

## Orthopteran Biodiversity of Thar Desert, Sindh, Pakistan

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**Abstract:** During the present study 29 species of grasshopper (Orthoptera) were collected from desert area of Tharparkar, Umerkot, Sanghar and Badin districts of Sindh. Of these 24 belong to Acrididae, 4 to Pyrgomorphidae and one species to Tetrigidae. The genus *Criotettix* is recorded from low sea level from desert area for the first time. This single collected individual is very closely related to *Criotettix latifrons* Hebard (1929). In this paper its comparison with other known species in the sub-continent is also provided. In addition to this, relationship of the life-forms of the species in relation to various bio-geographical elements was also examined. Out of 29 species of grasshoppers seven were geophiles, while 16 were phytophiles and remaining six were Intermediate.

**Key words:** Thar, biodiversity, Acrididae, Pyrgomorphidae, Tetrigidae, *Criotettix*, geophiles, phytophiles grasshoppers.

### INTRODUCTION

Grasshoppers represent perhaps the most conspicuous of all insect pests and are abundant insects of dry grassland and desert (Lomer *et al.*, 2001). They pose constant threat to pastures and variety of crops in both irrigated and rain-fed areas of Pakistan. Stretches of sand in the desert are interspersed by hillocks and sandy and gravel plains because due to the diversified habitat and ecosystem, the life of grasshopper in this arid region is very rich in contrast to the other deserts of the world. Amongst them some species of grasshoppers can reach high densities, concentrate their feeding on valued plants, and thus damage the agricultural value of both range and cropland in Sindh. At time they destroy by the vegetation and cause economics loss to mankind. The grasshopper's fauna of Sindh zone in general and Thar in particular, has attracted less attention of early entomologists and no serious attention was paid to the wealth of Thar, except for a few causal references (Bei-Bienko and Mishchenko, 1952; Moeed, 1966, 1976; Jago, 1977; Ahmed, 1980; Perwin *et al.*, 1983; Wagan and Solongi, 1989; Riffat and Wagan, 2008, 2009, 2010a, b, 2012).

Studies on the biodiversity and ecology in tropical areas are rendered difficult due to lack of

modern taxonomic literature. Our knowledge about the diversity in desert area is very poor. The intention of the present study is to contribute a brick to the knowledge of the diversity of Orthoptera of desert. Basically, this study is presented in two parts the first is a systematic list of orthopteran species of Thar region which includes three families *viz.* Acrididae, Pyrgomorphidae and Tetrigidae with seven sub-families of Acrididae such as Oxyinae, Hemiacridinae, Cyrtacanthacridinae, Eyprepocnemidinae, Oedipodinae, Acridinae and Gomphocerinae. The second part is concerned with the information about the life form and their distribution at district level. The life-form concept is a complex one since the shape of body of species bears a relation not only to its habitat, but also to its habits (Uvarov, 1977). The present study was carried out for the first time from this region in order to bring the knowledge of grasshopper's fauna of Thar up to date.

### MATERIALS AND METHODS

#### Collection of samples

The survey of Thar was carried out during 2007-2009 from four districts of Sindh *viz.*, Tharparkar (longitude 68.5°E to 70.5°E, latitude 24.2°N to 25.7°N), Umer Kot (longitude 69°E to 70.2°E, latitude 25°N to 25.7°N), Sanghar (longitude 68.2°E to 70°E, latitude 25.7°N to 26.5°N) and Badin (longitude 68°E to 69.5°E, latitude 24°N to 25°N). The specimens of grasshopper were collected from the different

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vegetation of grasses with the help of traditional insect hand-net (8.89 cms in diameter and 50.8 cms in length) as well as by hand picking.

