



## SURVEY, DISTRIBUTION PATTERNS AND ABUNDANCE OF PYRGOMORPHID FAUNA (ORTHOPTERA: PYRGOMORPHIDAE) IN AGROECOSYSTEMS OF SOUTH WESTERN RAJASTHAN

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### ABSTRACT

Surveys conducted in the five districts of Rajasthan viz., Banswara, Dungarpur, Rajsamand, Sirohi and Udaipur during 2005-06 and 2006-07 indicated that five species of short horned grasshoppers belonging to the family Pyrgomorphidae were regular and abundant. The diversity comprised of four genera (*Chrotogonus*, *Atractomorpha*, *Pyrgomorpha* and *Poeciloceris*) and five species i.e. *Chrotogonus trachypterus* (Blanchard), *Chrotogonus oxypterus* (Blanchard), *Atractomorpha crenulata* Fabricius, *Pyrgomorpha bispinosa* Walker and *Poeciloceris pictus* Fabricius. *C. trachypterus* (33.34±7.63) and *C. oxypterus* 29.45±6.93), were relatively more abundant in Udaipur district than in the other four districts. *A. crenulata* (07.09±1.66) and *P. bispinosa* (06.35±1.54) had a relatively equal representation in all the districts, but their abundance was a little more in the district Banswara. *P. pictus* (07.00±2.82) was relatively more in Rajsamand and was not recorded from Banswara. The mean population of the surface grasshoppers, *C. trachypterus* and *C. oxypterus* was relatively more in Udaipur. *Atractomorpha* was almost equally represented in all the five districts. However, their population was relatively more in Banswara. *Pyrgomorpha* also had a similar representation from all the five districts surveyed, though the hopper population was relatively more at Banswara with a mean population of (3.42 hoppers/ 25 stops). *Poeciloceris* was relatively more in Rajsamand with 2.43 hoppers per 25 stops.

**Key words:** Abundance, density pattern, pyrgomorphid, survey

A central problem in ecology is to identify and understand patterns in the distribution and abundance of species. Widespread species are generally locally abundant, and have populations that fluctuate than the scarce, geographically restricted species. Predicted effects of body size are less well supported, although common, widespread, widely fluctuating species tend to be small (Gaston and Lawton, 1988). Orthoptera are a group of large and easily recognized insects that include the grasshoppers, locusts, ground hoppers, crickets, bush crickets, mole crickets and camel crickets as well as some lesser groups. Members of the Acridiidae and Pyrgomorphidae (earlier considered as a subfamily Pyrgomorphinae, under the family Acrididae), grasshoppers and surface grasshoppers, are important pests of forage and crop plants. Of the nearly five thousand known species of grasshoppers, only nine are categorized as locusts on account of their capability to devastatingly plague large geographical areas. Surface grasshoppers are widely distributed in the orient and Africa. In India, *C. trachypterus* is common in the north, whereas *C. oxypterus* occurs in the southern regions. Short horned grasshoppers are

belonging to the family Pyrgomorphidae, characterized by the presence of *fastigial furro*; and the apical *areolae*, besides having the lower basal lobe of the hind femora longer than the upper lobe. Misari and Raheja (1976) reported that the most abundant species of pyrgomorphids were *Chrotogonus senegalensis* and *Pyrgomorpha vignaudi*. Khaemba (1979) recorded *Acrotylus patruelis*, *Chrotogonus hemipterus*, *Gastrimargus africanus*, *Morpharis fasciata*, *Ornithaeris* sp., and *Zonocerus elegans*, as pests of sunflower before the flowering stage. Loss of vegetation due to grasshopper have also been evaluated thoroughly in some other parts of the globe; an estimated 6 to 12% of the available forage is consumed by them in U.S.A. (Cowan, 1958). Anderson (1961) reported 25.9 % to 62.1 % loss of forage due to grasshopper in Montana range lands of U.S.A.

