Pakistan J. Zool., vol. 46(1), pp. 203-213, 2014.

Systematic Study on the Various Tribes of Phaneropterinae (Tettigonioidea: Orthoptera) Occurring in Pakistan

Waheed Ali Panhwar,[1] Riffat Sultana,[1]* Muhammad Saeed Wagan,[1] Imran Khatari[2] and Santosh Kumar[1]

[1]*Department of Zoology, University of Sindh, Jamshoro*

[2]*Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University, Tandojam*

Abstract.- The present survey for the Phaneropterinae conducted during the year 2011-2012 from various provinces of Pakistan and by previous workers has yielded a total of 14 species. Half of the species were collected during survey. The collected material was sorted out into 8 genera belonging to 5 tribes *viz*., Phaneropterini, Trigonocoryphini, Ducetini, Holochlorini and Elimaeini. During present study, *Ducetia japonica* Thunberg 1815, *Elimaea* sp., *Phaneroptera spinosa* Bei-Bienko 1954, *Trigonocorypha angustata* Uvarov, 1922, *Trigonocorypha unicolor* Stål 1873 were reported as new records for the first time from Pakistan. It was also observed that *Phaneroptera spinosa* Bei-Bienko 1965, *Phaneroptera roseata* Walker, 1869, were widely distributed species. The distribution of all previously recorded species has been greatly extended to the localities. The taxonomic keys for various taxa have also been constructed for their future identification.

Key words: Phaneropterinae, Orthoptera, taxonomic keys.

INTRODUCTION

Phaneropterinae are important pests of agriculture crops while many species are ecologically associated with forest biocenoses, damaging trees and shrubs. In addition to herbaceous plants, these facts extend the range of injurious plants to forest, fruit orchards, berry shrubs and grasses (Shishodia, 2000a,b). Bisby *et al*. (2007) stated that Tettigoniidae is a heterogeneous group with more than 1120 recognized genera and 6800 species and are the largest family within the Orthoptera. While studying the habitat of Phaneropterinae, Kocarek and Holusa (2006) observed that it occupies a wide range of open habitats from xerothermic to wetlands and mostly consumed tall herb or lower shrub. However, Jago (1997) stated that they are one of the most widespread old world groups of the order. While studying the habitats of Tettigoniidae Samways (1989) and Ciplak (2003) reported that they usually live in the open places mainly dry habitats over a wide range of altitude.

Despite this possibly pest status, a survey of long-horned grasshoppers has not been undertaken in from all the provinces of Pakistan. Considerable taxonomic work has been done on Caelifera of Pakistan (Ahmed, 1980; Wagan, 1990, 2008; Wagan and Naheed, 1997; Yousaf, 1996; Sultana and Wagan, 2012, Sultana *et al*., 2013) but little attention has been paid to long-horned grasshoppers (Ensifera) of Pakistan except the studies of Ingrisch (1996) and Garai (2002). The Tettigonioidea insect fauna of Pakistan is very insufficiently known and there is no monographic treatment of the Tettigonioidea of Pakistan. Thus for identification of species one has to rely on the old monographs *e.g.*, Stål (1874) Brunner von Wattenwyl (1878, 1891) and Redtenbacher (1891) which are out of date. In addition, one has to consult numerous publications (Ragge, 1956, 1961; Bei-Bienko, 1965; Ingrisch 1990, 2002; Ingrisch and Shishodia, 1998, 2000; Liu, 2011).

The aim of present study is to contribute to the knowledge of taxonomic status of Phaneropterinae of Pakistan. Besides, the distribution of many of previously recorded species has been extended. In addition to this, simplified taxonomic keys based on the easily recognizable morphological characters and supported by appropriate illustrations are provided for the

* Corresponding author: riffatumer@hotmail.com
0030-9923/2014/0001-0203 $ 8.00/0

identification of tribes, genera and species of Phaneropterinae. Furthermore, a brief description of each supra-generic category of Phaneropterinae along with photographs is also presented. Hopefully, this work will be helpful for the people dealing with pest control in Pakistan.

MATERIALS AND METHODS

Collection of grasshoppers

The adults of Phaneropterinae were collected from the agricultural fields of rice, sugarcane, forests, fruit orchards, grapevine, berry shrubs, hilly, semi desert and desert areas, trees, shrubs, herbs and grasses with the help of traditional insect hand-net (8 inches in diameter and 50 inches length) as well as by hand catching. The collection was made during the year 2011-2012 in the months of March to November from various provinces of Pakistan.

