The Research of Medical Science Review

Received: 30 November, 2024
Accepted: 31 December, 2024
Published: 07 January, 2025

ISSN: 3007-1208 | 3007-1216
Volume 3, Issue 1, 2025

DIVERSITY AND GUILD STRUCTURE OF SPIDER FAUNA FROM WHEAT FIELDS OF DISTRICT LARKANA, SINDH, PAKISTAN

Imran Ali Soomro[1], Jawaid A. Khokhar[*2], Tahira J. Ursani[3]

[1,*2,3]*Department of Zoology, University of Sindh, Jamshoro*

[*2]*khokharjawaid@gmail.com*

ABSTRACT

This study explored the complex dynamics of spider species diversity and distribution across wheat crop associations, with a specific focus on the Larkana district.The study was conducted in four specific regions dedicated to wheat cultivation, located at 27° 33' 30³ North and 68° 12' 40³ East. It covers the agricultural years 2021 and 2022 and involves extensive annual surveys. This study provides new knowledge by using the ecological guild concept to classify spiders according to their unique foraging techniques for shared resources. The main spider groups found in wheat crops are web-builders/orb weavers, wandering spiders, jumping spiders, and sheet-line weavers. Examination of spider communities at different growth phases of wheat harvests revealed noticeable changes in the overall variety and number of species, suggesting fluctuations in the availability of resources. The considerable influence of these spider groups on insect populations is responsible for the remarkable decrease in agricultural losses, which can be classified based on their specific nutritional preferences and foraging behaviors. This classification helps to identify how different species are distributed throughout wheat fields, showing geographical variation. Factors such as the location of the field (edges versus center) and the complexity of the wheat crop play a crucial role in influencing the outcomes. This study highlights the concept of "disparity," which encompasses differences in guild structures that indicate both competition and cooperation among guild members. The exceptional ability of spiders to hunt and capture pests that harm wheat crops has strengthened their ecological importance. The study used sweep nets, pitfall slope traps, and manual sampling to collect 4428 spider specimens. These specimens were then sorted into seven families, namely, Araneidae, Linyphiidae, Lycosidae, Oxyopidae, Salticidae, Tetragnathidae, and Thomisidae, using a systematic approach. This comprehensive strategy enhances the field of Integrated Pest Management (IPM). By applying the formula $R = s/\sqrt{N}$, we calculated a species richness of 0.471.The utilization of the Simpson Index and Biodiversity Index in biodiversity analyses provides a detailed representation of the wide range of spider species that flourish in the wheat fields of the Larkana area. These findings offer useful insights for ecological management and conservation endeavors in agricultural ecosystems.

Keywords: *Diversity; Guild Structure; Spider; Fauna; Wheat Fields; Larkana; Sindh; Pakistan.*

INTRODUCTION

Spider Diversity:

Biodiversity encompasses the vast array of living organisms found on Earth. Many systematic and phylogenic studies were carried out on the spiders from world which are significant for researchers [1- 3]. Studying different insect including spider's populations is crucial because insects make up a

significant fraction of the world's animal species. Biogeography is studies the mechanisms and patterns of how living creatures disperse and distribute themselves. The allocation process has been thoroughly examined in this field of research [4-8]. The spiders are of considerable economic importance as biological control agents and their poison are of great demand can also purchase and put up for sale. They can be kept as pet animals in the house because their beauty is overlooked especially when they capture a prey [8-10].

Guild Structure:

The concept of environmental guilds or associations holds significant importance for Arachnologists, as it provides insights into the diverse foraging behaviors of spiders in their search for general resources. The complexity of arthropod hunting has led to the identification of guilds, particularly within the realm of spiders, a concept rooted in the analysis of Trophic Levels known as Genossenschaften by ecologists [11]. The term "guild" was initially introduced in the field of Floral and Faunal Ecology and has recently gained prominence in studying patterns of niche exploitation among birds [13] and the broader arthropod fauna [14]. According to research [15], guilds offer a suitable ecological framework for studying both interspecific and intraspecific competition among species. Arachnologists have made numerous attempts to categorize spiders into guilds, varying from as few as two to as many as eleven guilds, although challenges arise when generalizations are based on higher taxa due to the diverse diurnal and nocturnal behaviors of species [16-21].

