

## **EFFECT OF SOME ECOLOGICAL FACTORS ON THE DISTRIBUTION AND DIVERSITY OF PYRGOMORPHIDAE (ORTHOPTERA: PYRGOMORPHOIDEA) IN PUNJAB OF INDIA**

**H. Kumar\*, M. K. Usmani\* and M. H. Akhtar\***

\* Section of Entomology, Department of Zoology, Aligarh Muslim University, Aligarh-202002, INDIA. E-mail: usmanikamil94@gmail.com

[Kumar, H., Usmani, M. K. & Akhtar, M. H. 2013. Effect of some ecological factors on the distribution and diversity of Pyrgomorphidae (Orthoptera: Pyrgomorphoidea) in Punjab of India. *Munis Entomology & Zoology*, 8 (2): 646-653]

**ABSTRACT:** Twelve species of grasshoppers of family Pyrgomorphidae belonging to five genera and four tribes were collected during consecutive survey of Punjab. From South-western Punjab eleven species of grasshoppers collected belonging to four tribes and five genera. The value of Shannon Diversity index, Species richness, Evenness and Simpson's dominance value are 1.92, 1.70, 0.80 and 0.19 respectively. From Central Punjab eight species of grasshoppers collected belonging to five genera and four tribes. The value of Shannon Diversity index, Species richness, Evenness and Simpson's dominance value are 1.86, 1.11, 0.89 and 0.15 respectively. From Eastern Punjab seven species of grasshoppers collected belonging to two genera and two tribes. The value Shannon Diversity index, Species richness, Evenness and Simpson's dominance value are 1.42, 1.22, 0.73 and 0.31 respectively.

**KEY WORDS:** Ecology, Distribution, Diversity Pyrgomorphidae, Orthoptera, Punjab, India.

Punjab has been divided into South-Western Punjab, Central Punjab and Eastern Punjab on the basis of soil and climatic conditions. South-western Punjab includes the districts bordering Haryana and Rajasthan and having some arid climatic conditions. In Central Punjab the climatic conditions are semi-arid type. While the Eastern Punjab covers the districts which are present in the foot hills of Himachal Pradesh and the climatic conditions are sub-humid type.

Pyrgomorphidae is a family of the Order Orthoptera belonging to suborder Caelifera under the superfamily Pyrgomorphoidea. The members of this family are commonly known as gaudy grasshoppers. Pyrgomorphids are very colorful insects and due to their bright colours they seem to be poisonous to their predators (called aposematic colouration). It contains 29 genera and at least 70 species and subspecies worldwide. They are characterized by the presence of fastigial furrow, lower basal lobe of hind femur longer than the upper one, absence of antennal grooves and Krauss's organ and presence of apical fastigial areolae etc. The members of this family are mostly preferred to live in desert areas.

Grasshoppers constitute one of the largest and most diverse groups of insects causing damage to agricultural crops (Joshi et al., 1999) are considered as oligophagous (Mulkern, 1967). Studies on Ecological study of grasshoppers has been done by Mondal and Shishodia (1982), Julka et al. (1982), Tandon & Khera (1978) in India. Locusts are probably the most formidable enemy of man since the onset of agriculture. Although only a few species are considered serious pests, other non-gregarious species can become very dangerous when climatic conditions facilitate their multiplication. Therefore, it is necessary to have systematic knowledge of all locust species that settle in a territory. It no longer makes sense in the field of Acridology to publish taxonomical lists without the necessary basic environmental species distribution data (Lecoq, 1991). For this

region a preliminary inventory of Pyrgomorphoidea in relation to different vegetation types in the three different regions of Punjab is provided.

The present study is mainly based on a few ecological aspects such as distribution, diversity and host plant interaction of Pyrgomorpha insects in three different regions of Punjab. The specimens are deposited in Insect Museum, Department of Zoology, Aligarh Muslim University, Aligarh, Uttar Pradesh, India.

## MATERIALS AND METHODS

**1. Study area:** The present study was conducted in the Punjab state which is situated in the northwest India. It stretches from 29°32' to 32°32'N latitude and 73°55' to 76°50'E longitude, occupying a land of 50,362 sq. kms in the north-western part of India. Its average elevation is 300 m from the sea level. On the basis of soil types Punjab can be divided into following three distinct regions.