Preservation and identification of grasshoppers

Collected material brought into the laboratory and was killed and preserved by standard entomological methods described by Vickery and Kevan (1983) and Sultana and Wagan (2012). The material is deposited at Insect Museum of University of Sindh, Jamshoro, Pakistan.

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". Some of the species identification was confirmed by Dr. J.C. Hartley, Department of Zoology, University of Nottingham, U.K and Late Prof. Dr. D.K.McE, Kevan Lyman Entomological Museum and Research laboratory McGill University Canada. The diagrams were all drawn with the help of "Ocular Square Reticule" fitted in one Ocular of Binocular dissecting microscope.

Depository

All the material presented here is deposited in the Insect Museum, University of Sindh, Jamshoro, Pakistan.

RESULTS AND DISCUSSION

Checklist of Phaneropterinae of Pakistan

Ducetia japonica Thunberg 1815. New record.

Elimaea sp. New record.

Holochlora japonica Brunner von Wattenwyl, 1878; cited by Garai 2002.

Leptophyes purpureopunctatus Garai 2002.

Letana sp.; cited by Garai 2002.

Nephoptera tibialis; cited by Ingrisch, 1996.

Phaneroptera bivittata Bey-Bienko, 1954*;* cited by Ingrisch, 1996, Garai. 2002.

Phaneroptera gracilis gracilis Burmeister 1838; cited by Ingrisch, 1996; Garai, 2002.

Phaneroptera roseata Walker 1869; cited by Garai 2002.

Phaneroptera spinosa Bey-Bienko 1954. New record.

Trigonocorypha angustata Uvarov, 1922. New record.

Trigonocorypha brevinota Ingrisch 1996; cited by Ingrisch 1996.

Trigonocorypha thiamae raggei Cejchan 1969; cited by Garai 2002.

Trigonocorypha unicolor Stål 1873. New record.

KEY TO THE TRIBES OF PHANEROPTERINAE OCCURRING IN PAKISTAN

1. Pronotum with lateral carinae serrate like straight & saw like tegmen broad (Fig. 4d,e)..... Trigonocoryphini
--. Not as above 2
2. Male cerci long & curved (Fig. 1f; Fig. 2f)..... ..... Phaneropterini
-- Male cerci not long (Fig. 6b) 3
3. Ovipositor not shorter than pronotum (Fig.6e)..... .....Holochlorini
--. Ovipositor longer than pronotum (Fig. 3d) 4
4. Subgenital plate of male not deeply bifurcate with long lobes styles ..... Ducetiini
--. Subgenital plate of male with deeply bifurcate ...Elimaeini

Tribe Phaneropterini Burmeister 1838

Eyes round; partially hemispherical; pronotum with acute humeral notches on lateral lobes; Tegmen, wing fully developed; tegmina of moderate width short as compare to wings. fore coxae with spine or without spine, femora usually lack spines from lower side, fore tribe and midtibiae with longitudinal upper groove; lacking marginal

spines (single apical spine); fore tibiae with markedly widened base; thin distally opening of tympanal organ exposed, oval, covered by membrane; Subgenital plate of male not bifurcating into two long lobes, not tubular, usually without apical styles.

KEY TO SPECIES OF *PHANEROPTERA*

1. Cerci apex tapering gradually with well-developed spine (Fig. 1b,f) ..... *P.roseatea* Walker
- Cerci of male long, strongly arcuate, not undulate (Fig. 2f).....*P. spinosa* Bey-.Bienko

Genus *PHANEROPTERA* Serville 1831

Description

Body slender. Fastigium acute, narrow, with thin groove in upper part, separated anteriorly from the frontal apex by a conspicuous notch. Antennae thin, longer than the body. Pronotum markedly flattened in posterior part; lateral lobes almost vertical, flat, with sharp deep humeral notch and round posterior margin. Tegmina narrow, tapering to a round apex. Wings much longer than tegmina, without clearly defined triangular apical area. Cerci of male long, strongly curved, pointed apically; cerci of female thin, distinctly curved, subulate. Subgenital plate of male short, not longer than cerci, with moderate apical notch, without styles; in female triangular. Ovipositor short, less than 1.5 times as long as pronotum, laterally compressed, bent sharply upward in basal part; upper margin beyond base almost straight.

Phaneroptera roseata Walker 1869
(Fig. 1)

Description. Body medium sized, greenish with small reddish-brown dots; fastigium narrow, acute; antennae pale-yellow. Pronotum almost cylindrical in apical part flat along its entire length (Fig.1c,e,g,h); male stridulatory organ not protruding beyond the level of posterior tegminal margin; Cerci of male much thinner than second antennal segment very slightly and gradually widened and barely flattened outer margin (Fig.1f). Subgenital plate in male with parallel margins.