Objectives:

The aim of this study is to compile a comprehensive and precise list of spider species and guild they made in wheat fields for the prey along with and their distribution in the wheat growing region of District Larkana

Novelty Statement:

This study significantly advances our knowledge of the varied spider species and their Guild structure in the Larkana district. It investigates into the intriguing process by which spiders in wheat fields spontaneously organize into hunting groups shortly after the crop is planted, a phenomenon occurring immediately following the sowing of the crop. The research provide precise and detailed insights into the common spider species prevalent in wheat fields, shedding light on the indispensable role these arachnids play in the biological management of agricultural areas. Notably, the study underscores the crucial economic benefits that can be harnessed by employing spiders as an effective biocontrol method. It fervently advocates for the strategic utilization of spiders in this capacity, emphasizing their potential to revolutionize agricultural practices and enhance crop yield while promoting ecological balance.

Methodology:

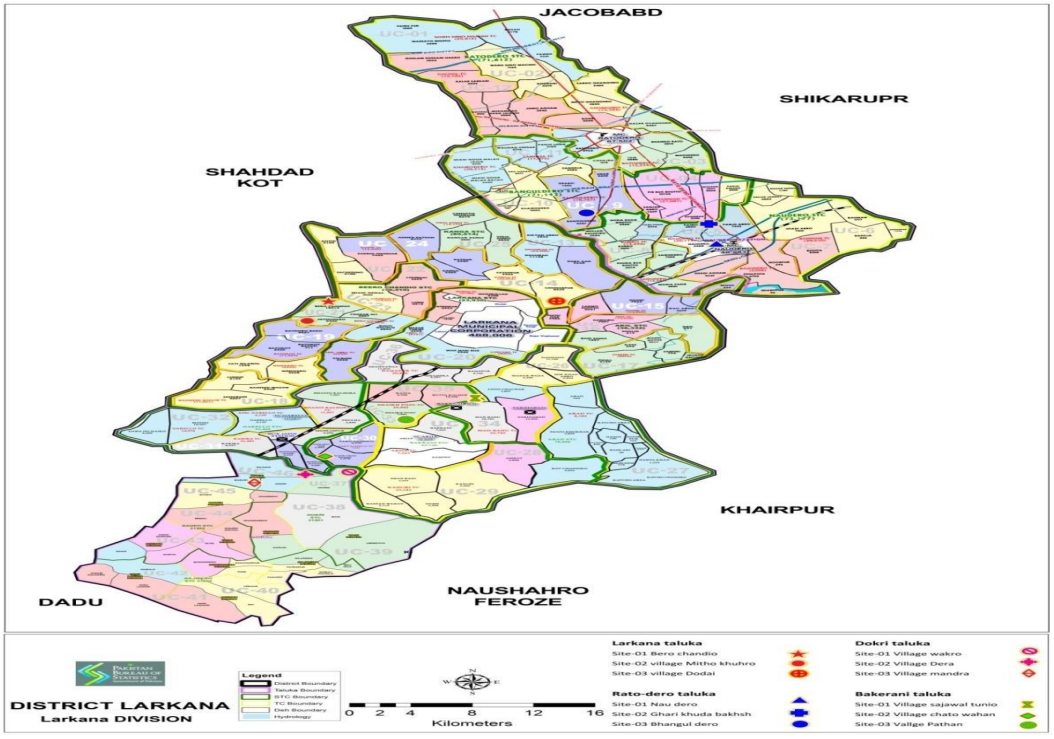
Sample consist of 4428 specimen (including spider ling) were composed in the 2- segments, a) January to May 2021 and b) January to May 2022. Collection was made by 1) **Pitfall Method (PM):**The majority of specimens were gathered by **PM**,it is verified more suitable and efficient for the spider collection especially during early sowing till the harvesting of the wheat crop as shown in (Fig.1 and 2). 2) **Hand Picking Method (HPM):** Spiders are fast runners mostly live in holes, cracks in the soil but this **HPM** method was used for those species which are found to be visible in the ground, middle and top of the wheat fields (Fig.3).

