

Description and distribution of Bush hoppers (Pyrgomorphidae) from district Khairpur Mirs, Sindh, Pakistan

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Abstract- Bush hoppers belongs to the Orthoptera and Caelifera family Pyrgomorphidae. The Pyrgomorphidae family is characterized by huge morphological variations among species and genus worldwide. Because of their body colouration, this charismatic group of bush hoppers is famous for its unique pronotum patterns. They are considered moderate pests, which attack a broad range of farm crops and cause an outbreak of their instars. Present study was carried out during (January-September) 2020 from various tehsils of Khairpur. About 432 Pyrgomorphidae specimens were collected which were sorted into family Pyrgomorphidae with (05) genera and (06) species i.e: *Tenuitarsus orientalis* Kevan, 1959, *Chrotogonus trachypterus* (Blanchard, 1836), *Chrotogonus homalodemus* (Blanchard, 1836) *Atractomorpha acutipennis* (Guerin-Meneville, 1844), *Pyrgomorpha bispinosa deserti* Bey-Bienko and Mistshenko, 1951 and *Poeciloceris pictus* (Fabricius, 1775). Of which *Tenuitarsus orientalis* Kevan, 1959 is redescribed from Pakistan. In addition to this, all species were first time recorded from district Khairpur Mirs. Besides, tehsil wise distribution of species along with description is provided.

Index Terms- Bush-hoppers, Caelifera, Morphological variations, Pyrgomorphidae, Species

I. INTRODUCTION

Bush hoppers belongs to family Pyrgomorphidae order Orthoptera and sub-order Caelifera. The family Pyrgomorphidae have great morphological variations amongst species as well as upto genus level throughout world. This charismatic group of Bush hoppers are well known due to their body coloration, unique patterns on their pronotum and usually featured as showy insects in displays [1]. Presently this family comprises nearly 488 species, out of which 385 species are found in Asia and Africa. Bush hoppers are mostly cryptic and less known Orthopteroid insects. Many of species are colourful and might be overlooked by the public [2].

Pyrgomorphidae are widely distributed in Oriental, Palearctic, Australian and Neotropical regions. There are about 477 species under 149 genera of family Pyrgomorphidae throughout the world including Indocontinent [3]. Many of species of Bush hoppers are important pest and attack several types of ornamental

plant and crops. About 20 genera are regarded as moderate pests such as *Zonocerus elegans* and *Zonocerus variegatus* attack on wide range of agricultural crops in Africa and their instars caused outbreak [4]. Pakistan is most diverse region with its great importance from different geographical point of view falling oriental, Palaertric and some intermingling with afro-tropical elements that give ideal place for breeding of these insects [5].

Histological and anatomical study of reproductive structure of *Poeciloceris pictus* species of family pyrgomorphidae was conducted and was compared with other species such as *Locusta migratoria* and *Schistocerca gregaria* [6]. About 28 species of various families of Orthopteroid were reported. Only single species i.e: *Pyrgomorpha conica* of Pyrgomorphidae was recorded from Faisalabad [7].

Taxonomic study of Thal area of Punjab resulted in discovery of 05 species of Pyrgomorphidae under 05 genera i.e: *Tenuitarsus*, *Chrotogonus*, *Pyrgomorpha*, *Atractomorpha* and *Poeciloceris* [8]. Six species were identified i.e: *Poeciloceris pictus*, *Pyrgomorpha bispinosa deserti*, *Aularches miliaris*, *Chrotogonus trachypterus trachypterus*, *Atractomorpha sinensis sinensis* and *Conophyma semenovi* under 02 genera were recorded from Azad Jammu Kashmir Pakistan [9]. Biological observation of single species of Pyrgomorphidae i.e: *Chrotogonus trachypterus trachypterus* was carried under laboratory conditions in Tandojam Sindh [10].

