



FAUNISTIC STUDY OF LADY BIRD BEETLE ON THE BASIS OF EXTERNAL MORPHOLOGY OF URBAN AND RURAL AREAS OF DISTRICT PISHIN, BALUCHISTAN

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ABSTRACT

Lady bird beetle (Coccinellidae: Coleoptera) are voracious predator and entomophagous of many insects pests of economic importance. So, far only 75 species are reported in Pakistan. Keeping in view limited work in Pakistan, an extensive survey was conducted for the 1st time in Pishin to assess the fauna and distribution of coccinellids beetles in 05 different study sites during March-August 2019. A total of 578 specimens of lady bird beetles were collected by hand picking and aerial netting. Identification of these beetles on external morphology showed that 09 species belonging to 02 sub-families were confirmed. The sub-family coccinellinae represent 07 species viz, *Coccinella quinquepunctata*, *Coccinella septempunctata*, *Coccinella transversoguttata*, *Coccinella undecimpunctata*, *Coccinella hieroglyphica*, *Hippodamia variegata*, *Hippodamia tredecimpunctata* and sub-family chilcorinae was represented by *Chilocorus infernalis* and *Exochomus nigripennis*. Among all the species *C. septempunctata* (n=375) was most abundant while *Chilocorus infernalis* was the least abundant. The value of H, highest was calculated in Hurrainzai (1.051) and the value of D, was highest in Pishin (0.511).

1. INTRODUCTION

Faunistic study or Biodiversity is used to describe the variety of life. It refers to the number and variety of organisms within an area. Biodiversity is often used as a measure of the health of biological systems. Ladybird beetles are placed in family Coccinellidae. These beetles are part of the chitins winged insects (Order: Coleoptera) located above the super-family Cucujoidea and under the sub order Polyphaga [1].

The family Coccinellidae study was first appeared in Systema Naturae [2] under genus *Coccinella* and observed 36 Species. Recent literature revealed that lady bird beetle's families have been divided into 06 sub-families i.e. Chilcorinae, Sticholotidinae, Epilachninae, Coccinellinae, Coccidulinae, and Scymninae [3]. Recently the family comprises 360 genera and approximately 6000 species worldwide [4].

Ladybirds beetles play a significant role in development of biological control strategies. Most ladybird species, both adults and larvae, are predators of small insects (entomophagous) such as mites, whiteflies, scale insects, aphids and mealybugs [5,6]. Adult *Hippodamia variegata* can engulf 32,329 eggs, larvae and adults of reddish spider mites in its life span [7]. Similarly, adult lady bird beetle consumes up to 5000 aphids in its total life span while a female feed on almost 300 mites and aphids just before laying eggs [8]. Ladybirds are regarded to be important to human, because they eat plants pest, remember that not all ladybirds eat plant pests some of them are also phytophagous.

Life cycle of lady bird beetle takes almost 01 month. Depending upon suitable temperature and prey availability and good habitat, they can produce 02 or 03 generations in a year [9].

Looking to the economic significance of this family, it remains always in focus of interest since the inauguration of classification or systematics by Linnaeus [2]. After Linnaeus a lot more European taxonomist work on both taxonomy and biodiversity of this family.

In Pakistan, not much work has been done on the biodiversity of this important family. Ghani [10] provided a list of predatory beetles of the country. Gilani [11] surveyed the lady bird beetle fauna from Faisalabad, Punjab. As well as CIBC [12] conducted a study in Pakistan which found new seven species of Epilachninae. Din [13] described predatory coccinellid fauna of Chitral. Similarly, Rafi et al [14] prepare a complete checklist regarding predatory coccinellids of Pakistan mentioning 75 species throughout the country. Alia [15] conducted a survey in Azad Jammu and Kashmir and reported 60 species of lady bird beetles.

District Pishin situated in Quetta Division, lies in north of Baluchistan. Pishin has splendid natural resources and has expanded flora and fauna because of its unique ecology and varied climatic condition. After surveying available literature, it can be assumed that there is no information present regarding lady bird beetle and no work have been so far reported. Looking to beneficial aspect of these predatory insects the study was thus aimed to observe distribution of coccinellid beetles in Pishin and to observe the ecological status of ladybird beetle and to

analyze their occurrence, habitat and ecological niche.

2. MATERIALS AND METHODS

Study area

Pishin, a northern district of province Balochistan. Pishin district coordinates lies between 30° 20' to 31° 15' North latitudes and 66° 13' to 67° 50' East longitudes and is bounded on the North by Killa Saifullah district and Afghanistan, while on the east by Loralai and Killa Saifullah and on the south by Quetta and Ziarat while Killa Abdullah in the west. District Pishin approximate length from North to South is not far off from 68 km and its distance across from East to West stretches from 8 to 38 km. Total area of Pishin is 7,874 Sq. Km.

