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Re-description of *Tenuitarsus orientalis* Kevan, 1959 (Pyrgomorphidae: Orthoptera) from Pakistan

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ABSTRACT: Pakistan is the most unique and geographically important region with the Oriental, Palaelarctic and coexisting components with afro-tropical elements, which are suitable for breeding these insects particularly Pyrgomorphidae species. They are most spectacular grasshoppers causing severe damage to various crops. It was therefore present was designed to explore the Pyrgomorphid fauna especially, genus *Tenuitarsus* Bolívar, 1904 from this region. For the present study, surveys were carried out during the month of March 2019- August 2020 from different localities of district Khairpur Mirs Sindh, Pakistan. The samples were identified into single genus with single species i-e: *Tenuitarsus orientalis* Kevan, 1959. In this paper we re-describe *Tenuitarsus orientalis* Kevan, 1959. Beside this, morphometric variations of male and female are presented.

Keywords: Pyrgomorphidae, Species, Morphometry, Grasshoppers, Damage, Checklist, Re-description.

Abbreviations: NH, Natural History Museum; EL, Entomological Lab; LP, Length of Pronotum; LT, Length of Tegmina; LF, Length of Femur; TBL, Total body length

I. INTRODUCTION

Some of the most spectacular grasshoppers in the world are belonging to Pyrgomorphidae, family which is why this group of insects is also known as "gaudy grasshoppers." There are currently 487 valid species in 149 genera in this family. This is a lineage recognized mainly in Africa and Asia, but the genera have been found in Mexico and South America, in addition to Australia. Pyrgomorphs are easily diagnosable by the presence of a groove in the fastigium of vertex and very distinctive phallic. Some individuals may demonstrate significant color, and this is usually interpreted as such [1]. The Pyrgomorphidae is a representative of the super family Pyrgomorphoidea and is sister group to the Acridoidea [2]. Pyrgomorphidae are found worldwide. There are around 477 species under 149 genera of family Pyrgomorphidae worldwide [3]. The study carried out on single genera of Pyrgomorphidae determine the significance of historic geological and climatic incidents on the lineage variation [4]. Orthopteroid insects belonging to family Pyrgomorphidae usually disappear into the environment undetected. Many species are colorful and can be neglected by the public and cultivators. Numerous species of are considered key pests and attack several types of ornamental and field plants. In 2012, about 20 genera such as *Zonocerus elegans* and *Zonocerus variegatus* caused great financial losses to farmers by seriously damaging a variety of crops [5]. Pakistan is the most unique and geographically important region with the oriental, Palaelarctic and coexisting components with afro-tropical elements, which are suitable for breeding these insects [6]. There have been reports of about 28 species of different Orthopteroid families. It was recorded from the Faislababd only one species: *Pyrgomorpha conica* of the Pyrgomorphidae [7]. The thal area of Punjab was studied and about 05 species were discovered of Pyrgomorphidae under 05 genera viz: *Tenuitarsus, Chrotogonus, Pyrgomorpha, Atractomorpha* and *Poekilocerus* [8]. Studies were conducted on bushoppers of Thar desert resulted in finding of 04 species i.e. *Pyrogomorpha bispinosa deserti, Chrotogonus trachypterus, Poekilocerus pictus and Tenuitarsus orientalis* [9]. Survey of caelifera of Gorakh hill resulted in discovery of 39 species. Out of which 19 species belong to family Acrididae, 11 species to Tetrigidae, 05 species to Dericorythidae and 04 to Pyrgomorphidae [10]. The discoveries of Bush hoppers in the district of Shikarpur have shown 07 species: *Pyrgomorpha bispinosa* Walker, 1870, *Pyrgomorpha deserti* Bei-Bienko & Mistshenko, 1951, *Poekilocerus pictus* (Fabricius, 1775), *Chrotogonus trachypterus* (Blanchard, 1837), *Atractomorpha acutipennis* (Guerin-Méneville, 1844) and *Atractomorpha blanchardi* Bolívar, 1905 [11]. A dichotomous key for identifying the 21 genera of Pyrgomorphidae from Indian subcontinent was developed which included a figure for each pair, that shows clearly diagnostic characters whenever possible. A short morphological guide was developed to help in identification of Pyrgomorphidae. A careful selection of morphological features was made [12]. The aim of this paper is to provide re-description of *Tenuitarsus orientalis* of family Pyrgomorphidae from this region. In Addition, we intend to lay down the gaps in the understanding and the necessity for future exploration of this group.