### MATERIALS AND METHODS

Surveys to assess the relative incidence of the pyrgomorphids was conducted in Udaipur, Dungarpur, Banswara, Rajsamand and Sirohi districts of South Western Rajasthan.

**(a) Estimation of adults:**

The standardized sweep net method was employed to estimate the relative abundance and community composition of grasshoppers (Orthoptera: Pyrgomorphidae), walking through two-metre wide strip 200 meter long and collecting the adults that get trapped from the non-cropped areas. In each area selected, known replicates of 400-m<sup>2</sup> strips were observed at random. The sampling was done in the forenoon from 8 to 10 a.m. and in the afternoon from 4 to 6 p.m. (Kushwaha and Bhardwaj, 1977).

**(b) Estimation of hoppers:**

The "Percentage Infestation" method was employed. Quadrates of vegetation (1 sq. m.) were inspected closely for hoppers at every 10 spaces in a given area. Inspection of the crop area and clumps of grass that fall within the unit area at regular intervals were done. The number of stops containing hoppers as a fraction of the total number of 25 such stops made were calculated and expressed as percentage infestation. The following mathematical/ statistical analyses were made towards estimating the species richness and diversity indices.

**(i) Mean Density:**

$$\text{Mean Density} = \frac{\sum X_i}{n}$$

Where,

$X_i$  = Number of grasshopper in  $i^{\text{th}}$  quadrates

$n$  = Total number of quadrates sampled.

**(ii) Fiducial limits of population mean at 5% fiducial limits of population mean:**

$$\bar{X} \pm \frac{\sigma}{\sqrt{N}} X t_{0.05}$$

$\sigma$  = Standard deviation of the population

$N$  = Number of observations in the sample

**RESULTS AND DISCUSSION**

Survey conducted in the five districts of Rajasthan viz., Banswara, Dungarpur, Rajsamand, Sirohi and Udaipur during 2005-06 and 2006-07 yielded five different species of short horned grasshoppers belonging to the family Pyrgomorphidae, characterized by the presence of *fastigial furrow* and the apical

*areolae*, besides having the lower basal lobe of the hind femora longer than the upper lobe (Fig.1).

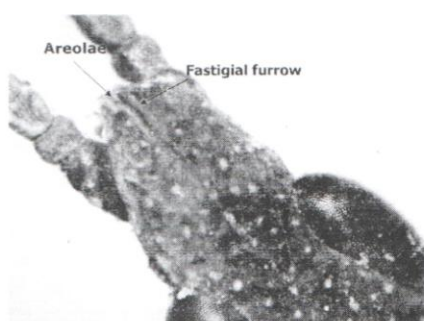


Fig. 1. Pyrgomorphidae-characters

The adult pyrgomorphids, determined on the basis of their morphological features, belonged to four genera (*Chrotogonus*, *Atractomorpha*, *Pyrgomorpha* and *Poeciloceris*) and five species i.e., *Chrotogonus trachypterus* (Blanchard), *Chrotogonus oxypterus* (Blanchard), *Atractomorpha crenulata* Fabricius, *Pyrgomorpha bispinosa* Walker and *Poeciloceris pictus* Fabricius. Joshi et al (1999) observed that the habitats represented a range of anthropogenic disturbances, including an undisturbed site, a naturally recovering site (deforested and replanted 20 years earlier), a moderately disturbed site (lightly grazed by cattle), and a severely disturbed site (artificially reforested and heavily grazed by livestock).

Distribution pattern of pyrgomorphid fauna in South-Western Rajasthan (Fig.2).