Collection of coccinellids beetles

The specimens were collected from 5 different areas of Pishin. These localities are: tehsil Pishin, karezat, barshore, saranan and hurramzai. All sorts of vegetation were selected for sampling such as grassy patches, grassy fields, field crops, orchards and bushes. Study period consist of six months starting from March to August. Each locality was surveyed once in every 15 days. Ladybird beetle specimens were collected with the help of hand-picking method and aerial nets. Collection was done between 10 am to 12 pm in the morning and again on the same day from 03 pm to 05 pm.

Specimen preservation

Field collected ladybird beetles were taken to laboratory and transferred into jars containing ethyl acetate-soaked cotton. Then the insects were stretched and pinned properly to study the morphological features.

Identification

The identification was done with the help of literature and available keys furnished by Kapur [16,17] and Rafi et al [14].

Statistical analyzes

The collected data was analyzed statistically to calculate the diversity abundance, richness and equitability. To calculate the diversity of lady bird beetles, following 2 diversity indices were used.

Shannon-Wiener's diversity index [18] and the formula for Shannon-Wiener's index is

$$H = -\sum_{i=1}^S (p_i \cdot \ln p_i)$$

where:

H = stands for Shannon diversity index

P_i = fraction of the entire population made up of each species i

S = numbers of species encountered

\sum = sum of all species from species 1 to species S

Ln= natural logarithm

The form of the **Shannon's equitability** was also used as:

$$J = H/H_{\max}$$

Shannon's equitability can be calculated by dividing H by H_{\max} (here $H_{\max} = \ln S$). Shannon's Equitability measure a value lies between 0 and 1. While value 1 being complete evenness.

The data was also analyzed by **Simpson's Index (D)** [19] is also a measure of diversity. The formula for calculating Simpson's index is

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

D= Stands for Simpson's index

n = total number of each individual species,

N = denotes total number of organisms of all species encountered

Simpson's diversity index 1-D and Simpson's reciprocal index 1/D were also calculated.

3. RESULTS

Research study was conducted in district pishin from March to August in 2019. A total of 578 specimens of coccinellids beetles were collected from all available vegetation throughout sampling period. Results revealed that all collected species were predatory in nature. Further the taxonomic treatment confirms that there are 09 species of lady bird beetle in pishin under 04 genera's, 02 sub-families and 02 tribes (Table 1). The sub-family coccinellinae (n=562) was the most abundant sub-family and comprising 07 species under 02 genera. similarly, the sub-family chilocorinae (n=16) comprises 02 genera's and each represents 01 specie.

Among the genus coccinella (n=537) (Table 2) *Coccinella septempunctata* was the most abundant

(n=375) and found in all sampling sites. Second most abundant species was *Coccinella undecimpunctat* (n=126). *Coccinella quinquepunctata* (n=17), *Coccinella hieroglyphica* (n=10), *Coccinella transversoguttata* (n=9) were from the identified species of genus coccinella.

The genus Hippodamia (n=25) represent 02 species which are *Hippodamia tredecimpunctata* (n=08) and *Hippodamia variegata* (n=17). The genus Exochomus represent *Exochomus nigripennis* (n=10) while genus Chilocorus with 01 specie *Chilocorus infernalis* (n=06).

Barshore, Hurramzai, Karezat, Pishin and Saranan were from the selected sites for study (Table 3). Pishin was the most abundant site with 283 specimens of ladybird beetles while Saranan was the less abundant site with only 16 specimens. The lady bird beetles were found to be fluctuating throughout study period (Table 4). In April and May the greatest number of lady bird beetles were collected, 178 and 180 respectively while in August only 35 specimens were collected.

A diversity index is a mathematical measure of species diversity in a community. Diversity indices provide more information about community composition than simply species richness, but they also take the comparative abundance of each species into account. So, abundance and richness percent for coccinellids beetles was also studied. Diversity of lady bird beetle was evaluated by Simpson's and Shannon-wiener index. By simpson's index, Diversity, dominance and reciprocal index was calculated These indices decided total number of species encountered and also distribution of individual among species (Table 5). It was concluded for the whole community that Simpson's index calculated value was $D=0.4704$. Species dominance index $1-D=0.5296$ and reciprocal index $1/D=2.126$ was also determined. Similarly, Shannon-wiener index (H) was also used to describe species diversity in a community. The results show that the Shannon-wiener index for the whole community is $H=1.132$. The form of the **Shannon's equitability** is also used as $J=H/H_{\max}$ and the value was 0.5152. Diversity indices for each study site was also calculated. As shown, (Table 6) the highest and lowest value of D was calculated for Pishin (0.511)

and karezat (0.4483) respectively. The value of H, highest was calculated in Hurramzai (1.051) and lowest in Saranan (0.7755).