#### *Killing and preservation of grasshoppers*

The following method has been adapted from Vickery and McKevan (1983). Collected material was killed with KCN in the entomological killing bottles for 30 min. The green colour of grasshoppers is likely to change if kept in the KCN bottle for longer time. The collected specimens were examined under the stereoscopic dissecting microscope and sorted out according to sub-families and species. Pinning of the specimens was done within a few hours. The insect pins were inserted on the pronotum posterior to transverse sulcus slightly to the right of median dorsal carina. The left wings were set with the long axis of the body nearly at right angle to the pin and the head was directed slightly downwards. The posterior legs were bent beneath the body to minimize the possibility of breaking and to occupy the least amount of storage space. The abdomen was so set that it dropped below the wings and not obscured by the hind legs as several taxonomic characters are found on the terminal end and these were not to be hidden till the specimens were dried thoroughly. The body parts had to be supported with extra pins so that it can dry in the desired position and also special attention was paid to the antennae, wings and legs in order to display important taxonomic characters. Dust and other extraneous matter were removed with the help of a dry camel hairbrush. The fully dried specimens were removed from stretching boards and were stored in standard entomological boxes with labels showing locality, date of collection and collector name. Napthalene balls were placed in boxes to prevent the attack of ants and other insect. The collected material was deposited in the Entomology Museum, Department of Zoology, University of Sindh, Jamshoro. The system of Acridoidae adopted here agrees with the outline given by Uvarov (1966), which is a modified version of Dirsh (1961).

#### *Identification of the specimens*

Identification of specimen was carried out under the stereoscopic dissecting binocular microscope with the help of keys and description

available in literature and on the web site “(<http://www.orthoptera.org>) Orthoptera Species File Online”

#### *Statistical analysis*

Data obtained from experimental groups were subjected to one-way analysis of variance (ANOVA) (SPSS 10.0 Soft-Ware) with repeated measures and significant means were determined using Duncan's New Multiple Range Test (DNMRT).

## RESULTS AND DISCUSSION

A total of 29 species of grasshopper were collected and their distribution is shown in Table I along with their life forms. Out of these 24 species were placed in Acrididae, 4 in Pyrgomorphidae and one in Tetrigidae. The species *Oxya hyla hyla* Serville, 1831, *Heteracris littoralis* Rambur, 1838), *Acrotylus humberianus* Saussure, 1884, *Mioscirtus wagneri rogenhoferis* (Saussure, 1888), *Sphingonotus savignyi*, Saussure, 1884, *S. rubescens* (Walker, 1870), *Acrida exaltata* (Walker, 1859), *Duroniella laticornis* (Krauss, 1909), *Truxalis eximia eximia* Eichwald, 1830, *Chrotogonus trachypterus trachypterus* (Blanchard, 1836) and *Poeciloceris pictus* (Fabricius, 1775) occur in all districts, while majority of the other species were collected from fodder crops, herbs and shrubs. However, some species e.g., *Spathosternum prasiniferum* (Walker, 1871), *Eyprepocnemis alacris alacris* (Serville, 1838), *Trilophidia annulata* (Thunberg, 1815), *Truxalis eximia eximia* Eichwald, 1830, *T. fitzgeraldi* Dirsh, 1950, *Ochrilidia geniculata* (Bolívar, 1913), *O. gracilis gracilis* (Krauss, 1902) were collected from the cultivated maize and jowar field where they are regarded as a minor pest. Contrary to this, *Hieroglyphus nigrorepletus*, Bolívar, 1912, *Anacridium rubrispinium* Bey-Bienko, 1948, *Schistocerca gregaria* Forsskål, 1775, *Acrotylus humberianus* Saussure, 1884, *Aiolopus thalassinus thalassinus* Fabricius, 1781), *Hilethera aeolopoides* (Uvarov, 1922), *Locusta migratoria* (Linnaeus, 1758), *Scintharista notabilis pallipes* Uvarov, 1941, *Sphingonotus savignyi* Saussure, 1884, *Chrotogonus trachypterus trachypterus* (Blanchard, 1836),

