

IDENTIFICATION OF GROUND CRICKET (ORTHOPTERA: GRYLLIDAE: NEMOBIINAE) WITH REFERENCE TO THEIR SOUND PRODUCING STRUCTURE

NASREEN KHAN¹ AND SYED KAMALUDDIN²

¹Department of Zoology, Jinnah University for Women, Karachi.

²Federal Urdu University of Arts, Sciences and Technology, Gulshan- E- Iqbal, Karachi.

Abstract

In the present work three species of the Genus *Pteronemobius* Jacobson and Bianchi of sub-family Nemobiinae, family Gryllidae, are described on the basis of male sound producing structures i.e. tegmina, plectrum and the stridulatory file. The venations of tegmina, number of oblique veins, size of harp, size of apical field and shape and structure of mirror emerge as important characters to distinguish males of sub-family Nemobiinae from other related taxa from Pakistan.

Introduction

The representatives of the genus *Pteronemobius* are cosmopolitan, mostly found in tropical areas. They are pests of different crops and also pests of stored grains (Hinton and Cobert, 1949). The structure of the tegmen of different species that emit and radiate the acoustic signals, possess different structures (Walker and Carlyle, 1975), and later may be used as taxonomic character. Different species were described on the basis of morphological structures including male stridulatory veins (Vickery and Johnstone, 1973). After examining different characters of male tegmina and male genitalia it was considered that a number of species were placed in the wrong genus (Otte, 1985). Genus *Pictonemobius* was considered as a single species on the basis of calling songs, morphology and habitat, now on the basis of tegmina strokes rates and other characters of tegmina they are demonstrated into at least four sibling species (Gross *et al.*, 1989). Three new species of genus *Pteronemobius* described from Pakistan with special reference to their male and female genitalia and other morphological characters (Kamaluddin and Khan, 2005). Ensifera (Orthoptera) are well known for their tegmina, stridulum and loud call to attract conspecific females (Desutter-Grandcolas, 2002). Two new species of Gryllidae from Mangrove forest of Singapore were described with the description of their male genitalia and other morphological characters including size and venations of their tegmen (Kai and Robillard, 2012). Ahmad and Khan (2015) redescribed *Acheta domesticus* on the basis of its tegmen and male genitalia.

Materials and Methods

The specimens were collected from different areas of Pakistan and preserved as per standard procedure. These specimens were identified by authors with the help of literature at hand. The collected specimens were killed with the help of ethyle acetate and were pinned, then dried and preserved. After preservation the specimens were placed in boiling water to soften them for detaching the right tegmina with the help of fine forceps. Tegmina were pulled out at its basal joint in the thoracic region, then cleaned with brush using 50% alcohol on slide and finally covered with a clean cover slip to take the photograph by using Nikon Cool Pix 5400 digital camera after placing it under Nikon SMZ 800 Binocular.

Results

Pteronemobius heterospinus Kamaluddin and Khan

Figs. 1 and 2

Colouration: General body colour brown, with dark brown hairs and bristles, head adorned with light bands at its vertex, and a black spot at frontal rostrum and in compound eyes, last segment of maxillary palpi dark brown, pronotum dark brown with dark patches, covered with white hairs, leg and hind wings yellow, abdomen and cerci blackish brown.

Head: Head small, round, covered with hairs and bristles, vertex convex, frontal rostrum narrow, compound eyes large, prominent, one median and two lateral ocelli present, median placed on transverse line, lateral ocelli small and oval, interocular distance 0.6 mm., antocular distance 0.2 mm. posterior of head including eyes 0.8 mm., interocellar distance 0.6 mm., width of head 1.6 mm., length of head 1.0 mm.

Pronotum: Pronotum broader than long, almost 1 ½ X broad, pubescent, anterior region narrow, posterior region broad, a constriction is present in the middle, anterior margin straight, posterior margin convex, lateral margin straight with few large spines, callosities thick and rather large, length of pronotum 0.9 mm., width of pronotum 1.5 mm.

