre of speciation Pune region.

Keywords: University of Pune, diversity and abundance, spiders, araneidae, families.

INTRODUCTION

India is rich in both flora and fauna and is mega diverse country. Knowledge about the diversity, Spiders is one of the most diverse groups of organisms. Though spiders form one of the most ubiquitous and diverse groups of organisms existing in India, their study has always remained largely neglected. They have, however, largely been ignored because of the human tendency to favor some organisms over others of equal importance because they lack a universal appeal (Humphries et al. 1995). Due to high species endemism, Western Ghats are listed in the 34 'Biodiversity hotspots' of the world (Mittermeier et al. 2005). In this Forest there are considerable plans for its protection. Due to less awareness about the spiders, diversity study in Western Ghats remains unexplored. Also there are many environmental factors that affect species diversity (Rosenzweig 1995). Studies have demonstrated that a correlation exists between the structural complexity of habitats and species diversity (Hawksworth and Kalin-Arroyo 1995). Diversity generally increases when a greater variety of habitat types are present (Ried and Miller 1989). Structurally more complex shrubs can support a more diverse spider community (Uetz 1991). Spiders are extremely sensitive to small changes in the habitat structure; including habitat complexity, litter depth and microclimate characteristics (Downie et al. (1999) and New (1999). 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 (Riechert, Gillespie 1986).

Therefore, documenting spider diversity patterns in this ecosystem can provide important information to justify the conservation of this ecosystem. Species richness is only one way of assessing habitat quality.

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Table 1. Description of sites for present study

SR. No.	Study Site	Plantation in Habitat
GARDEN	1. Elise Garden	*Pethecelobium saman , Colvilla racemosa, Dalbergia melanoxylon, Tamarindus indica , Ficus religiosa , Ficus bengalensis, Pletophorum ferruginium, Guzuma tomentosa,magnifera indica*
	2.Botanical Garden (Department of Botany)	Medicinal Plants, ferns, gymnosperms pteridophytes, lawns and green house.
	3. Medicinal Plants	Various species of medicinal plants
	4.Garden of Finance Department	Bottle palm, *Dalbergia melanoxylon, Tamarindus indica , Ficus religiosa , etc*
	5.Khoti gate area	*Polyalthea longifolia,delonix regia,Guzuma tomentosa,Peltophorum ferruginium,Ficus bengalensis etc*

MATERIALS AND METHODS

Study site

The present study was conducted from September 2011 to March 2012 at different study sites at Pune University campus, District – Pune, Maharashtra. (Table 1)

Sampling methods

Survey was conducted for 6 months from Sept 2011 to March 2012 at different sites. Five 20 x 20 m quadrates were taken for extensive surveys. Spiders were collected by Line transect and Quadrate methods. Spiders were collected by adopting standard sampling techniques such as sweep netting, beating sheets, active searching and hand picking and Umbrella collection. All surveys were conducted in the morning hours between 7:00 am to 11:00 am. Collected spiders were photographed in live condition identified and then released to their natural habitat. Few spiders were observed under microscope for identification and study of some morphological characteristics

Identification

Spiders were observed using stereo zoom microscopes for studying identification keys. All specimens were identified using the taxonomic keys for Indian spiders given by Tikader (1987), Reddy and Patel (1992), Biswas and Biswas (2003) ,Majumdar (1995) and Sabbastian ,and Peter (2009).