Prey of Spiders:

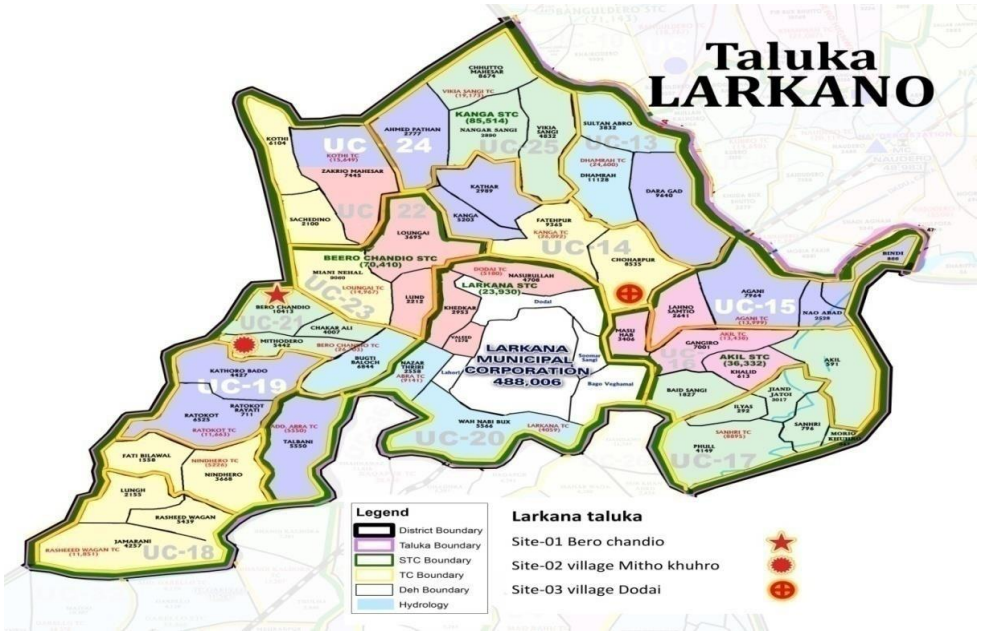
Spiders are carnivorous and great hunters so their attack on the prey was noticed quickly and bring the prey into holes and cracks, but some observations were made only on the web making spiders as shown in the (Fig. 4).

Guild (Assembly) of Spiders:
For the study of guild a few experiments were designed and experimental observations were documented at green house of Tando Jam University and advanced laboratory of Arachnology and Predatory Insects at Department of Zoology (Fig.5).
Preservation of Spiders:
Spiders were assembled into voiles, different size jars and preserved into 70% alcohol with 2 ml of glycerin. The entire specimens were labeled according to the standard methods (Fig.3.).

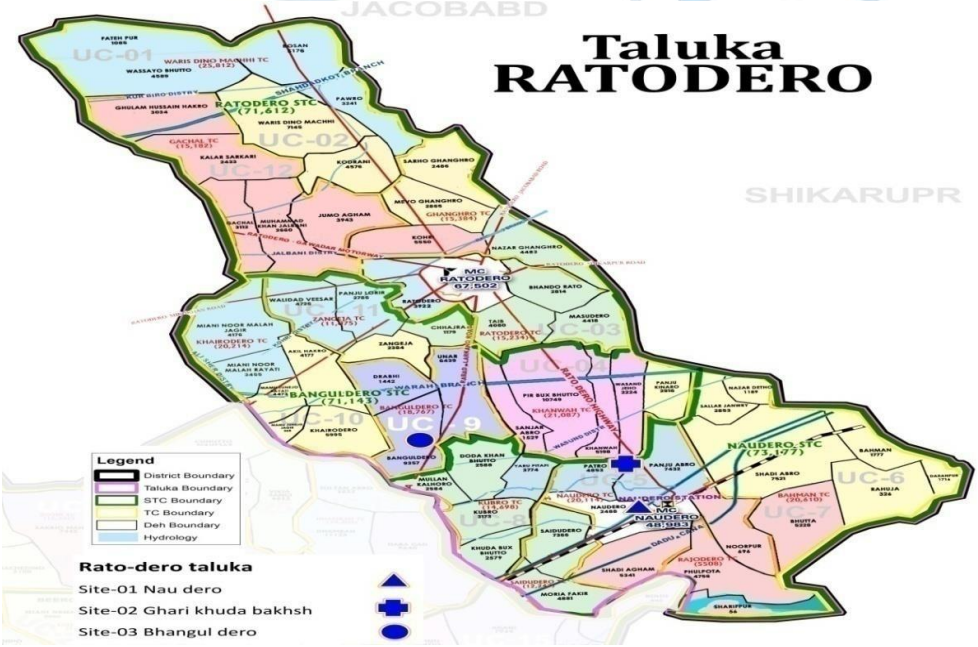
Research Sites:
For this research was planned from district Larkana, therefore its four Talukas along with three selected sites were chosen from each taluka as shown in (table.1,2), and sites names are (Site-I Bero chandio, Site-II,Village Mitho Khuhro, Site-III Village Dodai, *Site-IV Nau Dero, Site-V Ghari Khuda Bakhsh, Site-VI Bhangul Dero, *Site- VII Village Wakro, Site-VIII Village Dera, Site-IX Village Mandra, *Site-X Village Sajawal Tunio and Site-XII Village Pathan. Note*: these sites were selected from edges of wheat fields which were touched with forests, roads, Villages and River side) (Map 1-5).