Legs: Pubescent, large bristles present, fore tibia has two terminal spines, whereas the mid tibiae has three unequal terminal spines, hind legs with bristles, feebly pubescent, tibial margins armed with three posterior and four anterior spines, first segment of hind tarsi has two unequal apical spurs, in which one is very long slightly more than 2nd segment of tarsi, length of posterior femur 0.7 mm. tibia 1.0 mm.

Tegmen: Tegmen (Fig.2) long, longer than the abdomen, mirror large, broader than long, divided with curved ribs into two large and three small cells, apical field very short having few cells, oblique veins absent, one harp, two curved diagonal veins, lateral field has four long veins, subcostal vein unbranched, harp branched, length of tegmen 2.9 mm., width 1.0 mm. Plectrum absent, representing only short, thick and pointed spines, directly originate from the membrane of tegmen, they vary in size.

Abdomen: Abdomen slightly shorter than tegmen, pubescent, hind wings long, cerci long and thick covered with long and short hairs and bristles, length of abdomen 02 mm. Total body length 4.9 mm.

***Pteronemobicus indicus* (Walker)**
(Figs. 3 and 4)

Colouration: General body colour black, with dark brown hairs and bristles, head brown with black patches, last segment of maxillary palpi brown, pronotum dark brown with dark patches, covered with dark hairs and bristles, legs relatively darker than the tegmen, abdomen and cerci blackish brown.

Head: Head much broader than long, rounded, covered with hairs and bristles, vertex broad and flattened, slightly narrow than the pronotum, frontal rostrum narrow, compound eyes large, prominent, one median and two lateral ocelli present, median disposed in a transverse line, lateral ocelli small and oval, surface very finely and closely punctate, interocular distance 0.7 mm., anteocular distance 0.2 mm, posterior of head including eyes 0.8 mm., interocellar distance 0.6 mm., width of head 1.6 mm., length of head 1.0 mm.

Thorax: Pronotum broader than long, almost 1 ½ X broad, pubescent, anterior region narrow, posterior region broad, a median vertical line is present, anterior margin concave, posterior and lateral margins convex, lateral margin straight, with few large spines, posterior angle rather sharp, callosities thick and rather large, prominent, length of pronotum 1.1 mm., width of pronotum 1.8 mm.

Legs: Pubescent, large bristles present, fore tibiae has one terminal spine, whereas the mid tibiae have two unequal terminal spines, hind legs with bristles, feebly pubescent, tibial margins armed with four posterior and four anterior spines, first segment of hind tarsi has two unequal apical spurs, in which one is very long slightly shorter than 2nd segment of tarsi, length of posterior femur 2.5 mm. tibia 1.7 mm.

Tegmen: Tegmen (Fig. 4) long, longer than the abdomen, mirror large, broader than long, divided with curved ribs into two large and one small cell, apical field very short having few cells, oblique veins absent, one harp, two curved diagonal veins, join with chords, lateral field has long veins, subcostal vein unbranched, harp branched, length of tegmen 3.3 mm., width 0.9mm. Plectrum absent, representing only short, thick and pointed spines, directly originate from the membrane of tegmen, they vary in size.

Abdomen: Abdomen slightly smaller than tegmen, pubescent, hind wings long, cerci medium, thick covered with long and short hairs and bristles, length of abdomen 1.3 mm. Total body length 5.8 mm.

***Pteronemobius. sindallus* Kamaluddin and Khan**
(Figs. 5 and 6)

Colouration: General body colour brown, with dark brown hairs and bristles, head adorned with light bands, compound eyes dark brown, palpi whitish, pronotum dark brown with light bands, tegmen blackish with yellow band on lateral sides, legs light brown with dark bands, dark brown hairs and bristles present all over the body, mostly on pronotum and head.