### A. South-western Punjab

This region covers Muktsar, Bhatinda, Mansa, Faridkot and Ferozepur which border Haryana and Rajasthan states in the south-west. The soil is predominantly calcareous, developed under hot and arid to semi-arid conditions. The pH value ranges from 7.8 to 8.5 which shows that the soil is normal in reaction. Temperature ranges from 2°C to 48°C and annual rainfall is 380-450 mm.

### B. Central Punjab

The region covers the districts of Sangrur, Ludhiana, Jalandhar, Kapurthala, and Amritsar. The soil of this zone is of semi-arid type showing sandy loam to clayey with pH ranging from 7.8 to 8.5. Problem of alkalinity and Salinity is quite acute, especially in districts of Amritsar, Sangrur. The soil of the central zone is generally recognised as alluvial. Temperature ranges from 4°C to 45°C and annual rainfall is 680-780 mm.

### C. Eastern Punjab

The soil has developed in the sub-humid foothill areas bordering Himachal Pradesh covering eastern parts of Gurdaspur, Hoshiarpur, Rupnagar and Nawanshahar district etc. Because of the undulating topography and fair amount of rainfall, normal erosion is quite common. The fertility of the soil is medium to low and the texture is loamy to clayey. The soil is neutral in reaction (pH 6.5 to 7.5). Temperature ranges from 4°C to 44°C and annual rainfall is 780-900 mm.

## 2. Collection of grasshoppers

Authors surveyed agricultural crops and grassland ecosystems of Punjab to collect the grasshoppers and locusts during the period 2011 and 2012. They were caught by hands, forceps, and through the ordinary aerial insect net. The net was used for catching insects individually or by sweeping on grasses, bushes and other vegetables. Attempts were made to collect the specimens from their host plants. The collected specimens were killed in cyanide bottles.

## 3. Preparations for morphological studies

Dry mounts were prepared for better understanding the certain characters like size, colour, texture etc. For this purpose, the specimens were first relaxed, stretched, later pinned and labeled. Complete records were also maintained indicating the reference number, locality, data of collection and name of host plants. Permanent collections of pinned specimens were kept in store boxes and cabinets for further studies on their morphological structures.

#### 4. Preparations for genitalic studies

For detailed study, permanent slide of their genitalic structure (Supra anal plate, Sub genital plate, Epiphallus, Aedeagus, Ovipositor and Spermatheca) were prepared, examined under the microscope and drawings were made with the help of Camera Lucida. Details were filled in by conventional microscope examination.

#### 5. Data analysis

Diversity indices, richness, evenness and dominance were calculated by using SPECDIV program

**A. Shanon and Wiener (1963) diversity index:-**  $H = -\sum p_i \log p_i$

**B. Species richness**  $SR = (S-1)/\ln N$ ,

$$\lambda = \sum \frac{n_i(n_i-1)}{N(N-1)}$$

**C. Simpson's Dominance:**

**D. Evenness**  $J = H/\ln S$

Where  $H$  = Species diversity,  $P_i = n_i/N$  is the probability of an individual to belong to a species,  $n_i$  = Number of individuals of one species in sample,  $\ln$  = Natural log,  $N$  = Total number of individuals in samples,  $R$  = Species richness,  $S$  = Total number of species,  $J$  = Evenness,  $\lambda$  = Dominance

