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Studies on the Diversity and Relative Abundance of *Orthoptera* and *Lepidoptera* Species in Urban and Crop Land Areas of Dera Ghazi Khan

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Abstract: Insects are most diverse and largest group of organisms. Insects are vitalfor ecosystem due to their abundance andspecies richness. Studies on diversity and abundance of insect species of *Orthoptera* and *Lepidoptera*were conducted on monthly basis, for this purpose the samples were collected fromurban and cropland area (wheat, sugarcane, mustered, fodder etc.) in District D.G. Khan, Pakistan. Identification and comparison was done with taxonomic manuals. From this study it was concluded that *Orthoptera* specie was one of the largest and diverse groups in the study site. Relative index was higher in the month of march, there was positive strong correlation temperature and insect abundance with R (0.93). Different crops showed different responses towards insect populations highest index was observed in sugarcane (3.57) fallowed by fodder (3.45) while least population index was observed in mustered fields (2.93).

Key words: *Lepidoptera* · *Orthoptera* · Insects · Diversity · Abundance

INTRODUCTION

Speciesdiversity is used to explain the variety of different species (whether domesticated or wild) within a given area [1]. In forestry parlance diversity is combination of species richness and species evenness. The "species richness" shows the species number existing in a selected region, while "species evenness" appears for the relative abundance of each species [2]. Species richness provides very useful measure of diversity when a complete record of species is obtained from selected area [3]. Biodiversity occurred at all levels it may include diversity within an ecosystem, species, population and by individuals. In an organized ecosystem there is division of work as different species do different jobs such as, supply of food and important nutrients recycling. In such kind of interdependent systems, loss of single species can strongly disturb the functioning of complete system [4].

More than half of the world's identified animal species are insects [5] in which Lepidoptera is the second largest and most diverse order of class Insecta [6]. More than 100,000 Lepidopterous insects species have been identified [7]. Butterflies belong to order Lepidoptera. All other insects and Butterflies are divided into three body parts as head, thorax and abdomen [8]. They are the most attractive and beautiful creatures which play a significant role in ecosystem [9]. Butterflies are diurnal in habitats and easily identified by their bright colours, graceful flight and marvelous shape [10]. Butterflies are found everywhere in the world where the colourful flowering plants present [11]. Butterflies serve as important plant pollinator, environmental indicator and have great commercial and aesthetic values [12].

Lepidoptera is one of the most appropriate groups for most quantitative comparisons among insect faunas to be valid to the ecosystem; many reasons were explained by Holloway [13].*Lepidoptera* used as a model by many scientists to estimate and predict the different biological issues like impact of global and local climatic changes, disturbance of habitat, distribution of animals and controlling practices on forest and natural ecosystems [14]. There are many factors (biotic and abiotic stresses) influence the butterfly population [15].

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Insects from the order Orthoptera are also very important. These grassland species perform fundamental role in ecological function [16]. Some species maintain the function of biological community while others may act as excellent indicators representing the health and stability of ecosystem [17]. Arthropods species regulate the structures and functions of natural environments, but their importance are always ignored [18]. Arthropods also are essential for breakdown of nutrient and thus making nutrient-rich soils for plants species [19]. Arthropods species satisfy a diversity of ecological functions inside natural environments, in addition to offering financial benefits in agricultural systems. For many taxa, Arthropods function as feed sources, as essential predators and as pollinators and seed dispersers [20].

The main objective of this research study was to collect, identify and calculate diversity, species richness and abundance of insect fauna of Dera Ghazi Khan District.

MATERIALS AND METHODS

The study was conducted in districtD.G. Khan lies in the north latitude 30-4 and longitude 70-49. The total area of the district is 11,922 Km, climate of the study area is hot in summer and cold in winter. The temperature during summer is usually about 46°C (115°F), while during winter season the temperature is as low as 4°C (40°F). The summer season start from April to October. May June and July are the hottest months. The most important crops are sugarcane, cotton, wheat and rice grown in district D.G. Khan.