Head: Head large, broader than pronotum, rounded, covered with hairs and few bristles, vertex convex, frontal rostrum broad, compound eyes large, prominent, one median and two lateral ocelli present, median placed in a

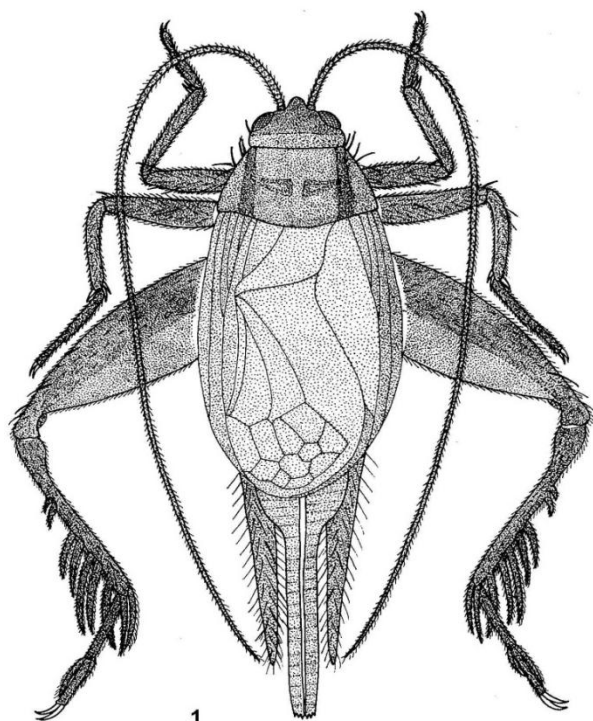
transverse line, lateral ocelli small and oval, interocular distance 0.8 mm. antecular distance 0.2 mm., posterior of head including eyes 0.8 mm. interocellar distance 0.8 mm, width of head 1.6 mm., length of head 1.0 mm.

Thorax: Pronotum almost rectangular shape, broader than long, almost 1 ½ X broad, pubescent, anterior region narrow, posterior region broad, a constriction is present in the middle, anterior margin straight, posterior and lateral margins convex, anterior and posterior angles round, callosities thick and rather large, width of pronotum slightly less than 1.5X of its length, length of pronotum 1.2 mm., width of pronotum 1.7mm.

Legs: Pubescent, large with black bristles, fore legs with three equal sized terminal spines on 2nd segment of tarsus, whereas the mid tibiae with three unequal terminal spines, hind legs pubescent, tibial margins armed with four spines on each margin, first segment of hind tarsi has two unequal apical spurs, in which one is very long reaching to the last segment of tarsi, length of posterior femur 1.8mm. tibia 1.7 mm.

Tegmen: Tegmen (Fig. 6) long, longer than the abdomen, mirror large, broader than long, divided with curved ribs into one large and five small cells, apical field very short having few cells, oblique veins absent, one harp, branched, two curved diagonal veins in which 2nd vein bifurcated, lateral field has four long veins, sub costal vein unbranched, length of tegmen 3.7 mm., width 1.0 mm. plectrum absent, representing only short, thick and pointed spines, directly originate from the membrane of tegmen, they vary in size.

Abdomen: Abdomen oval shaped, reaching to the apex of tegmen, pubescent, hind wings long, cerci long and thick covered with long and short hairs and bristles, length of abdomen 2.5 mm. Total body length 6.2 mm.