### RESULTS

In the present study authors collected 155 specimens of the family Pyrgomorphidae from different hosts and various areas of Punjab. In all, twelve species belonging to five genera and four tribes were identified (Plate 1: Table 1). From South-western Punjab region seventy eight specimens of the family were collected. The collected materials include eleven species belonging to four tribes and five genera (Plate 1: Table 2). The maximum number of specimens collected were of *Chrotogonus trachypterus trachypterus* species (Plate 2: Figure 1). The value of Shannon Diversity index 1.92 shows moderate range of diversity. Species richness, Evenness and Simpson's dominance value are 1.70, 0.80 and 0.19 respectively. In this region maximum numbers of specimens were collected from grasses followed by jowar and then oak (Plate 3: Figure 5). From the central Punjab region fifty one specimens were collected having the eight species over five genera and four tribes (Plate 1: Table 3). Specimens of *Atractomorpha psittacina psittacina* were in maximum number from this region (Plate 2: Figure 2). The value of Shannon Diversity index 1.86 shows medium range of diversity. Species richness, Evenness and Simpson's dominance value are 1.11, 0.89 and 0.15 respectively. In central Punjab the maximum number of samples collected from grasses followed by paddy and then oak (Plate 3: Figure 5). Twenty six individuals were collected from the eastern region of Punjab. These individuals include seven species from two genera and two tribes (Plate 1: Table 4). Specimens of *Atractomorpha psittacina psittacina* were also in maximum number in this region (Plate 2: Figure 3). The value of Shannon Diversity index 1.42 shows lesser range of diversity. Species richness, Evenness and Simpson's dominance value are 1.22, 0.73 and 0.31 respectively. In this region the maximum catch was from paddy followed by grasses and then maize (Plate 3: Figure 5).

No record of Pyrgomorphid grasshoppers occurs from Punjab except Thakur *et al* (2004) who reported only two species of Pyrgomorphidae i.e. *Atractomorpha crenulata crenulata* and *Chrotogonus trachypterus trachypterus* out of 21 species representing 19 genera of Acridoidea from Roper wetland

Punjab. Tewari & Kaushal (2007) worked on insect's diversity in Himalayan Tarai region. Similarly Usmani et al., (2010) reported only four species of Pyrgomorphidae out of 33 species from Western Uttar Pradesh whereas Usmani and Nayeem 2012 also reported four species of Pyrgomorphidae out of 37 species from Bihar while no species have been described by Nayeem and Usmani 2012 from Jharkhand. Paulraj *et al* in 2009 studied the distribution of grasshoppers from two districts of Tamil Nadu and described five species of Pyrgomorphidae out of 33 species of grasshoppers. Shoshodia and Gupta (2009) reported seven species of Pyrgomorphidae out of 165 species from Himachal Pradesh. The comparison in the values of Shannon Diversity, Species richness, Evenness and Simpson's dominance are shown in Plate 3: figure 1, 2, 3 and 4 respectively.

## DISCUSSION

Agriculture is one of the largest industries in Punjab and provides maximum amount of cereals and food grains to India. Locusts and grasshoppers cause considerable damage to agricultural crops which produce food both for humans and livestock. Keeping the economic importance of these insect pests, systematic and ecological studies were undertaken. Due to low diversity index from all three regions of Punjab, Pyrgomorphids can not be considered as major pests but its plague may be. Since South-Western Punjab is more diverse among three that indicates favourable climatic factors for the family, hence needs attention from agricultural community. Due to Biting and chewing type of mouthparts grasshoppers tear plant tissue and feed on foliage, flowers, fruits, seed heads, stems causing heavy loss in agriculture industry. To increase the yield it is recommended to control these pests for the sake of agriculture.

## ACKNOWLEDGEMENTS

Authors are grateful to Department of Science & Technology, New Delhi for financial assistance. Authors are also thankful to Prof. Irfan Ahmad, Chairman, Department of Zoology, Aligarh Muslim University, Aligarh for providing necessary facilities.