A survey of Mirpur division of Azad Jammu Kashmir revealed finding of 25 species of Orthopteroids including 02 species i.e: *Poeciloceris pictus* and *Chrotogonus trachypterus* of family Pyrgomorphidae [11]. Two new species i.e: *Ichthyotettix stricticaudatus* and *Ichthyotettix inexpectatus* of family Pyrgomorphidae from Mexico [12].

Four species i.e: *Pyrgomorpha bispinosa deserti*, *Chrotogonus trachypterus*, *Poeciloceris pictus* and *Tenuitarsus orientalis* were reported from Thar Sindh Pakistan [13]. Egg morphological and development of eggs study of 01 species i.e: *Poeciloceris pictus* of Pyrgomorphidae was carried in laboratory condition in Jamshoro District [14,15]. Taxonomic survey of Hazara division of Pakistan revealed 1402 species of Orthopteroids including Pyrgomorphidae family [5]. Study on biodiversity of caelifera of Gorakh hill resulted in finding of 39 species. Of which 19 species belong to family Acrididae, 11 species to Tetrigidae, 05 species

to Dericorythidae and 04 to Pyrgomorphidae [2]. But no data is reported on Pyrgomorphidae family from district Khairpur Mirs, thus it is proposed to conduct research on taxonomical and distributional record of this family from this area. This study was

II. MATERIAL AND METHODS

A. Collection of Pyrgomorphidae

Collection of Pyrgomorphidae species was conducted through extensive surveys from various tehsils of Khairpur district. Pyrgomorphidae species were captured by the help of insect nets, light traps, malaise traps and hand-picking methods. The species were captured from agricultural lands, grasses, shrubs and herbs. Some species of genus *Chrotogonus* were captured from roadsides due to their likeness of noisy habitat. At the time of collection name location, habitat and plant name was noted [5, 16].

B. Killing and preservation of Pyrgomorphidae

Pyrgomorphidae species were collected and kept into insect jars and will be taken into Entomology lab, Department of Zoology, Shah Abdul Latif University. Killing of species was done in jars having chloroform. The Pyrgomorphidae species were than stretched on thermopaul sheets, wings were carefully stretched in order to change in coloration. Pyrgomorphidae species were pinned on its thoracic part (pronotum) and dried for (4-5 hours) and then shifted to insect wooden boxes. Naphthalane bolls were kept in boxes for the prevention of parasite attack [17].

C. Identification of Pyrgomorphidae species

Pyrgomorphidae species were made under stereoscopic dissecting binocular microscope (SDBM). Taxonomic keys present in literature were used [4, 18]. Taxonomical description of species were noted and samples were processed for further confirmation through genitalia study.

D. Study of Genitalia

Pyrgomorphidae species were kept for a night (12 hours) in desicator with few drops of alcohol and tape water was added so as to prevent from infection of fungus. After (12 hours) the samples abdominal part was cut with help of fine scissor and kept in cavity slide possessing potassium hydroxide under light of bulb so as to soften the extra cellular muscles. The genitalia were cleaned with help of 0.1 camel hairbrush and will be observed. The preservation of genitalia was made into vials having glycerine [19].

E. Photography of Species

Species image was taken by help of CANON (16 MEGA Pixel camera) camera [5]. While for tehsil wise distributional data of species GIS Mapping software was used [20].

III. RESULTS

Present study was carried out during (January-September) 2020 from various tehsils of Khairpur (Table 1 and 2). About 432 pyrgomorphidae specimens were collected. Then were sorted into family Pyrgomorphidae with 05 genera and 6 species i.e: *Tenuitarsus orientalis* Kevan, 1959, *Chrotogonus trachypterus* (Blanchard, 1836), *Chrotogonus homalodemus* (Blanchard, 1836), *Atractomorpha acutipennis* (Guérin-Méneville, 1844), *Pyrgomorpha bispinosa deserti* Bey-Bienko and Mistshenko, 1951 and *Poekilocerus pictus* (Fabricius, 1775).

conducted in order to identify and provide comprehensive description of Pyrgomorphidae species along with the distribution of species in each tehsil of district Khairpur.