0.9 mm

Fig. 1

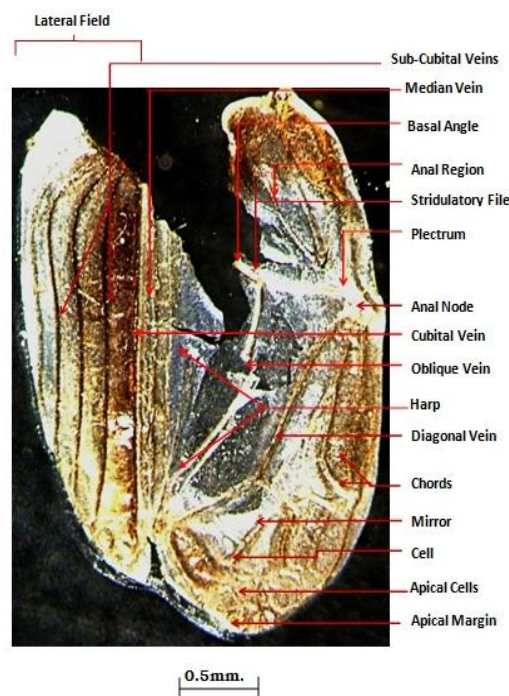
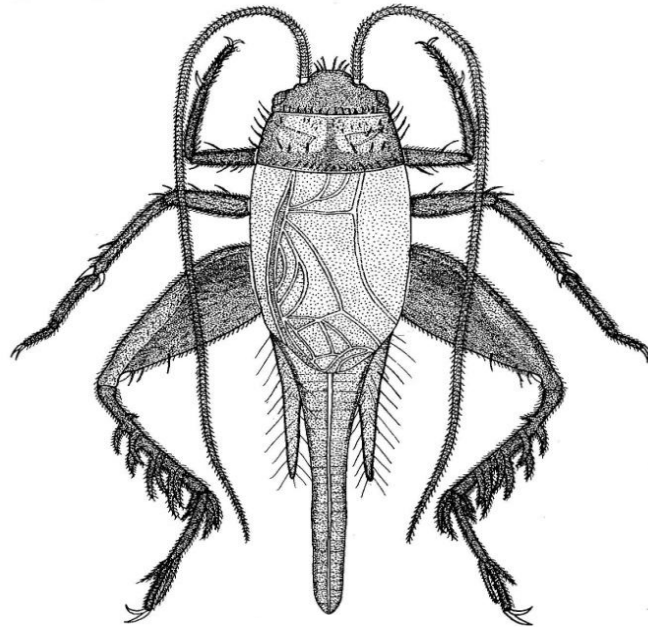