Material examined

The material has been collected from following districts of Pakistan:

Sindh: Sukkur, Khairpur, Larkana Thatta, Sujawal , Karachi, Badin, Mirpurkhas, Hyderabad, Tando. M. Khan, Tando Allahyar, Dadu, Jamshoro Balochistan: Barkhan, Lasbela

Khyber Pakhtunkhwa: Mansehra, Abbotabad, Haripur, D.I. Khan, Charsadda, Swat, Peshawar, Mardan.

Punjab: Chakwal, Rawalpindi, Faisalabad, Multan, Lahore ,D.G. Khan R.Yar Khan, Kasur, Bahawalpur, Sahiwal, Khanewal.

Remarks

It is widely distributed species occurring all over the country. It might be the pest of different fruits but our latter study will confirm it exact status.

Phaneroptera spinosa Bei-Bienko 1954
(Fig. 2)

Description

Body green, with slight yellowish tinge and small poorly defined reddish brown dots. Fastigium acute, with deep narrow groove. Pronotum sometimes with pale vague lateral band, with moderately cylindrical, clearly convex apical part in the anterior two-thirds, flat in the posterior third, *i.e.* behind the humeral notches (Fig.2b,d,e); stridulatory organ on left tegmen of male not protruding beyond the tegminal margin, brownish without three black dots; distal margin brownish-yellow. Cerci of male long, strongly arcuate, not undulate (Fig.2f). Subgenital plate of male narrow; apical part with sub-parallel sides; posterior margin with acute lateral lobes and a conspicuous blunt or rectangular notch occupying the whole length of the margin. Subgenital plate of female elongated, triangular, with slightly rounded apex. Ovipositor wide; upper margin bluntly curved in the basal part (Fig.2c).

Material examined

The material has been collected from following districts of Pakistan.

Sindh: Sukkur, Khairpur, Larkana, Thatta, Karachi, Badin, Matli, Mirpurkhas, Hyderabad, Tando M. Khan, Tando Allahyar.

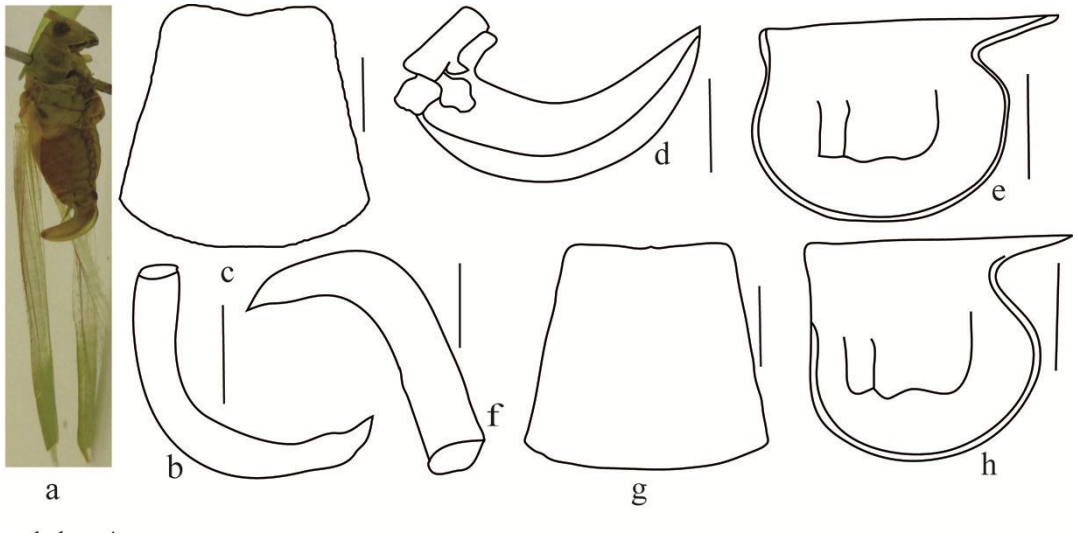

Fig. 1. *Phaneraptera roseata* a-c, female; a, adult LV; b, cercus LV; c, pronotum DV; d, ovipositor LV; e, pronotum LV.
Scale bar: 4 mm.