**Table I.- Main life forms of orthoptera species occurring in following districts of Sindh during the year 2007-2009.**

Species	Life Forms	Districts of Sindh			
		Tharparkar	Umer Kot	Sanghar	Badin
<b>Acrididae</b>					
Oxyinae					
<i>Oxya hyla hyla</i>	G	+	+	+	+
<b>Hemiacridinae</b>					
<i>Hieroglyphus nigroropletus</i>	G	-	+	-	
<i>Spathosternum prasiniferum</i>	G	+	-	+	+
<b>Cyrtacanthacridinae</b>					
<i>Anacridium rubrispinium</i>	A	+	-	-	-
<i>Schistocerca gregaria</i>	TH	+	-	-	-
<i>Cyrtacantharis tatarica</i>	TH	+	-	-	
<b>Eyprepocnemidinae</b>					
<i>Eyprepocnemis alacris alacris</i>	H	-	+	+	-
<i>Heteracris littoralis</i>	AH	+	+	+	+
<b>Oedipodinae</b>					
<i>Acrotylus humbertianus</i>	TG	+	+	+	+
<i>A. longipes subfasciatus</i>	Ta	+	+	-	-
<i>Aiolopus thalassinus thalassinus</i>	G	-	+	+	+
<i>Hilethera aeolopoides</i>	H	+	-	+	-
<i>Locusta migratoria</i>	G	-	+	+	+
<i>Mioscirtus wagneri rogenhoferi</i>	Td	+	+	+	+
<i>Scintharista notabilis cinctipes</i>	Ts	+	-	-	+
<i>Sphingonotus savignyi</i>	Td	+	+	+	+
<i>S. rubescens rubescens</i>	Td	+	+	+	+
<i>Trilophidia annulata</i>	TH	+	-	+	+
<b>Acridinae</b>					
<i>Acrida exaltata</i>	G	+	+	+	+
<i>Duroniella laticornis</i>	G	+	+	+	+
<i>Truxalis eximia eximia</i>	TG	+	+	+	+
<i>T. fitzgeraldi</i>	TG	-	-	-	-
<b>Gomphocerinae,</b>					
<i>Mesopsis cylindricus</i>	G	+	-	-	-
<i>Ochrilidia geniculata</i>	G	-	+	+	-
<i>O. gracilis gracilis</i>	G	-	+	+	-
<b>Pyrgomorphidae</b>					
<i>Chrotogonus trachypterus trachypterus</i>	Td	+	+	+	+
<i>Poekilocerus pictus</i>	A	+	+	+	+
<i>Tenuitarsus orientalis</i>	Ta	-	+	+	-
<i>Pyrgomorpha bispinosa deserti</i>	H	-	+	+	-
<b>Tetargidae</b>					
<i>Criotettix</i> sp.	Td	-	-	+	-

*Poekilocerus pictus* (Fabricius, 1775) and *Tenuitarsus orientalis* Kevan, 1959 were collected from rice and fodder crops and insufficiently reported as the major pest of agriculture in Pakistan.

However, the status of remaining species was uncertain due to insufficient collection from surveyed areas.

The most abundant species belonged to the

family Acrididae with 83.3% of the total number of all grasshopper's species collected from Thar followed by 15.83% of Pyrgomorphidae and 1.28% Tetrigidae. In Thar fauna total specimen of Pyrgomorphidae was found most abundant with  $(3.96 \pm 0.56)$  followed by Acrididae  $(2.99 \pm 0.26)$  while a single individual of *Criotettix* from Tetrigidae was considered rare (Table II). The genus *Criotettix* from Tetrigidae is recorded for the first time from desert area and from low sea level. This single specimen of the genus *Criotettix* collected is very closely related to *Criotettix latifrons* Hebard (1929) its dorsal surface of pronotum is more rugose however, its comparison with other known species in sub-continent is also provided (Table III). Variation in the different body parameters is an important feature of organism, because it strongly correlates with numerous ecological, physiological and life-history traits (Peters, 1983). Similarly Blackburn *et al.* (1999) stated that variation in body size and size related characters is related to latitudinal or altitudinal gradients. Present study is in agreement with this observation. The significant differences in richness and diversity of families and sub-families could be the result of inadequate collection or might be due to non-availability of host plants.