Fig. 2



0.9mm

Fig. 3

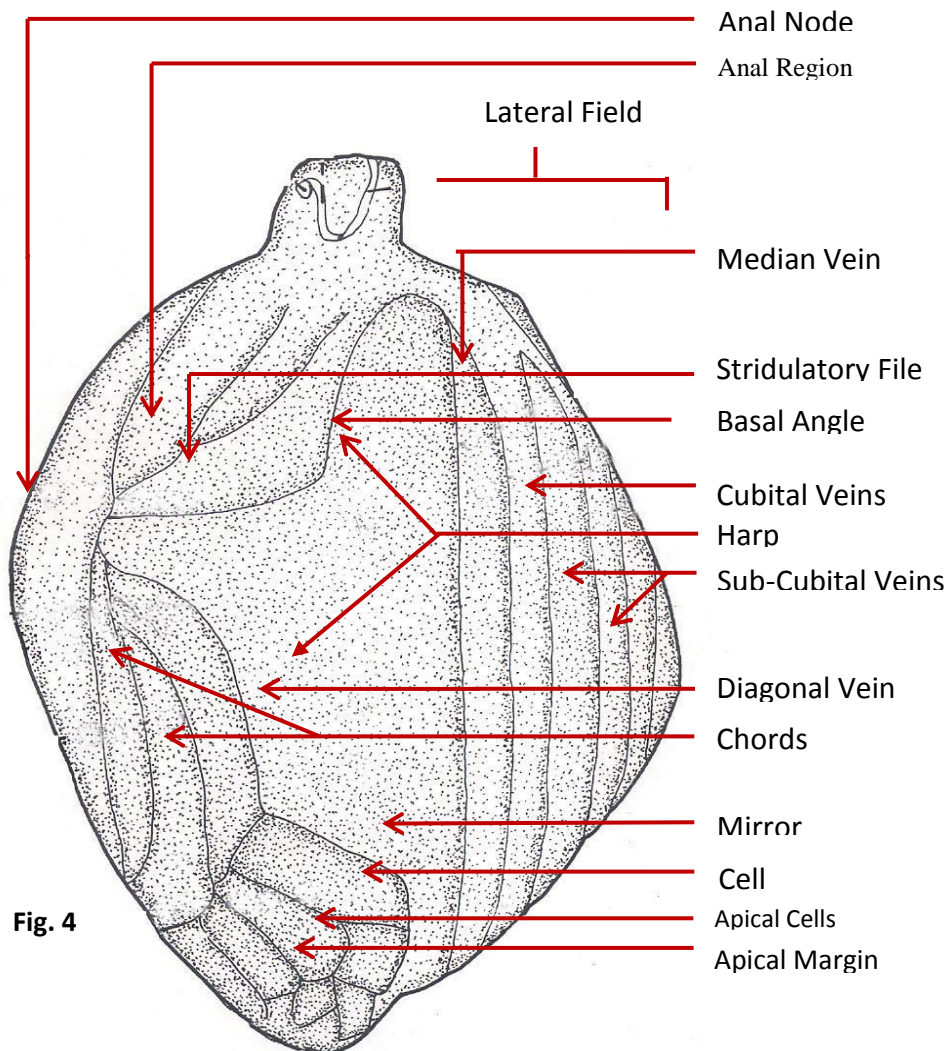


Fig. 4

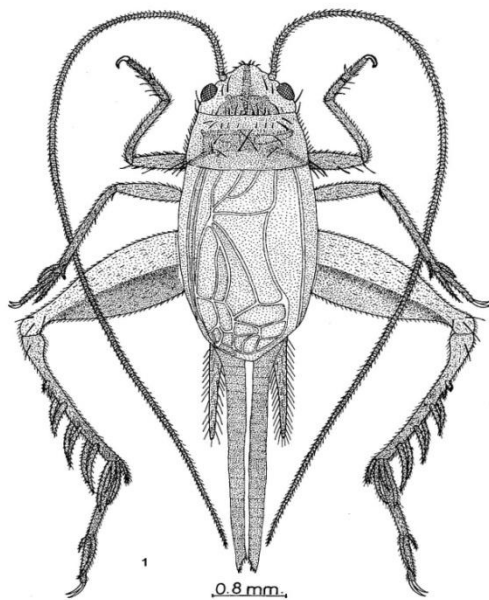


Fig. 5

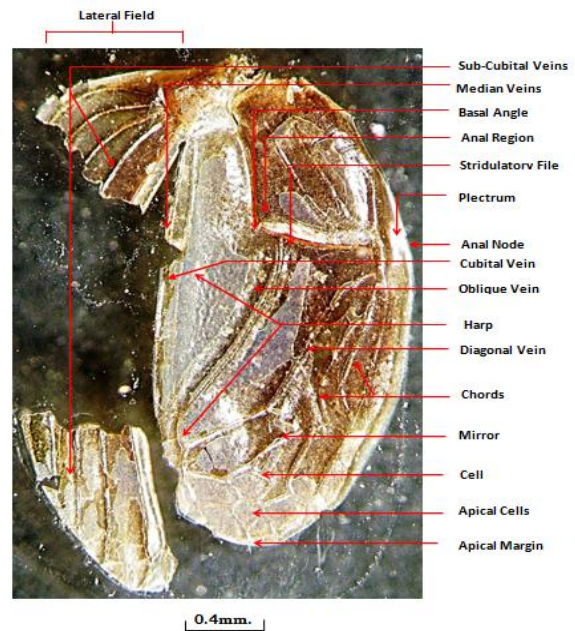


Fig.6

Discussion

Earlier genus *Pteronemobius* of sub-family Nemobiinae was revised on the basis of their morphological and genital components (Khan and Kamaluddin, 2006) and with these characters a cladistic relationship was also attempted (Kamaluddin and Khan, 2012), but the International literature presented that the songs and sound producing structures i.e. tegmina, stridulatory file, plectrum etc. are more important taxonomic structures for the classification of family Gryllidae (Ahmad and Khan, 2013). The error in their classification are being resolved with the help of their songs and sound producing organs. Recently, the researchers who worked on the family Gryllidae classify this group with the help of above mentioned characters especially the presence of venations on tegmina (Gorochov, 2002). Internationally, a number of taxonomists classify the group on the basis of their genital components (Randell, 1964; Libin and Gorochov, 2015). The genus *Pteronemobius* Jacobson and Bianchi is most closely related to the other genus of the subfamily Nemobiinae with tegmina longer than abdomen, having one oblique vein, mirror with more than two cells, but can easily be separated from the same by its autapomorphies like body size small, mirror large, having more number of cells, one diagonal vein, with one long, curved oblique vein having mirror large divided into 3-6 small cells with variable size and shape and lateral field short with 4-6 sub-cubital veins.