The insects were collected with the help of insect collecting net and hand picking during November to April (2013-2014) from different crops (sugarcane, wheat, mustard, fodder etc.) and different sites (city gardens, grassland areas) of district D.G. Khan in morning and evening time. Collected insects were transferred into cyanide bottle for killing. The specimens were stretched, pinned, labeled and then they were set in the insect collection box, phenolphthalein balls were kept in the boxes to keep them safe form insect pests. They were identified with help of already preserved specimen, internet, recent available literature, keys [21] and entomologist's experts on the bases of their colors and spots which are present on their wings upper and lower side. All specimens were then properly labeled.

RESULTS AND DISCUSSION

A survey was made to select the crops fields of sugarcane, fodder, wheat and mustard in district D.G. Khan. Total 15 numbers of species and 154 number of individual of butterfly were collected from selected areas. Their total Shannon's diversity index was 2.373. Comparison of species richness and abundance are given in following tables.

Table 1 shows the species richness, diversity and evenness calculated during the study period. Outstanding diversity and abundance of order Lepidoptera could be observed in the above Table 1 from the results it is clear that species richness was maximum in sugarcane (7) followed by fodder (6), wheat (5) and lowest richness were seen in mustard (3) while abundance of order Lepidoptera was also higher in sugarcane (67), while lowest species abundance were seen in fodder (18) as compared to the other crops in study area. From the results it is clear that evenness was higher in fodder (0.968) whose Shannon's diversity index was also higher in fodder (1.735), while evenness was lower in sugarcane (0.721) whose Shannon's diversity index was (1.404). Natural habitats conservation is very important for the existence of many species of Lepidopterans [22].

Diversity of order Lepidoptera fluctuates with season. They are abundant for only a few months and absent or rare during other months of the year [23]. When we compare different months for the richness and abundance of order Lepidoptera, from results it is clear that species richness was the maximum in March and April (14) whose Shannon's diversity indexes were 2.472 and 2.401 respectively. Species richness remains same in November, January and February (11). The maximum species abundance value was observed in April (34) and March (28), while in November and February (27) same value of abundance were observed. While overall evenness was higher in the month of January (0.963) which was similar to the finding of (Tiple *et al.,* 2007) [24].

Shannon index analysis was performed to evaluate the habitat preferences of different species in the cropland. It was speculated that similar crop would support same faunal diversity irrespective of the locality. From the above table it is very clear that species richness (48), species abundance (632) and Shannon's diversity (3.573) of order Orthoptera was highest in sugarcane. While, the lowest species richness (25), species abundance (89) and Shannon's diversity index (2.927)

Table 1: Shannon Index and other diversity for order Lepidoptera in Different crops

Crop	S (Richness)	N (Abundance)	H' Shannon index	λ (Lambda)	E (Evenness)
Sugarcane	7	67	1.404	0.288	0.721
Fodder	6	18	1.735	0.185	0.968
Wheat	5	42	1.548	0.223	0.962
Mustard	3	27	1.052	0.366	0.957
Total	15	154	2.373	0.112	0.876

Table 2: Shannon Index and other diversity for order Lepidoptera on monthly basis

	S (Richness)	N (Abundance)	H' Shannon index	λ (Lambda)	E (Evenness)
November	11	27	2.186	0.130	0.912
December	10	19	2.178	0.125	0.946
January	11	21	2.310	0.107	0.963
February	11	27	2.228	0.122	0.929
March	14	28	2.472	0.097	0.937
April	14	34	2.401	0.107	0.910
Total	15	154	2.373	0.112	0.876

Table 3: Shannon index and other diversity for of Orthoptera in different crops

Crop	S (Richness)	N (Abundance)	H' Shannon index	λ (Lambda)	E (Evenness)
Sugarcane	48	632	3.573	0.042	0.923
Fodder	38	281	3.447	0.037	0.947
Wheat	29	161	3.102	0.054	0.921
Mustard	25	89	2.927	0.066	0.909
Total	51	1163	3.661	0.036	0.931

Table 4: Shannon index and other diversity for orderOrthptera on monthly basis.