Statistical analysis

Shannon diversity index was calculated using the formula

H =? Pi * ln Pi,
Where
Hl= Shannon Index
Pi = Proportion of individuals belonging to the ith species
Pielou's Eveness was calculated by formula
Jl = Hl/Hmax
Where, Hl = Shannon value, Hmax = Maximum possible Shannon value if all the species were equally abundant.
Cluster analysis was calculated using the Bray-Curtis similarity matrix and a dendogram was constructed using the software Biodiversity professional Version 2.
The Jaccard's similarity index was also calculated using the following formula
J = Nc / Na + Nb - Nc
Where,
Na = Number of samples in Set A
Nb = Number of samples in Set B
Nc = Number of samples in intersecting Set C
Species richness was calculated by formula
S.R = S-1/Ln N
Where, S= no of species
N = no of total individuals

RESULTS AND DISCUSSION

Total 32 species under 17 genera and 7 families (Table 1) were recorded during the 6 month survey in Pune University. This area is rich in floral diversity. In our observation Araneidae is the most represented family with 11 species.

Distribution of Spider families at Pune University

Present study was done to observe the diversity of spider in Pune University. We observed 11 species belonging to family Araneidae, 8 species belonging to family Lycosidae., 6 species of family Salticidae 3 species of

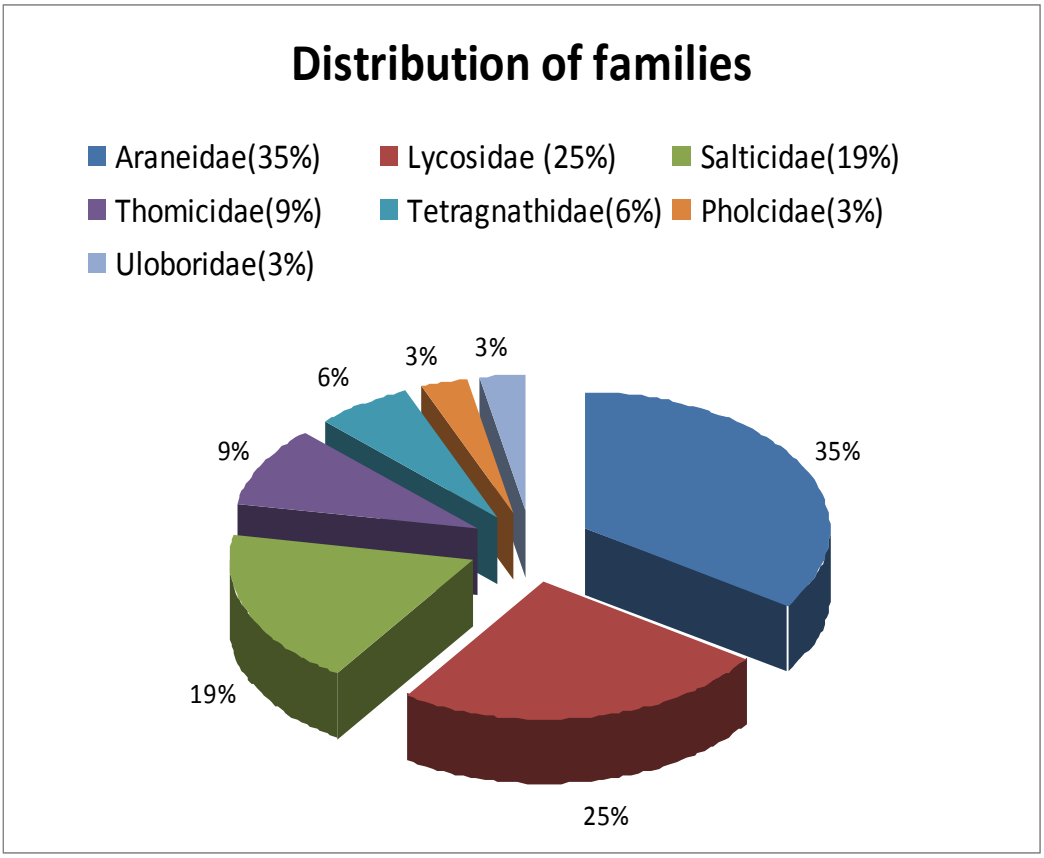

Figure 1. Distribution of Spider families at Pune University

family Thomicidae, 2 species belonging to family Tetragnathidae and one species belonging to each family Pholcidae and family Uloboridae . Thus family Araneidae is the most dominant family exploring 35%of species second leading family is Lycisodae with 25s% of species, families Salticidae and Thomicidae exhibit 19% and 10% species respectively , family Tetragnathidae with 6% of species , Pholcidae, and family Uloboridae display 3% each of the total species diversity.