The relationship of the life-forms of the species has also been studied in relation to various biogeographical elements (Tables I, IV). Out of 29 species phytophiles were dominant (55.12%) followed by geophiles (24.13%) and intermediate (20.68%) in the studied districts. The non-thar elements, on the other hand, were phytophilous. There were only seven terricole and six intermediates as against 16 phytophiles. There was some evidence of xerophily, as shown by the absence of typical graminicole with their elongate, slender form. One species *Mesopsis cylindricus*, fitted the concept of classic graminicole known from Tharparkar did not apparently reach other districts. *Truxalis eximia eximia*, despite its shape, is not a true graminicole, but rather a terri-graminicole, perhaps as a result of secondary re-adaptation it occurs xerophilous or at best mesophilous habitats and spends most of its time on the earth surface rather than on the vegetation.

According to Uvarov (1977), the life-form

concept is a complex one since the shape of the body of a species bears a relationship not only to its habitat, but also to its habits. A morphological basis is avoided here by making due allowance for a species ecology when determining its life-form label. Presently the following life-forms are recognized (Popov 1980): **1.** Terricoles are species living mostly on the ground and feeding on plants without climbing them. A sub-division of terricoles living in open desert is termed deserticole, while other divisions are made on the basis of the nature of ground into arenicoles on sand and saxicoles on rock, while mountane forms that have lost the power of flight and taken to a terrestrial existence are mountane terricoles. **2.** Arboricoles and arbusticoles are species living on tree and shrubs. **3.** Herbicoles which herbs and **4.** Graminicoles level on grasses. The members of the first group are geophilous, while those of the last three are phytophilous. Intermediate life-forms are also recognized particularly as terri-herbicoles and terri-graminicoles with largely terrestrial habits, at least during some of the life stages. Other life-forms such as aquaticoles and moutane terricoles exist, but do not concern, here. It is natural that bulk of thar fauna exhibit marked xerophily, with predominance of deserticolous elements well-adapted to life under desert conditions; this is so to the elements that the intermediate and phytophilous elements of the thar group have mixed xerophilous tendencies and graminicoles, like *Ochridia*, occur under conditions of extreme aridity.

In determining the grasshopper's population under natural conditions some practical difficulties were often encountered in observation area which have either thick or coarse vegetation or surrounded by tall grasses. Furthermore, due to their quick movement and migratory habit, no relationship could be established between the catches visual counting of grasshopper population. Wagan and Baloch (2001) had observed similar difficulties. Cotes (1893) recorded serious damage of *Aiolopus* species in upper Sindh. Wagan (1990) reported incidence of *Acrotylus* species at Khairpur Nathan Shah, Mehar and Larkana district. Earlier, the distribution of *Oxypterna* was reported by Moeed (1966, 1976) from Hyderabad, and Wagan (1990) reported it from Tharparkar, Sanghar, Nawab-Shah

**Table II.- The relative average abundance of grasshopper’s families and subfamilies from following districts of Sindh.**

Family/Sub-families	Tharparkar	Umer Kot	Sanghar	Badin
<b>Acrididae</b>	3.2±0.73 <sup>c</sup>	2.65±9.97 <sup>d</sup>	3.18±0.91 <sup>b</sup>	2.9±1.14 <sup>c</sup>
Oxyinae	3.0±1.58 <sup>f</sup>	3.0±1.0 <sup>d</sup>	2.5±1.2 <sup>ns</sup>	4.6±1.5 <sup>a</sup>
Hemiacridinae	3.4±2.3 <sup>d</sup>	4.0±1.0 <sup>b</sup>	1.75±0.95 <sup>ns</sup>	3.0±2.0 <sup>c</sup>
Cryptacanthacridinae	3.8±1.92 <sup>c</sup>	3.6±1.5 <sup>c</sup>	3.3±1.5 <sup>b</sup>	4.0±1.0 <sup>b</sup>
Eyprepocnemidinae	2.0±1.0 <sup>ns</sup>	1.33±0.57 <sup>ns</sup>	4.0±1.85 <sup>a</sup>	1.33±0.57 <sup>ns</sup>
Oedipodinae	2.6±1.51 <sup>ns</sup>	2.66±0.57 <sup>ns</sup>	4.5±1.29 <sup>a</sup>	2.0±1.0 <sup>ns</sup>
Acridinae	4.2±1.30 <sup>b</sup>	1.66±0.5 <sup>ns</sup>	3.25±1.70 <sup>b</sup>	3.33±2.57 <sup>c</sup>
Gomphocerinae	3.4±1.51 <sup>d</sup>	2.33±0.5 <sup>ns</sup>	3.2±1.6 <sup>b</sup>	2.33±1.52 <sup>ns</sup>
<b>Pyrgomorphidae</b>	4.2±2.16 <sup>a</sup>	4.6±1.52 <sup>a</sup>	3.75±2.5 <sup>a</sup>	3.3±1.52 <sup>c</sup>
<b>Tetrigidae</b>	--	--	1	--