	S (Richness)	N (Abundance)	H' Shannon index	λ (Lambda)	E (Evenness)
November	51	192	3.586	0.044	0.912
December	49	153	3.719	0.029	0.955
January	51	166	3.689	0.032	0.938
February	51	162	3.687	0.034	0.938
March	51	219	3.648	0.035	0.928
April	52	280	3.576	0.044	0.905
Total	52	1172	3.678	0.035	0.931

was observed in mustard crop. While, evenness was higher in fodder (0.947) followed by sugarcane (0.923), wheat (0.921) and mustard (0.909), respectively. Cropping pattern influences local diversity by different movement pattern between natural habitats and as well as crop and non-crop interfaces. In such conditions generalist predators select the habitats, where more food is available; in case one prey is absent its alternate is available in plenty [25].

To evaluate the monthly diversity of order Orthptera we can clearly conclude that species richness was higher in moth of April (52), while abundance of the species was also higher in month of April (280) whose Shannon's diversity index and evenness were (3.576) and (0.905). Species richness remains same in November, January, February and March (51), while species richness lowest in December (49) whose Shannon's diversity index was (3.719). In brief summery specie evenness was the maximum in the month of December (0.955). The results indicated that climate also affects the specie movement and their diversity in particular crop area and available food. Diversity and abundance of order Orthptera was in the line of (Usmani*et al*., 2010) [26].

From Fig. 1 it is clear that the diversity of insects is affected by variation in relative humidity (RH) and pattern of rain fall in different months. From the results it is clear that the insect diversity was higher in March as increase in rainfall and relative humidity (70 %) and (5 mm) of rainfall, respectively. In such conditions generalist predators prefer the habitats, where more food is available; in case one prey is absent its alternate is available in plenty [27].