Family diversity

Out of the 60 families recorded in the Indian region (Sebastian and Peter, 2009).Out of which 7 families were recorded at University of Pune District - Pune , Maharashtra, India. This represents 11.87 % of the total families recorded in India. Araneidae was the dominant family in this biome, which is composed of (11 species) of four genera. Lycisodae was the next dominant family with 8 species, Salticidae (6 species), Thomicidae (4 speices) Tetragnathidae (2 species), and Pholcidae, Uloboridae (1 species each) was the order of dominance of the families in this ecosystem. Distribution of Spider families at different habitat of Pune University is shown in Figure 1.

Distribution of Spider species at different habitat of Pune University

Total 33 species under 17 genera and 7 families (Table 1) were recorded during the 6 month survey in Pune University. Values of species richness are given in Table 2.

Diversity of different guilds of spider fauna at University of Pune

We studied the diversity of spiders on the basis of guild possessed by spiders. We observed spiders species belonging to seven different guilds like orb web builder, foliage runner, ground runner, sheet web builder, ambusher, scatter line weaver. We could observe that Orb web is the dominant guilds of spider at university of Pune exhibiting 34%.This might be because selected locations of University of Pune take care of shelter, reproductive behavior and foraging of these orb webs.

Table 2. Distribution of spider species at Pune University

Family	Species	Total observed species	Guild	Species Richness
Araneidae	*Argiope pulchela,(*Thorell,1881)	1	Orb web	12.81
	Cyclosa hexatuberculata ,(Tikader,1982)	5	spider	3.81
	Crytophora cicatrosa (Stoliczka,1869)	13		1.81
	Crytophora citricola (Forskal,1775)	3		2.81
	*Neoscona sanghi,(*Gajbe,2004)	1		0.81
	Neocona notica (L.Koch,1875)	1		0.81
	Neoscona sp,1	2		1.81
	Neoscona sp,2	2		1.81
	Neoscona sp, 3	4		3.81
	Neoscona sp,4	2		1.81
	Neocona thesis	1		0.81
Lycosidae	*Lycosa prolifica*(Pocock,1910)	9		6.81
	*Hippasa pisaurina,(*Pocock,1900)	7		3.81
	Hipassa sp,1	2		0.81
	Hipassa sp,2	15	Ground	22.81
	Pardosa brimanica,(Simon,1884)	4	runner	2.81
	Pardosa sumatrana,(ThorelL,1890)	3		0.81
	Pardosa mukundi, ,(Tikader and Malhorta,1980)	1		1.81
	Pardosa sp,	19		0.81
Salticidae	*Marphissa mandala*	1		1.81
	Phidippus bhimrakshiti (Gajbe,2004)	2		0.81
	Plexippus paykulli(Audouin1826)	1		0.81
	Plexippus petersi (Karsch 1878	4	Foliage runner	0.81
	Plexippus sp,	1		2.81
	Tellimonia dimidiate, (Thorelland Simon, 1899)	3		0.81
Thomisidae	*Misumenopus sp,1*	2	Ambushe**r**	1.81
	Xysticus bharatae (Gajbe and Gajbe 1999)	1		0.81
	Xysticus sp,	44		43.81
	Misumenopus sp,2	1		0.81
Tetragnathidiae	*Nephila sp.1*	5	*Orb web builders*	4.81
	Nephila sp.2	47		46.81
Pholcidae	*Pholcus phalangiodes* (Fuesslin,1775)	7	*Scattered line weaver*	6.81
Uloboridae	*Uloborous sp.*	1	*Orb web builders*	0.81

builders species. Most of the locations selected for the present study for example Elis garden, botanical garden, medicinal plant garden are rich in plant diversity. Ground runner is 25%. Whereas, sheet web builder, ambusher, scatter line weaver shows 3%, 9 % and 3 % respectively. Diversity of different guilds of spider fauna is shown in Figure 2.