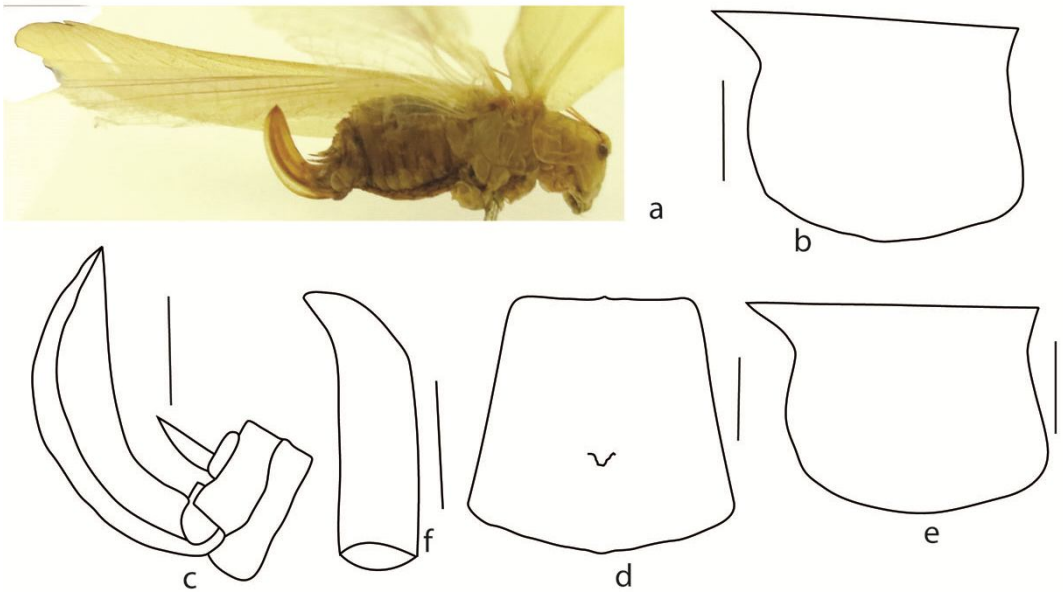

Fig. 2. *Phaneraptera spinosa* a-c, female; a, adult LV; b, pronotum; c, ovipositor LV; d-f, male; d, pronotum DV; e, pronotum LV, f, cercus.
Scale bar: 4 mm.

Dadu, Jamshoro.

Balochistan: Barkhan, Lasbela.

Khyber Pakhtunkhwa: Mansehra, Abbotabad, Haripur, D.I. Khan, Charsadda, Swat, Peshawar, Mardan.

Punjab: Chakwal, Rawalpindi, Faisalabad, Multan, Lahore, D.G. Khan, R.Yar Khan, Kasur, Bahawalpur, Sahiwal, Khanewal

Remarks

It is closely resemble with *P. roseata* but it is large in size. It is also widely distributed species

collected from different regions of country in fair numbers. The collection of it's in such greater numbers showed that it has dominant status but further, investigation will clear it correct standing.

Tribe Ducetiini Brunner von Wattenwyl 1878

Description

Pronotum moderately deep; with distinct humeral notch on lateral lobes. Tegmina fully developed ; wings longer or shorter than the tegmen; fore coxae without spine; sometimes with small spine; femora spinoses on lower side, fore and mid tibiae with longitudinal upper groove and spinules on margin fore tibiae moderately and gradually widened at bases tympanal opening oval ,exposed and covered by membrane; subgenital plate of male bifurcate with long lobes or tubular, lack apical styles.

A single genus with single species studied and given below

Genus *DUCETIA* Stål 1874

Description

Frons vertical or even slightly truncates anteriorly; eyes suboval. Pronotum with conspicuous but not deep humeral notches, cylindrical on upper side, without signs of lateral carinae. Cerci long, thin, moderately curved, in female gradually tapering apically. Subgenital plate of female triangular. Ovipositor relatively narrow, bent almost semi-circularly upward; apical part of lower margin and almost of upper margin finely serrate.

Ducetia japonica Thunberg 1815
(Fig. 3)

Description

Green or grayish-brown; antennae monochromatic; fastigium acute, low, fairly elongate, with deep groove; Lateral sides of pronotum with vertical median grooves and with a conspicuous longitudinal carinate fold above the lower margin (Fig.3b,e)

Material examined

Hyderabad 15.xii.2011 1♀. (A.P. Waheed, and S. Riffat)

Remarks

The material at hand generally agrees with the description given by B. Bienko (1965) except that tegmina are 2mm shorter. Earlier, B. Beienko (1965) reported this species from Korea, China and Szechwan provinces while Willemse (1933) recorded it from Japan, Taiwan, Philippines, Indo-China, India and some parts of Bengal. Presently we are reporting a single ♀ from Hyderabad district. This species is recorded for the first time from Hyderabad Sindh.