II. MATERIALS AND METHODS

Sporadic surveys were conducted during the month of March 2019- August 2020 from different localities of district Khairpur Mirs Sindh, Pakistan. The samples were collected with help of aerial nets, hand picking method and sweep netting. The samples were killed with potassium cyanide in standard entomological bottles or by chloroform after pinning the specimens. The Pyrgomorphids were examined under stereoscopic binocular microscope. The samples were identified with help of taxonomic keys available in literature and (www.orthopteraspeciesfile.com) [12], [13]. Identified samples were categorized and well-preserved into insect boxes. Characters were noted down and images were taken with the help of high Meji infinity camera 350 k pixel camera fitted on dissecting microscope Kyowa Medilux20.

III. RESULTS AND DISCUSSION

A. Systematics and Diagnosis of family

Pyrgomorphoidea Brunner von Wattenwyl, 1874
Pyrgomorphidae Brunner von Wattenwyl, 1874 urn:lsid: Orthoptera.speciesfile.org:TaxonName:36749
Diagnosis. Body of varying shapes, head deeply conical. Fastgial furrow clear in appearance. Prosternal process is present. Both elytra and wings are completely developed, absent or reduced. Tympanam usually present. The lower basal lobe of hind femur extended than the upper lobe. Brunner's organ present except in a few genera, with thin, almost cursorial hind legs. External apical spine of hind tbia present or absent. Ectophallus differentiated; cingulum capsule-like; valves of penis paired, undivided; spermatophore sac in dorsal positon. Epiphallus bridge shaped, with dorso-lateral appendices; ancore absent; lophi hook-like. Oval sclerites are absent. No stridulatory mechanism known. Pyrgomorphidae is a very well-defined family, with a peculiar phallic complex which is rather uniform through the family. The relationship with other families is rather obscure and no close affinities exist. They have some common features with Lentulidae, such as paired valves of the genitalial organare not divided and the dorsal position of the spermatophore sac, and others with Ommexechidae, such as the presence of a fastgial furrow and the paired undivided valves of the genitalial organ.

B. Tribe Chrotogonini Bolivar, 1904
Diagnosis. Body generally depressed, slightly rugose. Coloration mottled brown or grayish. Fastgium of vertex generally short, blunt, broad. Tegmina generally with small nodules on main veins. Hind wings are hyaline. Prosternum with reflexed, collar-like frontal margin and tubercle. Epiphallus having lateral plates wide. Ectophallus emarginated at base, shorter, broader.

C. Genus Tenuitarsus Bolívar, 1904
Diagnosis. Body small, cylindrical, somewhat depressed. Integument is with hairs and it is rugose. Antennae thickened at its apical half and shorter than both head and pronotum. Fastgium of vertex is short, sloping, concave, having obtusely angular. Weak occipital carina present. Frontal ridge between antennae compressed and protruding forwards, with slit-like sulcus, below almost obliterated. Pronotum sub-cylindrical, widening backwards, tuberculate, with weak linear median carina, crossed by three sulci. Lateral carinae absent, metazona about as long as prozona, its posterior margin rounded; anterior margin of prosternum strongly expanded, collar like, covering lower part of mouth; elytra and wings fully developed; tympanum absent; middle femur and tibiae elongated, thin; hind femur slender, with lower basal lobe slightly shorter than upper one; hind tibiae slightly expanded in apical half; external apical spine absent; spurs of hind tibiae strongly elongated, longer than basal tarsal segment, thin, internal pair longer than external; all tarsi thin, slightly elongated; arolium very small. Male supra-anal plate angular. Cercus short, obtusely conical. Subgenital plate short, widely subconical. Epiphallus with large lophi, moderately curved at apex.