Diversity indices of spider at Pune University

Different diversity indices were calculated to study diversity and abundance of spiders. Value of Shannon diversity index is 2.608. it means university of Pune holds good diversity of spiders. Evenness index is 0.752. Thus we can say that the distribution of spider is not even

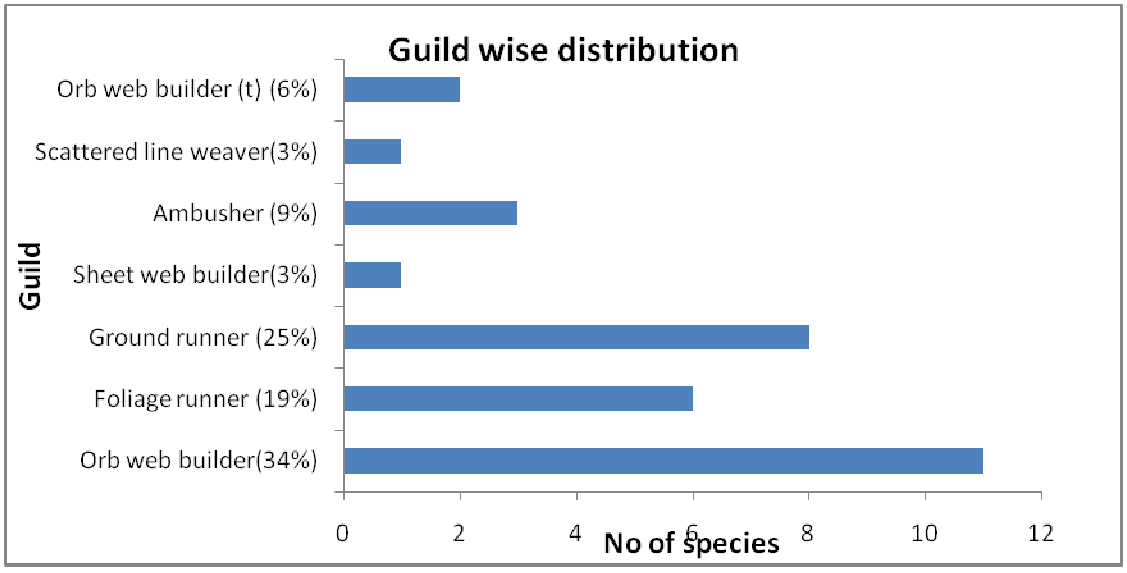

Figure 2. Guild wise distribution of species of spiders at different locations of University of Pune. X axis represents number of species and Y axis represent the Guild of families