Map. 1: District Larkana and location of four selected talukas



Map.2: Taluka Larkano and location of three chosen sites



Map. 3: Taluka Ratodero and location of three chosen sites

Map.4: Taluka Dokri and location of three chosen sites

Map. 5: Taluka Bakhari and location of three chosen sites

Figure.1: pitfall traps were fixed at different sites of wheat field, for the collection of spider.

Figure. 2: View of another site of pitfall traps for the spider collection in wheat field, Larkana

Figure. 3: View of site showing hand collection method for spider in the wheat.

Figure. 4: Spider and its web View of lost trip for the collection of spiders in wheat field, Larkana

RESULTS

Diversity:

The wheat edges were high species diversity and abundance due to denser permanent plant life and high dampness and moderate temperature. While domination was recorded in sparingly and middle of the wheat fields sites. The spiders included in to traveling or moving here and there were prevailing in all reported sites, while on the basis of guild only 4 above mentioned assemblages were recorded where there was a higher plant complexity. In this research observed in the wheat fields of the Larkana, the total 4 Guilds were recognized on the basis of their foraging, predatory and circadian behaviors. And beside seven families of the spider fauna were also recognized namely Araneidae, Linyphiidae, Lycosidae, Oxyopidae, Thomisidae, Tetragnathidae, Salticidae and 10 genera and 14 species (Tables. 2-10). Many

advantages of guild formation among the spider species found, and their great and significant impact were observed in the pest control by the spider fauna. Hence this research is the other gate way for the other researcher and peoples who engaged with pest control because of the predatory role of the spiders. The existence of the spider in the field of wheat crop is of great value. Because everybody knows that wheat crop is achieve cereal and folder crop for the peoples as well as their for their cattle.

Guild Structure:

The Arachnologist took great interest in the study of guild found in various ecological habitatas, also the variation in the foraging behavior for capturing of the prey leading to classified them in to guilds. During this study 4 guilds were observerd on the basis of circadian behavior, feeding behavior, web formation and prey capturing tactics;it was intresting to observe that most of the collection was collected from wheat field edges while the species richness was low in the middles of the wheat fields, one of the reasons was use of chemicals in the form of herbicides and pesticides spray. It was also observed that differences found in four dimentional scales like simple vs complex wheat fields and centre vs edges of the wheat fields. Present study submitted that use of various diverse wheat varieties, sponsored heterogeneity also promote diversity of spider fauna in the agro ecosystems also increased the annual yield of the crop (Table.9).

Table 1: Designed sites of District Larkana for the observation of spider diversity and Guild structure

S. #	LARKANA TALUKA	RATO-DERO TALUKA	DOKRI TALUKA	BAKERANI TALUKA
01	Site-I Bero chandio	Site-IV Nau Dero	Site-VII Village Wakro	Site-X Village Sajawal Tunio
02	Site-II Village Mitho Khuhro	Site-V Ghari Khuda Bakhsh	Site-VIII Village Dera	Site-XI Village Chato Wahan
03	Site-III Village Dodai	Site-VI Bhangul Dero	Site-IX Village Mandra	Site-XII Village Pathan

Table .2:Sites and collection of (specimen) spider diversity 2021 and 2022

Name of Sites	Collection Year 2021	Collection Year 2022
*S-I, IV, VII,X	589	1438
S-II, V, VIII,XI	605	438
S-III, VI,IX, XII	840	518
Total 2034 2394 = **4428**		

Abbreviations used:*Site-I Bero chandio, Site-II,Village Mitho Khuhro, Site-III Village Dodai, *Site-IV Nau Dero, Site-V Ghari Khuda Bakhsh, Site-VI Bhangul Dero, *Site-VII Village Wakro, Site-VIII Village Dera, Site-IX Village Mandra,

*Site-X Village Sajawal Tunio and Site-XII Village Pathan*these sites were selected from edges of wheat fields which were touched with forests, roads, villages and River side.