## LITERATURE CITED

- Joshi, P. C., Lockwood, J. A., Vashishth, N. & Singh, A.** 1999. Grasshopper (Orthoptera: Acridoidea) community dynamics in a moist deciduous forest in India. *Journal of Orthopteran Research*, 8: 17-23.
- Julka, J. M., Tandon, S. K., Halder, P. & Shishodia, M. S.** 1982. Ecological observation on grasshoppers (Orthoptera: Acridoidea) at Solan, Himachal Pradesh, India. *Oriental Insect*, 16 (1): 63-75.
- Lecoq, M.** 1991. *Gafanhotos Brasil. Natureza do Problema e Bibliografia.* CIRAD-PRIFAS, France-EMBRAPA/NMA, Brazil. 157p.
- Mondal, S. K. & Shishodia, M. S.** 1982. Population fluctuation of grasshopper fauna in a field near Culcutta. *Pro. Symp. Ecol. Anim. Popul. Zool. Surv. India*. 3: 127-132.
- Mulkern, G. B.** 1967. Food selection by grasshoppers. *Ann. Rev. of Ent.*, 12: 59-78.
- Nayeem, M. R. & Usmani, M. K.** 2012. Taxonomy and field observations of grasshopper and locust fauna (Orthoptera: Acridoidea) of Jharkhand, India. *Munis Entomology & Zoology*, 7 (1): 391-417.
- Paulraj, M. G., Anbalagan, V. & Ignacimuthu, S.** 2009. Distribution of grasshoppers (Insecta: Orthoptera) among different host plants and habitats in two districts of Tamil Nadu, India. *Journal of Threatened Taxa*, 1 (4): 230-233.

**Shishodia, M. S. & Gupta, S.** 2009. Checklist of Orthoptera (Insecta) of Himachal Pradesh, India. *Journal of Threatened Taxa*, 1 (11): 569-572.

**Singh, D., Bharti, H. & Ramanek.** 2007. Population dynamics of Orthoptera (Insecta) collected from light trap. *Journal of Entomological Research*, 31 (1): 63-71.

**Tandon, S. K. & Khera, P.** 1978 Ecology and distribution of grasshoppers (Orthoptera: Acridoidea) in Arunachal Pradesh, India and impact of human activities on their ecology and distribution. *Mem. of the School of Ent. Agra*, 6: 73-92.

**Tewari, M. & Kaushal, B. R.** 2007. Density, diversity and herbivory of aboveground insects in a grassland community of central Himalayan tarai region. *Tropical Ecology*, 48 (1): 71-78.

**Thakur, S. K., Shishodia, M. S., Mehta, H. S. & Mattu, V. K.** 2004. Orthopteran diversity of Roper wetland Punjab, India. *Zoos Print Journal*, 19 (11): 1697.

**Usmani, M. K. & Nayeem, M. R.** 2012 Studies on taxonomy and distribution of Acridoidea (Orthoptera) of Bihar, India. *Journal of Threatened Taxa*, 4 (13): 3190-3204.

**Usmani, M. K., Khan, M. I. & Kumar, H.** 2010 Studies on Acridoidea (Orthoptera) of Western Uttar Pradesh. *Biosystematic*, 4 (1): 39-58.



Table 1. Showing species of family Pyrgomorphidae collected from Punjab.

S. No.	FAMILY	TRIBES	SPECIES
1.	Pyrgomorphidae	Chrotogonini	<i>Chrotogonus oxypterus</i> (Blanchard)
2.			<i>Chrotogonus trachypterus trachypterus</i> (Blanchard)
3.			<i>Chrotogonus brachypterus</i> Bolivar, I.
4.			<i>Chrotogonus armatus</i> Steinmann
5.		Atractomorphi	<i>Atractomorpha angusta</i> Karsch
6.			<i>Atractomorpha burri</i> Bolivar, I.
7.			<i>Atractomorpha crenulata crenulata</i> (Fabricius)
8.			<i>Atractomorpha psittacina psittacina</i> (Haan)
9.			<i>Atractomorpha sinensis sinensis</i> Bolivar, I
10.		Pyrgomorphini	<i>Pyrgomorpha conica conica</i> (Olivier)
11.			<i>Zarytes squalinus brachypterus</i> (Kirby)
12.		Poecilocerini	<i>Poecilocerus pictus</i> (Fabricius)

Table 2. Showing distribution of species in different districts of South-Western Punjab.