4. DISCUSSION

Coccinellids plays immensely important role in biological control of soft bodied insects like aphids, scale insects, mealy bugs, white flies, mites and thrips which grow on cultivated crops, and cause severe damage to crop. Due to their diverse food habits, coccinellids were referred most successful bio-agent for IPM. The coccinellid beetles were regarded as 'Farmers' Friend', as it benefits the farmer in various ways. First, it helps to reduce the pest incidence from crop by feeding on the soft bodied insects like aphids, leafhoppers, scale insects, mealybugs, mites and others. Reduced pest population needs fewer amounts of chemical pesticides to be applied on the field for pest control which in terms reduce the cost involved in plant protection measures. In developed countries, for biological control strategies these coccinellids beetles are commercially reared and then releases them in the field. Therefore, lady bird beetles are considered one of important natural resource for pest control in a certain area and need to be well-kept-up for sustainable environmental protection. The first requirement of pest control strategies involve is to explore the lady bird beetle fauna of concern area and then developed species-based conservation plan for sustainable utilization. Therefore, looking to above mention control strategies for pest, the present study was conducted to discover the coccinellid fauna of Pishin and identified it through species level properly. During the study period, a total of 09 species of Ladybird beetle under 04 genera and 02 subfamilies were confirmed. Throughout study period, the most encountered specie of lady bird beetle was, *Coccinella septempunctata*, and a total of 375 individuals were collected from all 05 study sites. Previously this specie was also reported by Rahatullah [20] and he reported total 50 specimens during a survey that was conducted in district Lower Dir. This specie has also been reported by Rehman [21], Gilani [11] and Irshad [22] from different areas of Pakistan.

Second most abundant species was *Coccinella undecimpunctata*, and 126 individuals were collected.

Coccinella undecimpunctata completely resembles *coccinella septempunctata* but little smaller in size. This species was also found in all study sites through study period. This species was also previously reported from different parts of Pakistan and found widely distributed everywhere. The study was conducted in Peshawar [22], Malakand and Mardan, Rafi et al [14] Faisalabad, Mandi Bahauddin and Azad Jammu Kashmir as well Khan et al [23], Islamabad, Khan [24] and from Chitral Khan [25]. This species is found as a general predator and well adapted to the whole areas.

The 3rd most encountered lady bird beetle species was *Hippodamia variegata*, which is also highly polymorphic in spots numbers. A total of 17 specimens collected during the study. This species was abundant in Alfalfa, grass and on wheat. In Pakistan It is previously reported as widely distributed and abundant everywhere and has dissimilarity in size that is related with altitude [11,22,20].

Very little taxonomic work has been reported in Pakistan from this important family of the order Coleoptera. Irshad [22] listed the whole described 71 species of lady bird beetle from northern areas of Pakistan. Rafi et al. [14] listed 75 species under 37 genera and described them by only external morphological characteristics of predatory coccinellids mostly collected from northern parts of Pakistan with special reference with their hosts, prey, and area. During current study a total of 09 species were identified from Barshore, Hurramzai, Karezat, Pishin and Saranan tehsils. The identified species were *Chilocorus infernalis*, *Coccinella quinquepunctata*, *Coccinella septempunctata*, *Coccinella transversoguttata*, *Coccinella undecimpunctata*, *Coccinella hieroglyphica*, *Hippodamia variegata*, *Hippodamia tredecimpunctata* and *Exochomus nigripennis*. Hence it is concluded that this study was of its first type in pishin, Baluchistan and the study revealed that District Pishin is suitable home for family Coccinellidae.

5. CONCLUSION

So, from the above case study on lady bird beetles, it can be concluded that coccinellids beetles were not well distributed in pishin. Tehsil saranan and

barshore ecosystem had comparatively less abundance of lady bird beetle as compare to tehsil pishin. The fauna of lady bird beetle needs to explore as it its presence is most beneficial to environment in various ways, so the crops ecosystem can alter or modified to their population. Different types of crops can be grown in pishin to provide natural control of their pest. For this purpose, a preliminary survey was carried out in pishin. According to result 09 species under 04 genera and 02 sub-families exist in pishin. Almost all of species recorded are beneficial to crops due to their predatory nature. These findings will provide a baseline for perspective researches in order to study biology and predatory potential against different insect pest and will be helpful for the increase in crops yield.