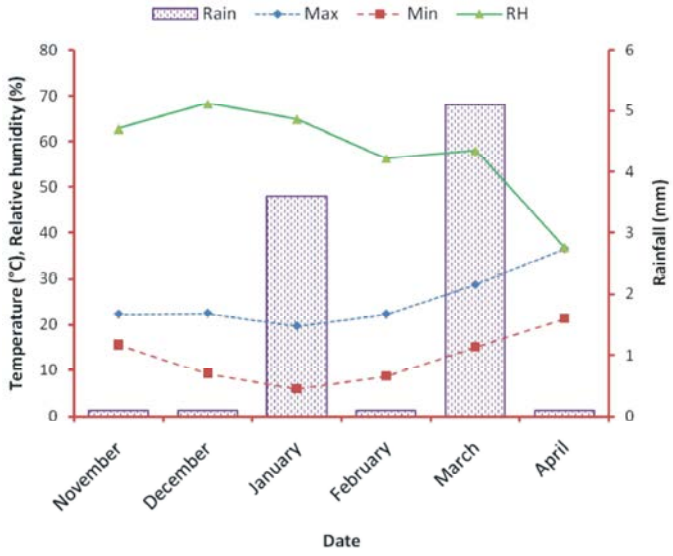

Fig. 1: Effect of relative humidity and rainfall on specie richness

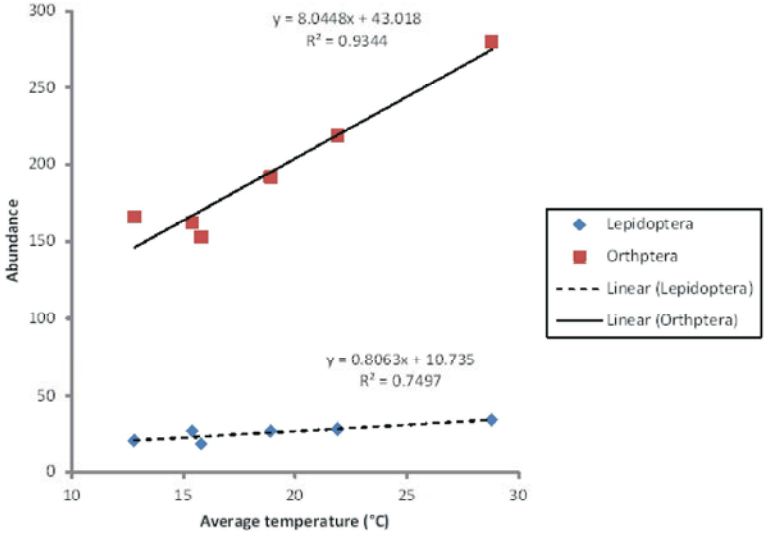

Fig. 2: Effect of average temperature on abundance of insect population

According to Table 2, value of R^2=0.9334 indicated that there is strong correlation between average temperature and abundance of Orthoptera where in case of Lepidoptera value of R^2=0.749 shows that correlation between average temperature and abundance is significant. So from results it can be calculated that the abundance of both orders is affected by average temperature of existing study area. In multi climatic factors particularly temperature can reduce or extend the life cycle of insects. The findings of this study are in the line of (Regniere *et al*., 2012) [28].

From the results in Fig. 3 it is clear that there is week correlation between rainfall and diversity of insects. In Orthoptera value of R^2=0.0328 indicated that diversity of insects is not effected by rainfall. While, in Lepidoptera value of R^2=0.4714 indicated that diversity of insects is significantly affected by rainfall and show positive correlation with diversity of Lepidoptera [29].

Results presented in Fig. 4 indicated that diversity of insects affected by wind velocity as value of R^2=0.6497 indicated that there is strong correlation between wind velocity and diversity of Orthoptera. While value of R^2=0.1057 indicated that there is week correlation between wind velocity and diversity of Lepidoptera. The findings of this study are in the line of (Kumar, 2013) [30].