South-western Punjab						
S. No.	Species	Districts				
		Muhtsar	Bhathinda	Mansa	Firozpur	Faridkot
1.	<i>Chrotogonus oxypterus</i> (Blanchard)	+	+	+	+	-
2.	<i>Chrotogonus trachypterus trachypterus</i> (Blanchard)	+	+	+	+	+
3.	<i>Chrotogonus brachypterus</i> Bolivar, I.	+	-	-	-	-
4.	<i>Chrotogonus armatus</i> Steinmann	+	+	+	+	+
5.	<i>Atractomorpha burri</i> Bolivar, I.	-	-	+	-	-
6.	<i>Atractomorpha crenulata crenulata</i> (Fabricius)	-	-	+	-	-
7.	<i>Atractomorpha psittacina psittacina</i> (Haan)	+	-	+	-	-
8.	<i>Atractomorpha sinensis sinensis</i> Bolivar, I	+	-	+	-	+
9.	<i>Pyrgomorpha conica conica</i> (Olivier)	+	+	-	+	+
10.	<i>Zarytes squalinus brachypterus</i> (Kirby)	-	-	+	-	-
11.	<i>Poecilocerus pictus</i> (Fabricius)	-	+	+	-	-

Table 3. Showing distribution of species in different districts of Central Punjab.

Central Punjab					
S. No.	Species	Districts			
		Ludhiana	Jalandhar	Kapurthala	Amritsar
1.	<i>Chrotogonus trachypterus trachypterus</i> (Blanchard)	+	-	-	+
2.	<i>Chrotogonus armatus</i> Steinmann	+	-	-	+
3.	<i>Atractomorpha angusta</i> Karsch	-	-	+	-
4.	<i>Atractomorpha psittacina psittacina</i> (Haan)	+	+	+	+
5.	<i>Atractomorpha sinensis sinensis</i> Bolivar, I	-	-	+	-
6.	<i>Pyrgomorpha conica conica</i> (Olivier)	+	-	-	+
7.	<i>Zarytes squalinus brachypterus</i> (Kirby)	-	+	+	-
8.	<i>Poecilocerus pictus</i> (Fabricius)	-	+	-	-

Table 4. Showing distribution of species in different districts of Eastern Punjab.

Eastern Punjab					
S. No.	Species	Districts			
		Hoshiarpur	Nawanshahar	Gurdaspur	Rupnagar
1.	<i>Chrotogonus trachypterus trachypterus</i> (Blanchard)	+	-	-	-
2.	<i>Chrotogonus armatus</i> Steinmann	+	+	-	-
3.	<i>Atractomorpha angusta</i> Karsch	-	+	-	-
4.	<i>Atractomorpha burri</i> Bolivar, I.	-	-	-	+
5.	<i>Atractomorpha crenulata crenulata</i> (Fabricius)	-	+	-	+
6.	<i>Atractomorpha psittacina psittacina</i> (Haan)	+	+	+	+
7.	<i>Atractomorpha sinensis sinensis</i> Bolivar, I	+	+	-	+

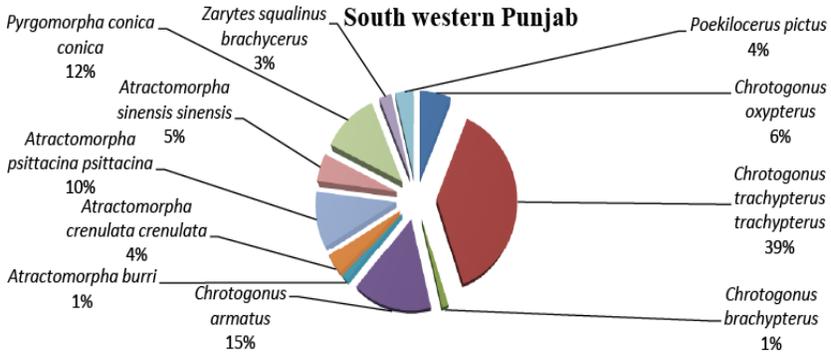


Figure 1. Percentage occurrence of different species of Pyrgomorphidae in South-Western Punjab.