Both the species *C. trachypterus* and *C. oxypterus* were relatively more abundant in Udaipur with a respective mean population of 33.34±7.63 and 29.49±6.93 adults per 400 sq. m., during both years followed by Sirohi (25.69±6.43 & 23.80±6.38); were less abundant in Dungarpur (20.41±5.20 & 19.13±5.01) and Banswara (18.89±5.35 & 17.89±5.12) districts. The genus *Atractomorpha* was almost equally represented in all the five districts surveyed; however, the adult population was relatively more in Banswara (07.09±1.66 adults per 400 sq. m.). *Pyrgomorpha* also had a similar representation from all the five districts surveyed, but the adult population was relatively more at Banswara with a mean

Table 1. Comparative pyrgomorphid diversity in South-Western Rajasthan-adults (2005-06 and 2006-07)

S.No.	Species	Udaipur	Sirohi	Rajsamand	Dungarpur	Banswara
1.	<i>C. trachypterus</i>	33.34±7.63 (13.00-52.84)	25.69±6.43 (09.17-43.50)	23.56±6.32 (07.84-40.34)	20.41±5.20 (10.00-34.34)	18.89±5.35 (08.00-33.34)
2.	<i>C. oxypterus</i>	29.49±6.93 (12.00-46.50)	23.80±6.38 (08.17-42.50)	22.39±8.36 (06.67-39.50)	19.13±5.01 (09.00-32.67)	17.89±5.12 (07.67-32.17)
3.	<i>A. crenulata</i>	05.81±1.63 (01.50-10.33)	05.13±1.44 (01.00-09.00)	06.25±1.44 (02.00-10.00)	04.06±1.37 (00.33-07.34)	07.09±1.66 (02.84-11.67)
4.	<i>P. bispinosa</i>	04.63±1.50 (00.84-09.00)	04.22±1.38 (01.00-08.17)	05.47±1.40 (01.67-09.34)	03.85±1.40 (00.00-06.34)	06.35±1.54 (02.50-11.34)
5.	<i>P. pictus</i>	05.83±3.05 (00.84-10.67)	05.50±2.67 (01.17-11.00)	07.00±2.82 (02.67-11.17)	03.42±1.99 (00.67-06.00)	00.00±0.00 (00.00-00.00)

Table 2. Comparative diversity of pyrgomorphid South-Western Rajasthan-hoppers (2005-06 and 2006-07)

S.No.	Species	Udaipur	Sirohi	Rajsamand	Dungarpur	Banswara
1.	<i>C. trachypterus</i>	6.50 (01-13)	5.17 (01-12)	4.36 (01-09)	4.18 (01-10)	4.10 (01-09)
2.	<i>C. oxypterus</i>	5.58 (01-12)	4.80 (01-10)	3.30 (01-07)	4.10 (01-09)	3.73 (01-08)
3.	<i>A. crenulata</i>	2.75 (01-07)	1.78 (01-04)	1.82 (01-05)	2.22 (01-05)	3.83 (01-08)
4.	<i>P. bispinosa</i>	2.00 (01-05)	2.00 (01-05)	1.90 (01-04)	1.43 (01-03)	3.42 (01-07)
5.	<i>P. pictus</i>	2.00 (01-04)	2.17 (01-04)	2.43 (01-05)	1.25 (01-02)	0.00 (00-00)






Photos	Scientific Name	Distribution in South-Western Rajasthan
	<i>Chrotogonus trachypterus</i> , Blanchard Length up to wing tip: Male-12.20-16.50 mm Female-18.02-23.52 mm	Udaipur, Sirohi, Rajsamand Dungarpur and Banswara
	<i>Chrotogonus oxypterus</i> Blanchard Length up to wing tip: Male-11.68-15.04 mm Female-16.38-21.13 mm	Udaipur, Sirohi, Rajsamand Dungarpur and Banswara
	<i>Atractomorpha crenulata</i> Fabricius Length up to wing tip: Male-21.09-25.54 mm Female-29.42-34.87 mm	Banswara Rajsamand Udaipur, Sirohi, and Dungarpur
	<i>Pyrgomorpha bispinosa</i> Walker Length up to wing tip: Male-16.28-20.61 mm Female-20.37-26.94 mm	Banswara Rajsamand Udaipur, Sirohi, and Dungarpur
	<i>Poeciloceruspictus</i> Fabricius Length up to wing tip: Male-44.63-53.26 mm Female-52.06-59.74 mm	Rajsamand, Udaipur, Sirohi, and Dungarpur

Fig. 2. Distribution of pyrgomorphids in South western Rajasthan

population of  $06.35 \pm 1.54$  adults per 400 square metre. The adult population of the colourful grasshopper, *Poecilocerus* was relatively more in Rajsamand, as compared to their population in the other 4 districts, with  $07.00 \pm 2.82$  grasshoppers per 400 meter square (Table 1).