6. CONFLICT OF INTEREST

All authors have declared that there is no conflict of interest regarding publication of this article.

REFERENCES

- [1] I. Kovar, Morphology and anatomy, In: Ecology of Coccinellidae. Springer Netherlands, pp. 1-18. https://doi.org/10.1007/978-94-017-1349-8_1, 1996.
- [2] C. Linnaeus, systema naturae, 10th edition. Stockholm, 826pp, 1758.
- [3] P. Bouchard, Y. Davies, A.M. Zarzaga, J.F. Lawrence, Family-group names in Coleoptera (Insecta). ZooKeys, 88: 1-972. <https://doi.org/10.3897/z>, 2011.
- [4] N.J. vandenbergh, Coccinellidae Latreille 1807. American beetles, 2, 371-389, 2002.
- [5] B.D. Moreton, Ladybirds and spider mites. In: Beneficial insects and Mites. Her Majesty, Stationary Office London. Ministry of Agriculture, Fisheries and Food. Bulletin 20:15-20, 1969.
- [6] M. Majerus, Ladybirds. Harper Collins London 359pp, 1994.
- [7] M. Anwarullah, M. Irshad, Studies on the biological control of phytophagous mites (Acarina: Tetranychidae) and aphids (Aphididae). Pakistan J. Scient. indust. Res, 9: 256-259, 1966.
- [8] A. Dixon, Insects predator-prey dynamics. Lady bird beetles and biological control. Cambridge University Press, New York: pp. 257, 2000.
- [9] M. Majerus, P.K. Kearns, Lady Birds. University of Cambridge. pp. 1-101, 1989.
- [10] A.M. Ghani, R. Ahmad, A new genus and species of Chilocorini (Coleoptera:Coccinellidae) from Pakistan. Proc. R. Ent. Soc. Lond. (B). 35(1-2):9-10, 1966.
- [11] W. Gilani, Studies on the Predaceous Coccinellidai of Lyal Pur. Unpublished Thesis, MSc (Hons) Department of Entomology, Agriculture University, Faisalabad, 1-87, 1976.
- [12] CIBC (Commonwealth Institute of biological control), Investigation on natural enemies of Epilachna I. Final report, Commonwealth Institute of biological control, Pakistan station, Rawalpindi, pp.31, 1982.
- [13] S. Din, Distribution of Predatory Coccinellid (Coleoptera: Coccinellidae) beetles in District Chitral. M.Sc. Thesis, 37pp., The University of Agriculture, Peshawar, Pakistan, 2002.
- [14] A.M. Rafi, M. Irshad. M. Inayatullah, Predatory Ladybird beetles of Pakistan. Rohani Art Press, Blue Area, Islamabad, Pakistan.105 pp, 2005.
- [15] A. Hayat, M.R. Khan, Biodiversity and species Composition of Ladybird Beetles (Coccinellidae; Coleoptera) from Mirpur Division of Azad Jammu & Kashmir, Pakistan. Sarhad J. Agric. 30(3): 341- 350, 2013.

- [16] A.P. Kapur, Coccinellidae of Nepal. Records of Indian Museum, 53: 309-338, 1958.
- [17] A.P. Kapur, The Coccinellidae (Coleoptera) of the Andamans Island. Zoological Survey of India, Calcutta. 14 (1):1-48, 1965.
- [18] E.R. Shannon, W. Wiener, The mathematical theory of communication. University of Illinois Press. Urbana, Illinois. 117pp, 1963.
- [19] E.H. Simpson, Measurement of diversity. Nature, 163: 688pp, 1949.
- [20] R. Ullah, F. Haq, A.S. Mehmood, K. Saeed, S. Rehman, Diversity and distribution of ladybird beetles in District Dir Lower, Pakistan. Int. J. Biodiv. Conserv., 3: 670-675, 2011.
- [21] H. Rehman and M. Inayatullah, Species composition and Distribution of coccinellids of District Tank. M.Sc thesis. Department of Entomology, the University of Agriculture, Peshawar, 2011.
- [22] M. Irshad, Distribution, Hosts, Ecology, and Biotic potential of coccinellids of Pakistan. Pakistan Journal of Biological Sciences 4 (10):1259-1263, 2001.
- [23] M.R. Khan, M.K. Sheikh, M.A. Rafi, A. Sharif, Predatory Coccinellid Fauna (Coleoptera: Coccinellidae) of Sudhnuti District, Azad Jammu and Kashmir. Pak. J. Entomol., Karachi, 14 (1-2): 5-7, 1999.
- [24] M.R. Khan, M. Irshad, M.A. Rafi, Insect fauna of Azad Jammu and Kashmir. MK Traders, Islamabad, 143, 2008.
- [25] I. Khan, S. Din, S.K. Khalil, M.A. Rafi, Survey of predatory coccinellids (Coleoptera: Coccinellidae) in the Chitral district, Pakistan. J. Insect Sci., 7:1-6. <https://doi.org/10.1673/031.007.0701>, 2007.