Description of species

Tenuitarsus orientalis Kevan, 1959

Slightly depressed, rugged, hairy integument; short antennae, and marginal pronotum, shorter; short, slightly concave fastigium of vertex; great apical fastigial areolas and sharp marginal carinulae. Sub-cylindric, reverse widening, tuberculous, with weak median carinate linearity, crossed by three carinae, absent lateral carinae, rounded metazona, its posterior margin; fully developed, elytra and the wings; slender, elongated, slender, middle femur and tibiae; slender, slightly shorter, hind femur, with a lower basal lobe.

Chrotogonus trachypterus (Blanchard, 1836)

Small and sturdy; organism depressed, tubercular integument; thick, slightly widening antennae together in apical half, shortened than head and pronotum; Short, angular, concave rapid vertex; large apical, quickgial arinulae, sharp marginal carinulae; present occipital carinulae; strongly compacted and protruding antennae frontal ridge forward, slitlike sulcus, almost obliterated below. Pronotum, fatten above, spread lateral sideways, strongly tuberculous with an after angle of carinae, irregular, broken, median and lateral, crossed by three sulci;; metazona long than prozona, its angular rear margin; strongly expanded anterior prosternal margin, collared like, with a pair of rear tubers, covering lower portion of the mouth; Fully developed, reduced and vestgial elytra and wings; Absent tympanum or vestgial; moderately slender hind femur; depressed and spread hind tibiae to apex; lack of external apical spinal columns; spurts much longer than outer; Medium sized arolium; male supra anal angular plate; short cersus, shaky conical; short subconic, obtuse plate; wide, slightly curved, acute lophi, epiphallus.

Chrotogonus homalodemus (Blanchard, 1836)

Body robust wings longer than body. Antennae thin, slightly narrowing at its apical part. Fastigium of vertex widened, carinated at the lateral sides. Pronotum with a prominent structure of horse shoe at its upper margins. Epiphallus pointed at its upper margins.

Atractomorpha acutipennis (Guerin-Méneville, 1844)

Small to medium size. Integument of ruggedness; slightly compressed, antennae shorter than head and pronotum together; their bases are positioned in front the lateral ocelli; the vertex rapidgium is elongating, smooth, horizontal or slightly curved with parabolitic or angular apex. elongated, subcylindrical, reverse slightly widening; slightly fatten dorsal crossing with three fine sulci; median and slightly carinarius medium size; Side lobe with a low marginal row; cuneiform prosternal procedure; elytra and wings fully developed, the apex of the elytron acutely attenuate; well-developed tympanical system; enhancer, engraved hind-footed, with externally low marginal area narrow, ventral to external medial area; lower lobes of the hind-footed body much less than prozona.

***Pyrgomorpha bispinosa deserti* Bey-Bienko and Mistshenko, 1951**

A body with varying shapes, a head that is acutely conical and fastigial. Present prosternal process. Elytra and wings developed fully, reduced or missing. Usually present is tympanum. Hind Femur's lower basal lobe is longer than its upper. Brunner's organ, with thin, just about cursorial hind legs, except for a few genres. External hind-tibia apical spine present or missing. Differentiated ectophallus; cingulum capsule-like; penis valves paired and divided; dorsal spermatophore sac. The bridge is shaped epiphallus, with appendices on the back of the side; not yet present, lophi-like. Absence of oval sclerites. No mechanism known stridulatory.

***Poeciloceris pictus* (Fabricius, 1775)**

Body greenish with yellowish line. Commonly known as AKK grasshoppers. Antennae filiform. Fastigium of vertex widened. Epiphallus triangular and much wider at the base with obtusely rounded at the apex.