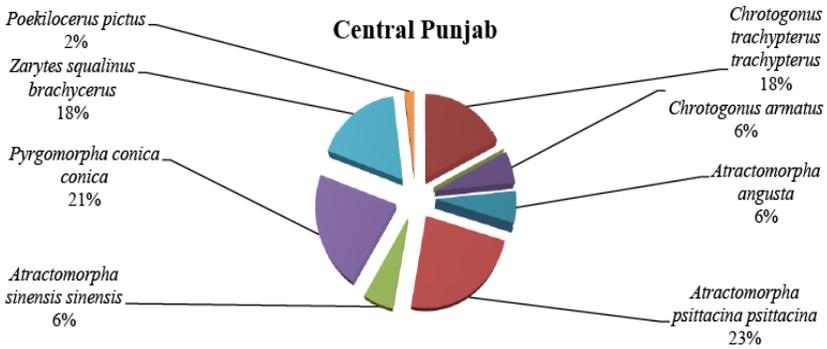


Figure 2. Percentage occurrence of different species of Pyrgomorphidae in Central Punjab.

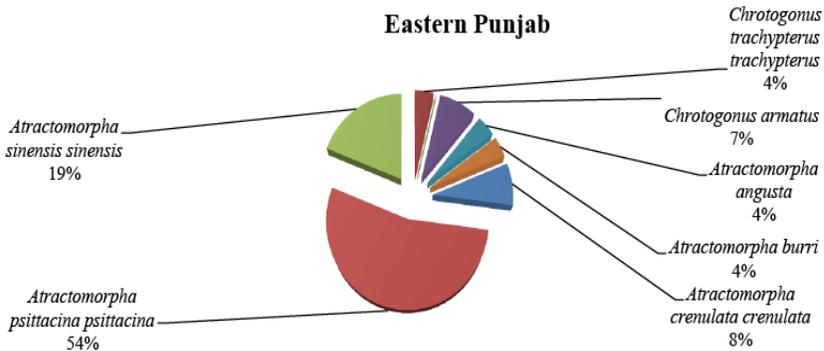


Figure 3. Percentage occurrence of different species of Pyrgomorphidae in Eastern Punjab.

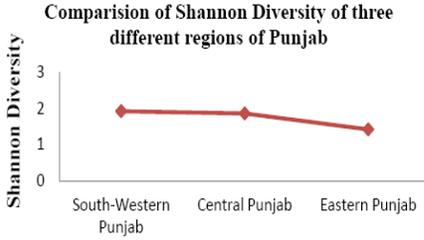


Figure 1

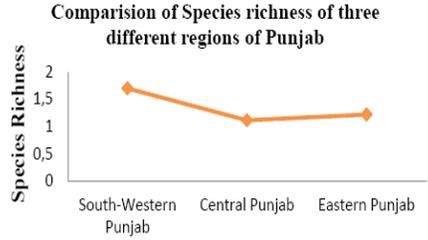


Figure 2

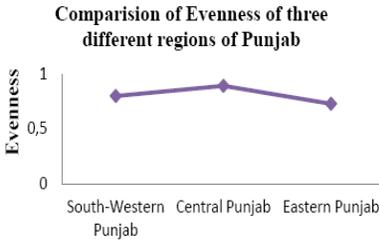


Figure 3

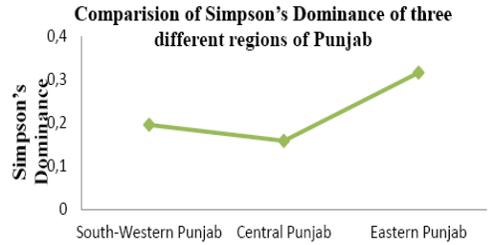


Figure 4

Showing Number of individuals on different host plants in three different regions of Punjab

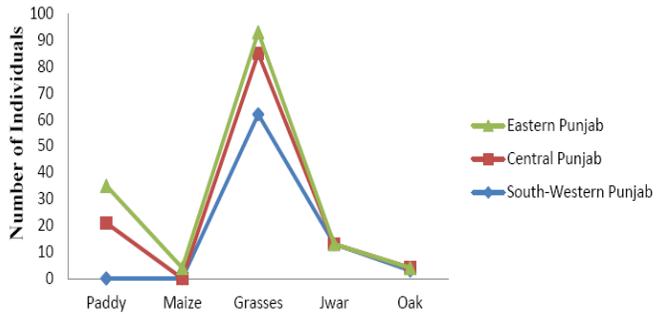


Figure 5