References

- Ahmad, I. and Khan, N. (2013). Sound producing organs of *Brachytrypes portentosus* (Lichteinten) (Orthoptera: Gryllidae) and their impact on classification. *Int. J. Bio. Biotech.*, 10 (4):479-482.
- Ahmad, I. and Khan, N. (2015). The house cricket, *Acheta domesticus* (L.), (Orthoptera: Gryllidae) is re-described with special reference to its tegmen and male genitalia, from Pakistan. *Pakistan J. Entomol. Karachi*. 30 (2): 101-104.
- Desutter-Grandcolas, L. (2002). Phylogeny and the evolution of acoustic communication in extant Ensifera (Insecta: Orthoptera). *Zoological Scripta*, 32 (6): 525-561.
- Gorochov, A.V. (2002). Taxonomy of Podoscirtinae (Orthoptera: Gryllidae). Part 1: the male genitalia and Indo-Malayan Podoscirtini. *Zoosystematica Rossica*, 10(2): 303-350.
- Gross, S. W., David, L. M. and Walker, T. J. (1989). Systematics of *Pictonemobius* Ground crickets (Orthoptera: Gryllidae). *Transaction of the American Entomological Society*, 115 (4): 433-456.
- Hinton, H. E. and Cobert, A. S. (1949). Common insect pest of stored food products. *Brit. Mus. Nat. Economic Series*. No. 15: 4.
- Kai T. M. and Robillard, T. (2012). Two new cricket species (Orthoptera: Gryllidae and Mogoplistidae) from the mangrove areas of Singapore. *The Raffles Bulletin of Zoology* 60 (2): 411-420

- Kamaluddin, S. and Khan, N. (2005). Three new species of the genus *Pteronemobius* (Orthoptera: Gryllidae: Nemobiinae) from Pakistan with a key and their cladistics relationship. *Int. J. Biol. Biotech.*, 2 (3): 521-530.
- Kamaluddin, S. and Khan, N. (2012). Cladistics analysis of the sub-family Nemobiinae (Orthoptera: Gryllidae) from Pakistan. *FUUAST J. Biol.*, 2(1): 63-69.
- Khan, N. and Kamaluddin, S. (2006). Aspects of morphology of head, thorax and abdomen and their appendages of *Pteronemobius indicus* (Walker) (Orthoptera: Gryllidae: Nemobiinae) and their relationship. *Pakistan J. Entomol. Karachi*, 21(1 and 2): 11-14.
- Libin, M. A. and Gorochoy, A.V. (2015.) The cricket genus *Abaxitrella* (Orthoptera: Gryllidae: Podoscirtinae) in China, with description of one new species. *Zoosystematica rossica*, 24 (1): 85–89
- Otte, D. (1985). African Crickets (Gryllidae) 8. Further notes on *Velarifictorus* and other genera. *Proceeding of the Academy of Natural Sciences of Philadelphia*, 137: 143- 152.
- Randell, R. L. (1964). The male genitalia in Gryllinae (Orthoptera: Gryllidae) and a tribal revision. *Can. Ent.* 96: 1565-1607.
- Vickery, V. R. and Johnstone, D. E. (1973). The Nemobiinae (Orthoptera: Gryllidae) of Canada. *The Canadian Entomologist*, 105: 623-645.
- Walker, T.J. and Carlyle, T.C. (1975). Stridulatory file teeth in crickets: taxonomic and acoustic implications (Orth.: Gryllidae). *Int. J. Insect Morphol. And Embriol.*, 4: 151-158.

Illustration of figures:

- Fig. 1. *Pteronemobius heterospinus* Kamaluddin and Khan: entire, dorsal view
- Fig. 2. Same: Tegmen
- Fig. 3. *Pteronemobius indicus* (Walker): entire, dorsal view
- Fig. 4. Same: Tegmen
- Fig. 5. *Pteronemobius. sindallus* Kamaluddin and Khan: entire, dorsal view
- Fig. 6. Same: Tegmen