Table 3. Diversity indices of spider at Pune University

Diversity indices	Pune University
Shannon index H	2.608
Evenness E	0.752

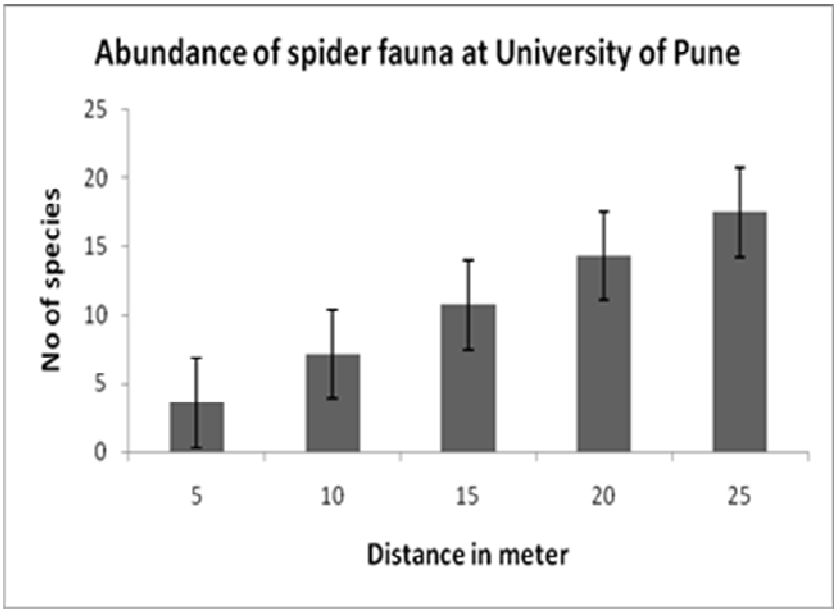

Figure 3. Abundance of spider fauna at University of Pune.

throughout the University of Pune. Some area of university of Pune like Ellis garden, botanical garden, khadki gate area are very rich in spider diversity while little area is not much diverse.(Table 3,).

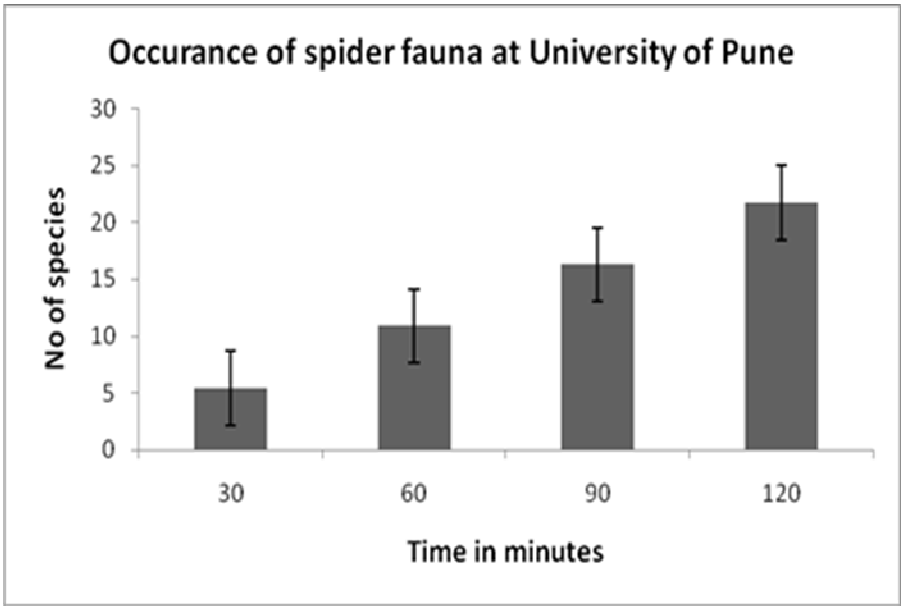

Figure 4. Probability of detection of spider fauna at University of Pune.

Table 4. Bray-Curtis species analysis showing species wise percent similarity between the different collection sites.

	Similarity Matrix						
Collection sites	**Ellis garden**	**University pond**	**Post office**	**Khadki gate**	**Faculty house**	**Zoo Dept**	**Ladies hostel**
Ellis garden	*	1.8349	3.8462	32.8125	11.0092	1.7094	1.8018
University pond	*	*	28.5714	0	7.6923	52.9412	64.2857
Post office	*	*	*	0	9.5238	6.8966	8.6957
Khadki gate	*	*	*	*	0	0	0
Faculty house	*	*	*	*	*	0	0
Zoo Dept	*	*	*	*	*	*	83.3333
Ladies hostel	*	*	*	*	*	*	*