Table 3: Name of Taulkas and name of their sites from collection were made in 2021 and 2022

District & Sites	Larkana 2021	2022	Rato-Dero 2021	2022	Dokri 2021	2022	Bakarani 2021	2022
*S-I, IV, VII,X	104	297	168	307	157	402	160	432
S-II, V, VIII,XI	190	75	108	94	190	156	72	113
S-III, VI,IX, XII	191	130	105	107	239	141	295	195
Subtotal:	987		889		1285		1267	
Total: 4428								

Abbreviations used:*Site-I Bero chandio, Site-II,Village Mitho Khuhro, Site-III Village Dodai, *Site-IV Nau Dero, Site-V Ghari Khuda Bakhsh, Site-VI Bhangul Dero, *Site-VII Village Wakro, Site-VIII Village Dera, Site-IX Village Mandra,

*Site-X Village Sajawal Tunio and Site-XII Village Pathan*these sites were selected from edges of wheat fields which were touched with forests, roads, villages and River side.

Table 4: Data of collected specimens from 3 sites in three months from Taluka Larkana

S.NO	Name of sites	*FV (February) 2021-2022		*SV (March) 2021-2022		*TV (April) 2021-2022	
01	Site-I	20	97	45	84	39	116
02	Site-II	81	25	66	30	43	20
03	Site-III	66	47	55	32	70	51
Total = 987							

*Abbreviations used: FV= First Visit, SV= Second Visit, TV= Third Visit.

Table 5: Data of collected specimens from 3 sites in three months from Taluka Rato Dero

S.NO	Name of sites	*FV (February) 2021-2022		*SV (March) 2021-2022		*TV (April) 2021-2022	
01	Site-IV	42	95	67	113	59	99
02	Site-V	46	12	25	37	37	45
03	Site-VI	29	37	47	40	29	30
Total = 889							

*Abbreviations used: FV= First Visit, SV= Second Visit, TV= Third Visit.

Table 6: Data of collected specimens from 3 sites in three months from Taluka Dokry

S.NO	Name of sites	*FV (February) 2021-2022		*SV (March) 2021-2022		*TV (April) 2021-2022	
01	Site-VII	57	103	39	139	61	160
02	Site-VIII	53	47	78	60	59	49
03	Site-IX	75	43	91	58	73	40
Total = 1285							

*Abbreviations used: FV= First Visit, SV= Second Visit, TV= Third Visit.

Table 7: Data of collected specimens from 3 sites in three months from Taluka Bakerani

S.NO	Name of sites	*FV (February) 2021-2022		*SV (March) 2021-2022		*TV (April) 2021-2022	
01	Site-X	43	105	50	140	67	187
02	Site-XI	16	30	19	37	37	46
03	Site-XII	86	55	91	61	118	79
Total = 1267							

*Abbreviations used: FV= First Visit, SV= Second Visit, TV= Third Visit.

Table 8:Total site wise and years wise collection of spider fauna from District Larkana

Sites	*FV*SV*TV, FEB to APR, 2021			*FV*SV*TV, FEB to APR, 2022			Total
S-I	20	45	39	97	84	116	
S-II	81	66	43	25	30	20	
S-III	66	55	70	47	32	51	
S-IV	42	67	59	95	113	99	
S-V	46	25	37	12	37	45	
S-VI	29	47	29	37	40	30	
S-VII	57	39	61	103	139	160	
S-VIII	53	78	59	47	60	49	
S-IX	75	91	40	43	58	40	
S-X	43	50	67	105	140	187	
S-XI	16	19	37	30	37	46	
S-XII	36	91	118	55	61	79	

*Abbreviations used: FV= First Visit, SV= Second Visit, TV= Third Visit, FEB

=February, APR= April

Table 9: Feeding/foraging guild in the wheat fields of District Larkana

Spider Family	Guilds
Araneidae Oxyopidae Lycosidae Thomisidae Salticidae Tetragnathidae Linyphiidae	Web-builders/orb weavers Wandering spiders = = Jumping spiders Wandering/diurnal running spiders = = Sheet line weavers