IV. DISCUSSION

Bush hoppers belong to the Orthoptera and Caelifera family pyrgomorphidae. The pyrgomorphidae family is characterised by huge morphological variations between species and genus worldwide. Because of their body colouration, this charismatic group of bush hoppers is famous for its unique pronotum patterns. They are considered moderate pests, which attack a broad range of farm crops and cause an outbreak of their instars. This family now includes almost 488 species, including 385 in Asian and African region. Bush hoppers are mainly mysterious and orthopteroid insects are less known. Several species are colorful and can be ignored by the layman [1].

About 432 pyrgomorphidae specimens were collected during (January-September) 2020 from various tehsils of Khairpur. Which were sorted into family Pyrgomorphidae with 05 genera and 6 species i-e: *Tenuitarsus orientalis* Kevan, 1959, *Chrotogonus trachypterus* (Blanchard, 1836), *Chrotogonus homalodemus* (Blanchard, 1836) *Attractomorpha acutipennis* (Guérin-Méneville, 1844), *Pyrgomorpha bispinosa deserti* Bey-Bienko & Mistshenko, 1951 and *Poeciloceris pictus* (Fabricius, 1775). Of which *Tenuitarsus orientalis* Kevan, 1959 is redescribed from Pakistan. Panhwar [2] reported a biodiversity study of Gorakh Hill caelifera led to 39 species being detected. Of which 19 are of the Acrididae family, 11 are of the Tetrigidae, 05 are of the Dericorythidae species and 04 are the Pyrgomorphidae. Zahid et al., [21] stated that there is known to be a high insect arable land and endemism in the Indian subcontinent, but grasshopper fauna is not fully understood in this region, partly due to a lack of suitable taxonomic resources. Based on detailed exams of museum samples and large digital images, an illustrious key has been developed to 21 generations of Pyrgomorphidae known in the Indian subcontinent. This new identification best approach will serve to enhance our knowledge of grasshoppers' taxonomy in this important biogeographical area. Li et al., [22] reported temperature effect on the *Attractomorpha species*.

Mariño-Pérez and Song [19] reported that there is a peculiar expatriate management of gaudy grasshopper family Pyrgomorphidae. Or less 10% of the 487 species described are in the Native Americans, whereas the remainder are found in

Africa, Asia and Australia. The taxonomic positions of those taxa in the great pyrgomorphidae phylogeny and relationships among them never have been investigated, and only 41 species are found to 4 tribes can be found in Central and South America and the Dominican Republic. As far as biogeography is concerned, three hypotheses regarding the source of New World Pyrgomorphidae were suggested, but they were not empirically tested. In this study, we display the first molecular pyrgomorphid phylogeny to examine the biogeographies of this fascinating lineage, which includes all four Global World tribes and fair representation Old World genes based on a whole mitochondria genome. Our results include: (1) The Mediterranean Jaragua + South American Algiers; (2) The Colombian and Central United states Sphenarium + Prospenes; and (3) The Mexican Ichthiacridini + Ichthyotettigetigins. We have found the following in Pyrgomorphidae as monophyllic and New World Pyrgomorphidae as paraphyles consisting of 3 cladi: The analysis of divergence estimates showed that the Pyrgomorphidae diverged in the Cretaceous Period (139-104 mya) from their relatives. After the biogeographical analysis using the BioGeoBEARS, the first New Frontier Pyrgomorphidae clade (Algete + Jaragua) was diversified into the old world after its diversification and was explained in two ways: the transatlantic colonisation from Africa with North South America or the survival of the two in the new world. Their distribution in the new world was explained in the newest of these two possible events. In Mexico, including in the Bajo of California, the current phase of colonisation took place around 69 mya at the end of the Latin Cretaceous with dispersals from Africa into South America, then to North America.

Usamani et al., [23] reported 10 species include several genera pertaining to four tribes of a Pyrgomorphidae family in northeastern India was carried out. The thorough structures of ambiguous genitalia also were included for identification in comparison to basic morphological characteristics. It is described all the genera studied. Every species is also given morphometry and distribution.