Mean in the same column followed by the same letters are not significantly different from one another at 5% level of probability (DNMRT) \*p≤0.05

Ns= not significant p≥ 0.05

**Table III.- Comparison of *Criotettix* sp. with its other known species from Indian Subcontinent**

Species	Sex	Length (mm)		Distribution
		Pronotum	Femur	
<i>Criotettix subulatus</i> Bolivar, 1887	Female	14.0	6.5	Indes Orientales (India)
<i>C. miliarius</i> Bolivar, 1889	Male	♂ 14.0-17.0	♂ 6.9-8.2	Sri-lanka type locality Keshwa, Sri-Lanka
	Female	♀ 15.9-18.8	♀ 8.0-9.0	
<i>C. tricarinatus</i> Bolivar, 1989	Male	♂ 10.5-12.5,	---	Sri-Lanka Tamil Nadu Sumba, Type locality Sri-Lanka
	Female	♀ 5.0-6.0		
<i>C. indicus</i> Bolivar, 1902	Male	♂ 11.0,	----	South India
	Female	♀ 6.5		
<i>C. aequalis</i> Hancock, 1912	Uncertain	P=17.0	----	Bengal Type locality Phoobsering Lebong 15000m Altitude
<i>C. curticornis</i> (Hancock, 1915)	Male	♂ 18.5	----	S.India Type locality, Medha, Yenna Valley, Satara district Bombay state 700m Altitude
	Female	♀ 7.0		
<i>C. fastiditus</i> Bolivar, 1918	Male	♂ 9.0	---	South India locality Taliparamba (Malabar)
	Female	♀ 3.8		
<i>C. latifrons</i> Hebard 1929	Male	♂ 13.5-16.0	---	India Sri-Lanka Type locality Coinbatore Tamil Nadu
	Female	♀ 5.5-6.0		
<i>Criotettix</i> sp.	Male	♂ 17.5,width 2.1	♂ 7.9	Pakistan, Type locality Sanghar

**Table IV. - Collected numbers of life-form of orthopteran species from four districts of Sindh**

	Terricoles									
	Td	Ta	Ts	TH	TG	A	AH	H	G	Total
Tharparkar	01	01	--	01	02	--	--	01	05	11
Umer Kot	--	01	01	02	--	01	--	--	02	07
Sanghar	02	--	--	--	01	01	--	--	02	05
Badin	01	--	--	--	--	--	01	02	01	05
<b>Total</b>	<b>04</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>10</b>	<b>29</b>

A, arboreal (arbusticole); A, AH, H, G, Phytophiles; AH, arbori-herbicole; G, graminicole; H, herbicole; Ta, terri-arenicole; Td, terri-deserticole; Td, Ta, Ts, Geophiles; TG, terri-graminicole; TH, terri-herbicole; TH, TG, Intermediate; Ts, terri-saxicole.

(now Shaheed Benazirabad), Khairpur and Jacobabad districts of Sindh but could not find the *Hieroglyphus nigrorepletus*, *Heteracris littoralis* and *Ochrilidia geniculata*. At present these species are being reported for the first time. The addition of Thar fauna together with pre existing species from other known districts of Sindh province could be helpful to identify the accurate pest status of the species so that diagnosis of economic problems could be made properly.

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