Note: 4 guilds were observed in the wheat fields of Larkana, on the basis of their 1. Feeding behavior and other is 2. Circadian

Table 10: Spider fauna (Diversity) found in wheat fields of Larkana in 2021 and 2022

Name of Families	Name of Species	*NOS	*N Specimens
Araneidae	Argiope pradhani (Sinha 1951) Neoscona Mukergei (Tikader 1980) Neoscona theisi (Walckenaer 1842) Argiope trifasciata (Forskal, 1775)	4	1498
Linyphidae	Linyphiidae (Abacoproeces topcui)	1	24
Lycosidae	Lycosa terrestris (Butt et al., 2006) Pardosa birmanica (Siman 1884)	2	654
Oxoypidae	Oxyopes marginslis (Mukhtiar 2004)	1	323
Salticidae	Marpissa tigrina (Tikader 1974) Plexippus paykulli (Audouin 1826) Hasarius adansoni (Audouin 1826)	3	587
Teteragnathidae	Tetragnatha javana (Thorell 1890)	1	416
Thomicidae	Thomisus elongatus (Stoliczka 1869) Thomisus pugilis (Stoliczka 1869)	2	426
Total: 07		14	**4428**

* Number of species and number of specimen

Table 11: Feeding/foraging guild structure formed by spider in the wheat fields of District Larkana

S.No.	Spider Family	Guild structure formed by of spiders in wheat fields
01	Araneidae	Orb-weavers are predators that are generally low in the food web. They built guild for food sources which is vary i.e many insects and other arthropods within the different webs.
02	Oxyopidae	The majorityof these spiders' species make insignificant use of webs, while foraging on insects deweling in wheat crops.
03	Lycosidae	It was observed that the members of the this family feed on the crickets, different ants species in the wgeatfields of reported areas
04	Thomisidae	They hunt onprimarily on insects likewheat aphids, when their size is small and their adults feed on other arthropods.
05	Salticidae	The members of this family feed on diverse small animlas in the wheat fields.
06	Tetragnathidae	They mostly found on the top of the wheat crops. And feed on exclusively on flies, mosquitos and diverse butterflies.
07	Linyphiidae	These are commonly called as sheet weaver or money spiders. These are feed upon on aphids, springtails, flies, and bugs occurring in the wheat.

Table 11: Diversity of Spider fauna recorded from District Larkana

Family	No. of Genera	No. of Species	No. of Specimens	% of Species
Araneidae	02	04	1498	33.83
Linyphiidae	01	01	24	0.542
Lycosidae	02	02	1154	26.061
Oxyopidae	01	01	323	7.29
Salticidae	02	03	587	13.256
Tetragnathidae	01	01	416	9.394
Thomisidae	01	02	426	9.62
Total	10	14	4428	99.9

Discussion:

Primarily guild structure in spider was study by Utez and its colleges in 1999, where he described many clusters or assemblages coexisting in the different crops. In this study he evaluated only two guilds of spiders namely (Web-builder spiders and Wandering spiders). Whereas the nice work related to this study was Post & Riechert , 1977 they evaluated eleven guilds/assemblages namely; Scattered-line weavers; Hackled band weavers; Sheet line weavers; Sheet line weavers; the hahnid spiders; Funnel web; Orb weavers, Orb weavers; Nocturnal running; Nocturnal running spiders; night-time running spiders; Day time running spiders day time running spiders, Jumping spiders and Crab spiders. In the same way the Young and Edward in 1990, studies five guilds in different crops. In Pakistan firs of all the Guild structure was study by Samina Malik and her colleagues, 2018 from sugarcane fields of District Matiari, to gather Samina and her colleagues work on the feeding and circadian behaviors of the spiders from the sugarcane fields evaluates and find out through extensive survey a few guilds. But in this research the author observed four guilds from the wheat fields of the Larkana from 2021 to 2022. These guilds are Web-builders/orb weavers, Wandering spiders; Jumping spiders; Wandering/diurnal running spiders and Sheet line weavers.

Conclusion:

Total 4093 specimens were collected and sorted out into seven families and four guilds from the wheat fields of the Larkana from 2021 to 2022. These guilds are Web-builders/orb weavers, Wandering spiders; Jumping Wandering/diurnal running spiders and Sheet line weavers. This guilds observation will help in provide basic knowledge about wheat spider's fauna, mainly in the field of IPM.