In present study a detail description of species is given for the first time. In addition to this, all species were recorded for the first time from district Khairpur Mirs. Besides, tehsil wise distribution of species along with description is provided.

V. CONCLUSION

Present study reveals the finding of 05 genera and 6 species of family Pyrgomorphidae.

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Table.1 Showing Latitude and Longitude of various Tehsil of district Khairpur

Study sites	Latitude (N)	Longitude (E)
FG	26° 7'	68° 4'
GB	27° 21'	68° 31'
KH	27° 32'	68° 49'
KG	27° 34'	68° 36'
KD	27° 20'	68° 42'
NR	27°	68°
SD	27° 18'	68° 24'
TW	27°	68° 6'

“E” East, “N” North

Table 2. Showing distribution of Pyrgomorphidae species

Species	Tehsil of District Khairpur Mir's							
	FG	GB	KH	KG	KD	NR	SD	TW
<i>Tenuitarsus orientalis</i>	03	02	05	04	02	03	02	03
<i>Chrotogonus trachypterus</i>	02	06	04	02	03	08	03	02
<i>Chrotogonus homalodemus</i>	05	02	04	04	04	06	03	06
<i>Atractomorpha acutipennis</i>	04	05	06	04	02	06	04	05
<i>Pyrgomorpha bispinosa</i>	04	06	03	06	04	03	07	05
<i>Poekilocerus pictus</i>	04	05	02	06	03	05	03	06

“FG” Faizganj, “GB” Gambat, “KH” Khairpur, “KG” Kingri, “KD” Kotdeji, “NR” Nara, “SD” Sobhodero, “TW” Tharimirwah

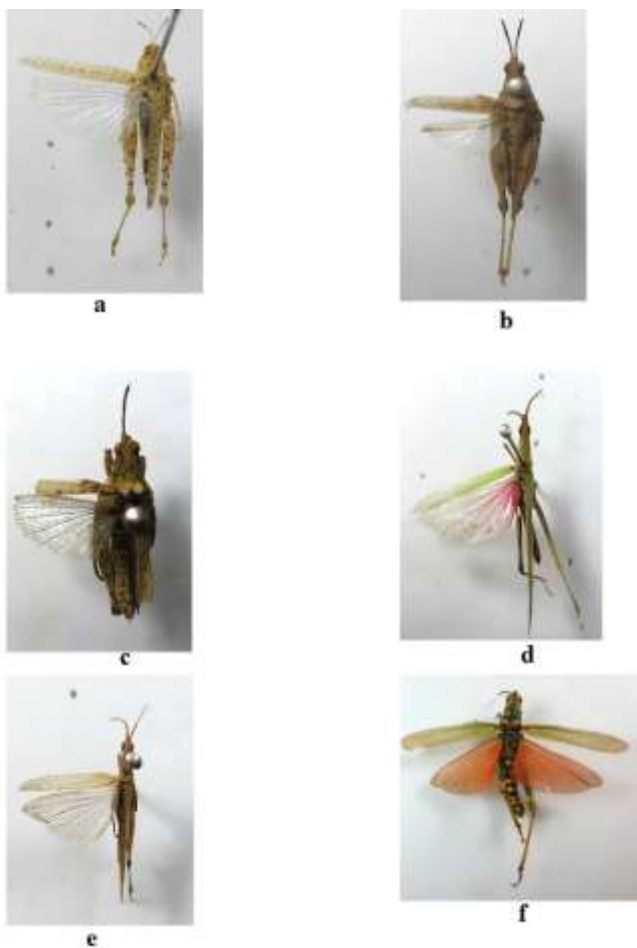


Figure 1 a. *Tenuitarsus orientalis*, b. *Chrotogonus trachypterus*, c. *Chrotogonus homalodemus*, d. *Atractomorpha acutipennis*, e. *Pyrgomorpha bispinosa deserti*, f. *Poekilocerus pictus*

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