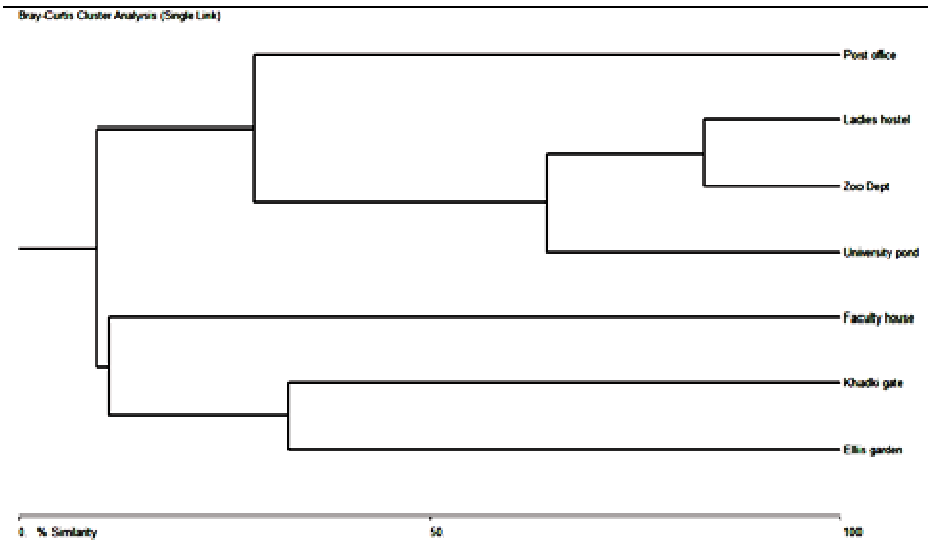

Figure 5. Bray- Curtis species analysis showing wise percent similarity between the different collection sites.

Table 5. Jaccard similarity matrix values

	Ellis Garden	University pond	Post office	Khadki gate	Faculty house	Zoo Dept	Ladies hostel
Ellis Garden	1	0.041	0.074	0.086	0.083	0.047	0.047
University pond		1	0.333	0	0.125	0.25	0.25
Post office			1	0	0.083	0.125	0.125
Khadki gate				1	0.125	0	0
Faculty house					1	0	0
Zoo Dept						1	1
Ladies hostel							1