REFERENCES

Clough, Y., Kruess, A., Kleijn, D. and Tscharntke, T., 2005. Spider diversity in cereal fields: comparing factors at local, landscape and regional scales. Journal of Biogeography, 32(11), pp.2007-2014.

Agnarsson, I., Coddington, J.A. and Kuntner, M., 2013. Systematics: progress in the study of spider diversity and evolution. Spider research in the 21st century: trends and perspectives.

Greenstone, M.H., 1984. Determinants of web spider species diversity: vegetation structural diversity vs. prey availability. Oecologia, 62, pp.299-304.

Wiens, J.J., Graham, C.H., Moen, D.S., Smith, S.A. And Reeder, T.W., 2006. Evolutionary And Ecological Causes Of The Latitudinal Diversity Gradient In Hylid Frogs: Treefrog Trees Unearth The Roots Of High Tropical Diversity. The American Naturalist, 168(5), Pp.579-596.

Ronez, C., Brito, J., Hutterer, R., Martin, R.A. and Pardiñas, U.F., 2021. Tribal Allocation and Biogeographical Significance Of One Of The Largest Sigmodontine Rodent, The Extinct Galápagos Megaoryzomys (Cricetidae). Historical Biology, 33(9), Pp.1920-1932.

Riechert, S.E. And Lockley, T., 1984. Spiders as Biological Control Agents. Annual Review of Entomology, 29(1), Pp.299-320.

Soomro, N., Khokhar, J. And Soomro, M., 2013. Biodiversity and

Biogeography of Praying Mantids in Sindh. Sindh University Research Journal-SURJ (Science Series), 45(2).

Simberloff, D. and Dayan, T., 1991. The guild concept and the structure of ecological communities. Annual review of ecology and systematics, pp.115-143.

Britannica, E., 2008. Britannica concise encyclopedia. Encyclopaedia Britannica, Inc.

Williams, S.E. and Hero, J.M., 1998. Rainforest frogs of the Australian Wet Tropics: guild classification and the ecological similarity of declining species. Proceedings of the Royal Society of London. Series B: Biological Sciences, 265(1396), pp.597-602.

Palem H, Kanike S, Purushottam VRS. Diversity of spider fauna (Arachnida: Araneae) in different ecosystems of Eastern Ghats, Southern Andhra. Pradesh India. S Asian J Life Sci. 2017; 4(2): 51-60.

Greenstone, M.H. and Shufran, K.A., 2003. Spider predation: species- specific identification of gut contents by polymerase chain reaction. The journal of arachnology, 31(1), pp.131-134.

Rinaldi, I.M.P., Mendes, B.D.P. and Cady, A.B., 2002. Distribution and importance of spiders inhabiting a Brazilian sugar cane plantation. Revista Brasileira de Zoologia, 19, pp.271-279.

Hibbert, A.C. and Buddle, C.M., 2008. Assessing the dispersal of spiders within agricultural fields and an adjacent mature forest. The Journal of Arachnology, 36(1), pp.195-198.

Sankari, A. and Thiyagesan, K., 2010. Population and predatory potency of spiders in brinjal and snake-gourd. Journal of Biopesticides, 3(1), p.28.

Warghat, N.E., Sharma, N.R., Chirde, S.G. and Chandrakar, M.R., 2010. Distribution of spiders from foothill agricultural fields of Satpura mountain range of Amravati district, Maharashtra, India. Bioscience Biotechnology Research Communications, 3, pp.150-153.

Tahir, H.M., Butt, A., Mukhtar, M.K., Bilal, M. and Khan, S.Y., 2012. Co- existence of four orb weaving spiders in the rice ecosystem. Pakistan Journal of Zoology, 44(6).

Ghavami, S., 2010. Investigation density of population of spiders in the rice fields in the northern part of Iran. Asian Journal of Experimental Sciences, 24(1).

Uetz, George W. "Gradient analysis of spider communities in a streamside forest." Oecologia 22, no. 4 (1976): 373-385.

Russell-Smith, A., 2002. A comparison of the diversity and composition of ground-active spiders in Mkomazi Game Reserve, Tanzania and Etosha National Park, Namibia. The Journal of Arachnology, 30(2), pp.383-388.