Both the species of *Chrotogonus* showed a gradual increase and decline at Udaipur. At Sirohi, the population dynamics was gradual. In the remaining districts Banswara, Dungarpur and Rajsamand the surface grasshopper population dynamics showed a steep rise and decline. It was notable that the population was found throughout the year with peaks during specific periods of the year. Kevan (1954) observed that the genus *Chrotogonus* contains among its species certain crop pests that the exact status is difficult to determine. This genus has been reported to be destructive both in the Indian region and tropical

Africa. Misidentifications such as *C. lugubris* in place of *C. trachypterus* by Cotes (1894), *C. robertsi* incorrectly named for *C. oxypterus* (Ballard, 1914) have also made it difficult for workers to concentrate on this genus. Species of *Chrotogonus* are geophilus and occur for most part on bare soil, especially near water where humidity is relatively higher, while some may be found at considerable distances from water and even under relatively dry conditions. The rise and fall of the population for *Atractomorpha crenulata* and *Pyrgomorpha bispinosa* was more or less similar in all the districts surveyed and their population was also present throughout the year with definite peaks. *Poecilocerus pictus* showed a similar trend of population built-up and fall in four of the five districts surveyed. The population was recorded from March that continued up to October, and from November to March they were not observed. They were not recorded from Banswara that could be attributed to the relatively

more humid climatic conditions and consequent vegetation. The genus has a preference for higher humidity conditions, as can be evidenced from the climatic conditions of Banswara. The annual precipitation range being 500 to 1050 mm, with an average of 775 mm and the annual temperature range from 45 to 25 °C during summers and above 20 °C during the winter months.

The mean hopper population of the commonly available pyrgomorphids is presented in Table 2. The mean hopper population of the surface grasshopper species *C. trachypterus* and *C. oxypterus* was relatively more in Udaipur with a respective mean population of 6.50 and 5.58 per 25 stops, followed by that in Sirohi (5.17 & 4.807 25 stops). They were least abundant in Banswara (4.10 & 3.737 25 stops). *Atractomorpha* was almost equally represented in all the five districts surveyed. However, their population was relatively more in Banswara (3.837 25 stops). *Pyrgomorpha* also had a similar representation from all the five districts surveyed, though the hopper population was relatively more at Banswara with a mean population of (3.42 hoppers/ 25 stops). The hopper population of *Poekilocerus* was relatively more in Rajsamand with 2.43 hoppers per 25 stops.

It is evident that both species of *Chrotogonus* had the highest hopper infestation (%) during February. *A. crenulata* and *P. bispinosa* had the maximum hopper infestation (%) during August and September. *P. pictus* happened to have the maximum hopper infestation during June and July in the four districts. The climate of the region has a major influence on the diversity and population abundance of the pyrgomorphids, similar to that for other insects. Of the five species collected it was notable that, sparing the genus *Poekilocerus*, the other four genera were recorded in all the five districts, which can be explained by the relatively more dry conditions preferred by this genus as compared to the other genera, *Chrotogonus*, *Pyrgomorpha* and *Atractomorpha*. The associated

vegetation and edaphic conditions are also important in influencing their diversity. *Poekilocerus* prefers relatively light soils than do the other genera for egg laying and prefers to breed well in areas with sparse vegetation than in areas with dense, low-growing vegetation unlike the genus, *Chrotogonus*.

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