TABLE 1: COMPLETE TAXONOMIC COMPOSITION OF ALL IDENTIFIED SPECIES IN FIVE STUDY SITES WITH PERCENT CONTRIBUTION OF EACH SPECIES

Family	Sub-family	Tribe	Genus	Species	Total	Percent %
Coccinellidae	Coccinellinae	Coccinellini	Coccinella	<i>C. undecimpunctata</i>	126	21.8
				<i>C. septempunctata</i>	375	64.9
				<i>C. quinquepunctata</i>	17	2.9
				<i>C. hieroglyphica</i>	10	1.7
				<i>C. transversoguttata</i>	9	1.6
			Hippodamia	<i>H. tredecimpunctata</i>	8	1.4
				<i>H. variegata</i>	17	2.9
	Chilocorinae	Chilocorini	Exochomus	<i>E. nigripennis</i>	10	1.7
			Chilocorus	<i>Chilocorus infernalis</i>	6	1.0
	2	2	4	9	578	100

TABLE 2: MONTHLY VARIATION OF EACH IDENTIFIED GENERA WITH TOTAL NUMBER

Month of Collection	Name of Genus				Total
	Chilocorus	Coccinella	Hippodamia	Exochomus	
March	----	58	5	----	63
April	----	164	14	----	178
May	5	175	----	----	180
June	1	66	5	----	72
July	----	49	1	----	50
August	----	25	----	10	35
Total	6	537	25	10	578

TABLE 3: COMPLETE INFORMATION OF EACH IDENTIFIED SPECIES FROM ALL STUDY SITES

Name of Species	Area of Collection					Total
	Barshore	Hurramzai	Karezat	Pishin	Saranan	
<i>Chilocorus infernalis</i>	0	0	6	0	0	6
<i>Coccinella undecimpunctata</i>	30	22	17	53	4	126
<i>Coccinella transversoguttata</i>	0	5	0	4	0	9
<i>Coccinella septempunctata</i>	20	79	70	195	11	375
<i>Coccinella quinquepunctata</i>	2	4	3	8	0	17
<i>Coccinella hieroglyphica</i>	1	2	0	6	1	10
<i>Hippodamia tredecimpunctata</i>	0	0	5	3	0	8
<i>Hippodamia variegata</i>	0	6	2	9	0	17
<i>Exochomus nigripennis</i>	0	0	5	5	0	10
Total	53	118	108	283	16	578

TABLE 4: MONTHLY VARIATION OF COCCINELLID BEETLES FROM ALL STUDY SITES

Name of Species.	Month of Collection						Total
	March	April	May	June	July	August	
<i>Chilocorus infernalis</i>	0	0	5	1	0	0	6
<i>Coccinella undecimpunctata</i>	17	46	33	14	14	2	126
<i>Coccinella transversoguttata</i>	1	1	5	2	0	0	9
<i>Coccinella septempunctata</i>	40	110	130	43	29	23	375
<i>Coccinella quinquepunctata</i>	0	7	5	0	5	0	17
<i>Coccinella hieroglyphica</i>	0	0	2	7	1	0	10
<i>Hippodamia tredecimpunctata</i>	1	6	0	0	1	0	8
<i>Hippodamia variegata</i>	4	8	0	5	0	0	17
<i>Exochomus nigripennis</i>	0	0	0	0	0	10	10
Total	63	178	180	72	50	35	578

TABLE 5: CALCULATED DIVERSITY INDICES FOR DISTRICT PISHIN

District	Simpson's index			Shannon-wiener index	
	D	1-D	1/D	H	E
Pishin	0.4704	0.5296	2.126	1.132	0.5152

TABLE 6: CALCULATED DIVERSITY INDICES FOR ALL STUDY SITES OF DISTRICT PISHIN

Area	Simpson's index			Shannon-wiener index	
	D	1-D	1/D	H	E
Barshore	0.4543	0.5457	2.201	0.8885	0.6409
Hurramazai	0.4844	0.5156	2.064	1.051	0.5866
Karezat	0.4483	0.5517	2.231	1.191	0.6118
Pishin	0.511	0.489	1.957	1.042	0.5012
Saranan	0.5083	0.4917	1.967	0.7755	0.7077