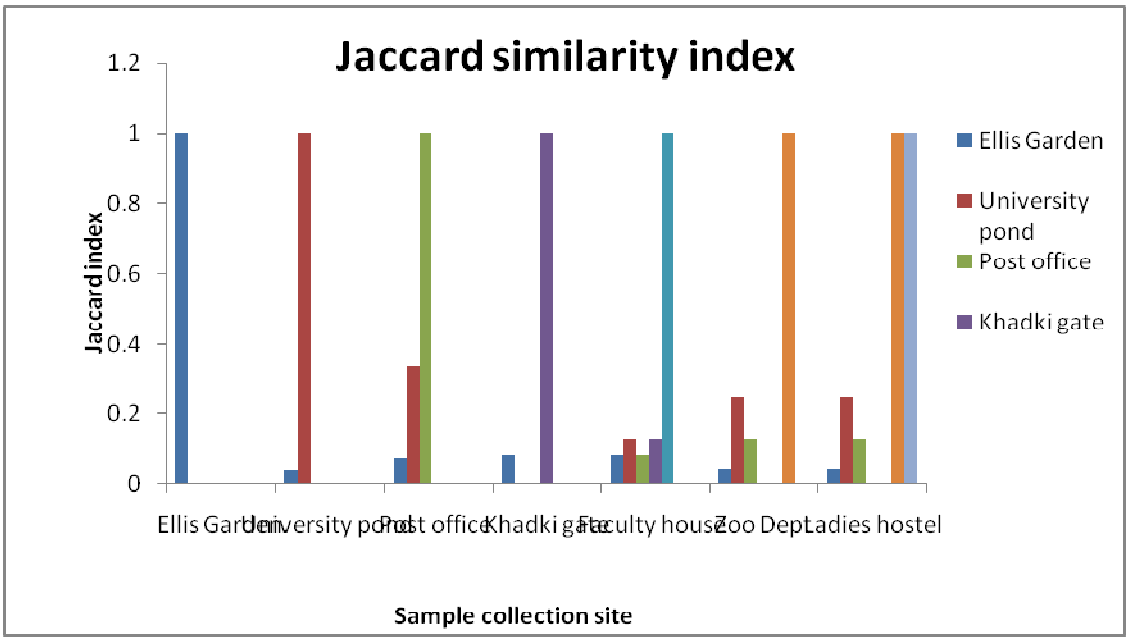

Figure 6. Jaccard similarity matrix

We studied the occurrence and Abundance of spider fauna at university of Pune, our results and different indices show that Abundance and Occurrence of spider fauna at university of Pune is satisfactory. We found that occurrence of spider fauna is 5.42 per 30 minutes, 10.85 per 60 minutes, 16.27 per 90 minutes and 21.7 per 120 minutes respectively. We also observed that the abundance of spider fauna is 17.44 species per 25 meter of distance. Abundance and Occurrence of spider fauna at different habitats of university of Pune are shown in Figure 3 and Figure 4.

Bray-Curtis species analysis showing species wise percent similarity between the different collection site

The dendrogram shows that there is 83 % similarity in species composition between ladies hostel and department of zoology belonging to family Pholicidea and scattered line weaver guild. While zoology department and Ellis Garden shows least similarity (1.7%). This could be due to the variable vegetation type. (Table 4), (Figure 5)

Jaccard similarity matrix values:-

From the Jaccard similarity matrix it is observed that ladies hotel and department of Zoology are showing more similar species composition were as less similarity is seen between University pond and Elis garden. (Table 5), (Figure 6)

Species richness

A total of 32 species are discovered from a limited area of

Pune University. This number is high compared with other regions like Andaman and Nicobar islands – 65 species, Sikkim – 55 species and Calcutta – 99 species (Tikader 1970, 1977 and Tikader, Biswas 1981). The above three studies were conducted over a period of one to two years while the present study was limited to six months.

Endemism

A total of 252 endemic species of spiders are reported from India so far (Siliwal et al. 2005). Among the collection, 5 species at Pune University, District-Pune, Maharashtra, India are found to be endemic, to India.

Of about 1442 species reported from India (Siliwal et al. 2005), 33 species have been recorded from University of Pune, Dist Pune, Maharashtra, India. Thus high species diversity of spiders in this area can be attributed to the high diversity of plants and insects. High plant diversity (Tectona grandis, Acacia catechu, Butia monosperma Pethecelobium saman , Colvilla racemosa, Dalbergia melanoxylon, Tamarindus indica , Ficus religiosa , Ficus bengalensis, Pletophorum ferruginium, Guzuma tomentosa,Bauhinia-purpurea, Cassine gluca Millingtonia hortensis, Roystoneae regia,Sterculia fertida, etc. sustains a high faunal diversity by providing diverse microhabitat especially for invertebrates. Unlike other ecologically important zones, there is no previous work in this area to compare the spider diversity. This indicates the need for further study in this area. Because of the complex interaction of various climatic factors like rainfall, temperature, availability of water source nearby this area may holds many smaller but diverse environmental niches. The presence of diverse habitats like deciduous forests, herbs and shrubs and sand and small water bodies can make Pune University area an important centre of speciation.

CONCLUSION

University of Pune Dist-Pune, Maharashtra, India is rich in spider diversity. University of pune also exhibits good number of spiders and remarkable diversity in guilds of spider fauna. This study serves as a baseline for future study of spiders in these ecosystems. But further study is required to confer. This study was conducted only for six months. So seasonal variation in diversity and abundance of spider fauna will needed to be studied. It also emphasizes the need for conservation of this ecosystem by characterizing species diversity and highlighting rare and endemic species in this ecosystem.

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