C. Species *Tenuitarsus orientalis* Kevan, 1959
urn:lsid: Orthoptera.speciesfile.org:Taxon Name: 38451
Re-description. Body slightly depressed, integument rugose and hairy. The antennae shorter than head and pronotum together. Fastgium of vertex short, slightly concave; large apical fastgial areolae and sharp marginal carinulae. Pronotum sub-cylindrical, widening backwards, tuberculate, with weak linear median carina, crossed by three sulci, lateral carinae absent, metazona about as long as prozona, its posterior margin rounded. Elytra and wings fully developed. Middle femur and tibiae elongated and thin. Hind femur slender, with lower basal lobe slightly shorter than upper one.Hind tibiae slightly expanded in apical half. In malesupra-anal plate angular with broad and small triangular epiproct, cerci if or slightly longer than the epiproct and obtusely conical at apex, paraproct also broader and equally or smaller than the epiproct. Subgenital plate broad and rounded at the apex. Epiphallus bridge shaped, bridge small and slightly wider; anterior projection less prominent with conical apex; lateral plates separated medially, lophi with curved apices, apex obtusely conical. Lateral appendices rod shaped and pointed at the apex and crossing the tip of Lophi. Aedeagus, apical valve much narrower, apex obtuse, if basal valve, basal valve uniformly broad, wide at base. In female supra-anal plate short, broad, wider than long, apex rounded, cercus short, broad, slightly longer than wide, apex obtuse, much shorter than supra-anal plate. Sub-genital plate, posterior margin smooth, round, without setae, egg-guide cone shaped, longer than wide, apex obtuse. Spermatheca, single apical diverticulum which is S-shaped, tubular, and consistently broad. Ovipositor, dorsal valve short, broad, rounded at apical tip.
Type specimen information: Cigliano *et al.,* [13]
Type locality: Asia-Tropical, Indian Subcontinent, Pakistan
Kind of type: Holotype
Specimen category: Female
Location of type: BMNH London NH Mus.
Studied Material Deposited: EL, Department of Zoology, Shah Abdul Latif University Khairpur Mirs, Sindh-Pakistan
Morphometric Variation.
The species *Tenuitarsus orientalis* Kevan, 1959 shows morphometric variations. The male is smaller in size as compared to female (Table 1 & Fig. 1).

Table 1: Measurements of *Tenuitarsus orientalis.*

Parameters	Measurements (mm) Male	Measurements (mm) Female
LP	4-5	5-6
LT	5-6	6-7
LF	13-14	14-15
TBL	20-21	24-25

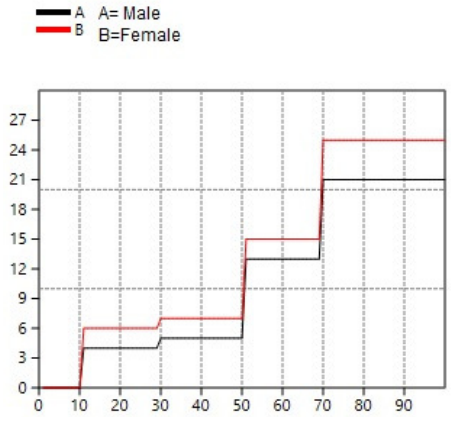

Fig. 1. Showing morphometric variation of Male and Female of *Tenuitarsus orientalis* Kevan, 1959.

Distribution. According to database, there are three species of genus *Tenuitarsus* found throughout the world. The distribution of three species is presented in Table 2.

Table 2: List of species of genus *Tenuitarsus* found world wide (Cigliano *et al.,* [13])

S.No.	Species	Distribution
1.	*Tenuitarsus angustus* (Blanchard, 1836)	Western Asia, Iraq, Mesopotamia, Baghdad, Somalia, Libya, Arabian Peninsula, Gulf States, United Arab Emirates, Iran, Cario, Egypt, Africa
2.	*Tenuitarsus orientalis* Kevan, 1959	Indian Subcontinent, Pakistan, Asia-Tropical
3.	*Tenuitarsus sudanicus* Kevan, 1953	Nigeria, Africa, Northeast Tropical Africa, Sudan

A

B

Fig. 2. Tenuitarsus orientalis, A = Dorsal view, B = Same but Lateral.

Pest Status of grasshoppers. Grasshoppers belongs to order Orthoptera and sub order Caelifera. They show long term association with human population due to their pest status of agricultural crops. Such As locusts, as they make swarm, they destroy wide area of agricultural lands. Even can affect scarcity of food for humans. While when they are in less numbers can be serious pests of agricultural crops [14-17]. On the other hand, the grasshoppers possess chewing type of mouthparts generally supposed to be foliage feeders. Additionally, grasshoppers feeding on seeds, fruits, flowers, fruits, stems triggering significant loss to agriculture, forests, orchards. The taxonomic changes in the morphology of mouth parts as well as in feeding potential is of importance [18-20]. During the present observation it was noticed that the preference of host plants depends upon the feeding behaviors and habitats of grasshopper's species.

IV. CONCLUSION

The present study concludes Pyrgomrophids are most fascinating grasshoppers with variety of colors. They are overlooked by the agriculturists and farmers. Many species are considered key pests and attack several types of ornamental and agricultural crops causing severe damage. In addition to this *Tenuitarsus orientalis* of family Pyrgomorphidae is re-described from this region.

V. FUTURE SCOPE

Pyrgomorphids detail study is needed to know the pest status of these beautiful creatures. The *Zonocerus elegans* & *Zonocerus variegatus* causes great financial losses to farmers by seriously damaging a variety of crops. So other species pest status is essential to be explored.

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Conflict of Interest. The authors declare no conflict of interest.

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