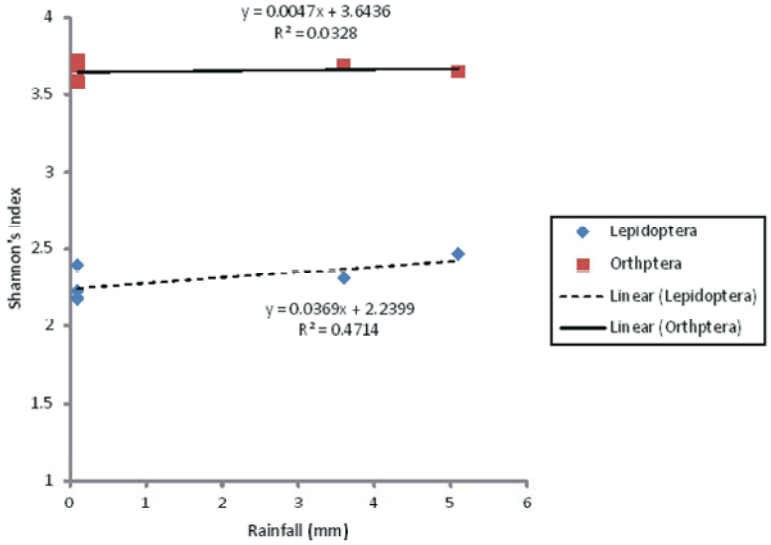

Fig. 3: Effect of rainfall on diversity of insect population

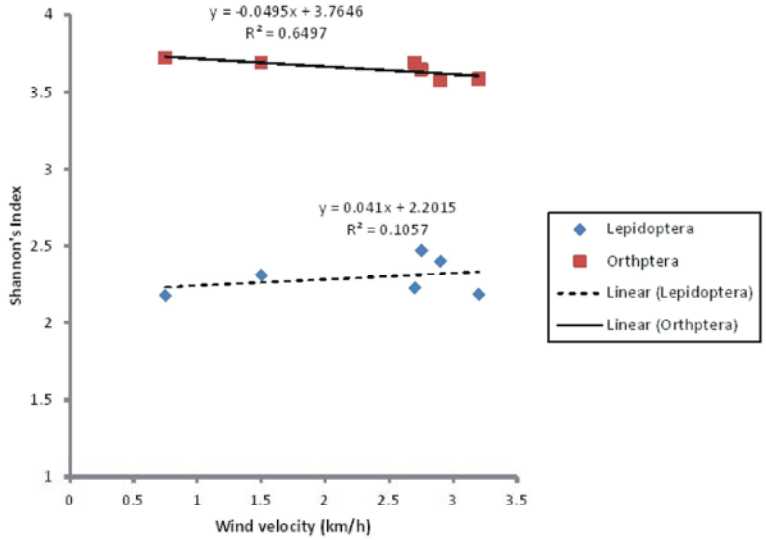

Fig. 4: Effect of wind velocity on diversity of insect population

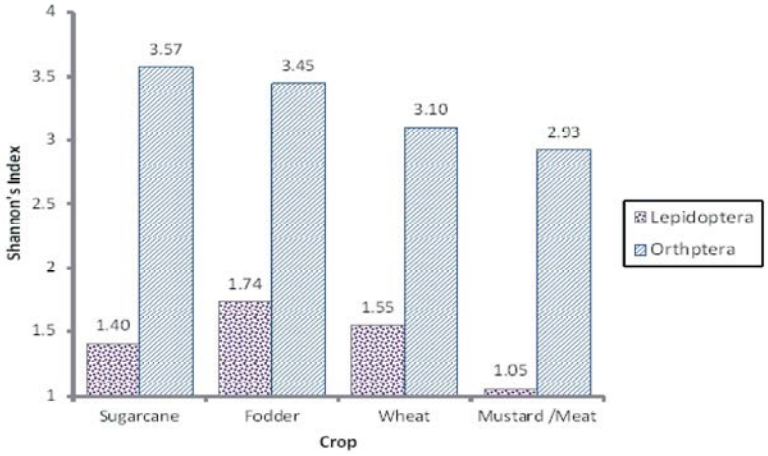

Fig. 5: Diversity of insects in different crops

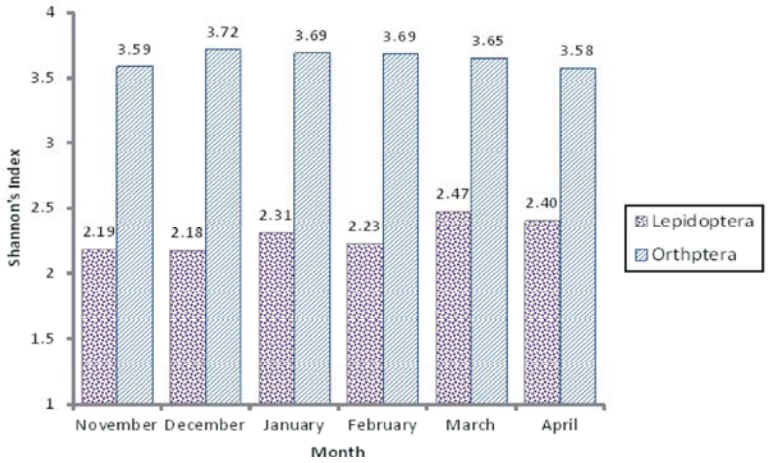

Fig. 6: Diversity of insects in different months

Data presented in Fig. 5 indicated that the Shannon diversity of orthoptera was more in sugarcane crops (3.57) followed by fodder (3.45), wheat (3.10) and mustard (2.93). While, the diversity of Lepidoptera species was the highest in the fodder (1.74) followed by wheat (1.55) sugarcane (1.40) and the lowest diversity was observed in the mustard (1.05) [31].

Figure 6 indicates the Shannon's diversity index of order Orthoptera and Lepidoptera above results indicated that highest diversity of orthoptera occurred in the month of December (3.72) and minimum diversity occurred in the month of (3.58). While, the highest diversity of order Lepidoptera was occurred in the month of March (2.47) followed by April (2.40), January (2.31), February (2.23), November (2.19) and December (2.18) [32].

CONCLUSION

From present study it was concluded that the population of insects is effected by environmental factors and cropping pattern as results indicates that highest insect population was observed in sugarcane (3.57) fallowed by fodder (3.45) while least population index was observed in mustered fields (2.93)

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