Tribe Trigonocoryphini Bei-Bienko 1954

Pronotum with flat disc, conspicuous straight, serrate lateral carina with deep humeral notch. Tegmen wider or strongly narrowed at apex; wings longer or shorter as compares to tegmen, fore coxae spinose or hind femora with spines at lower sides. Fore and, mid tibiae un-cylindrical; with longitudinal upper groove or flate; mid tibiae with spinules on posterior margin; openings of tympanal organ on fore tibiae oval, exposed and membranous.

Genus *TRIGONOCORYPHA* Stål 1873

A single genus Trigonocorypha with two species are given below:

Diagnosis

Fastigium very low, wide, triangular, wider basally than antennal pedicel; pointed anteriorly and almost in contact with frontal apex at a single point; on upper side grooved or with lateral fringe. Eyes wide, oval, moderately convex. Pronotum with flat, slightly concave disc; lateral carinae straight, conspicuous, divergent posteriorly, with fine obtuse serration; posterior margin of pronotum rounded, without elevated fringe. Lateral lobes of pronotum quite vertical, flat, forming distinct angle with the disc, slightly higher than long, with slightly rounded posterior margin; humeral notch sharp but of moderate depth. Tegmina compact, coriaceous,

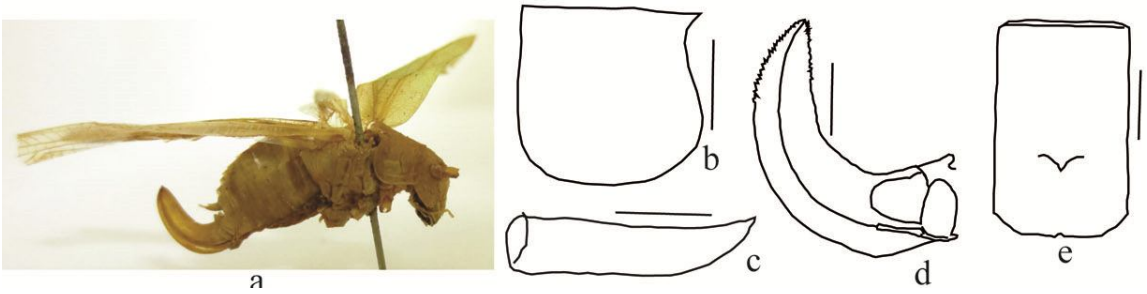

Fig. 3. *Ducetia japonica* a-e, female; a, adult LV; b, pronotum LV; c, cercus; d, ovipositor LV; e, pronotum DV.
Scale bar: 4 mm.

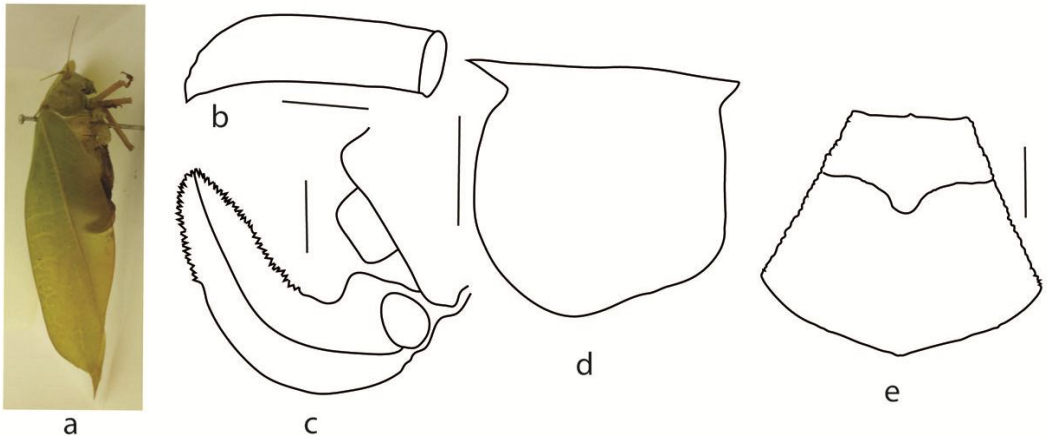

Fig. 4. *Trignocorypha unicolor* a-c, female; a, adult LV; b, cercus; c, ovipositor LV; d, pronotum LV; e, pronotum DV.
Scale bar: 4 mm.

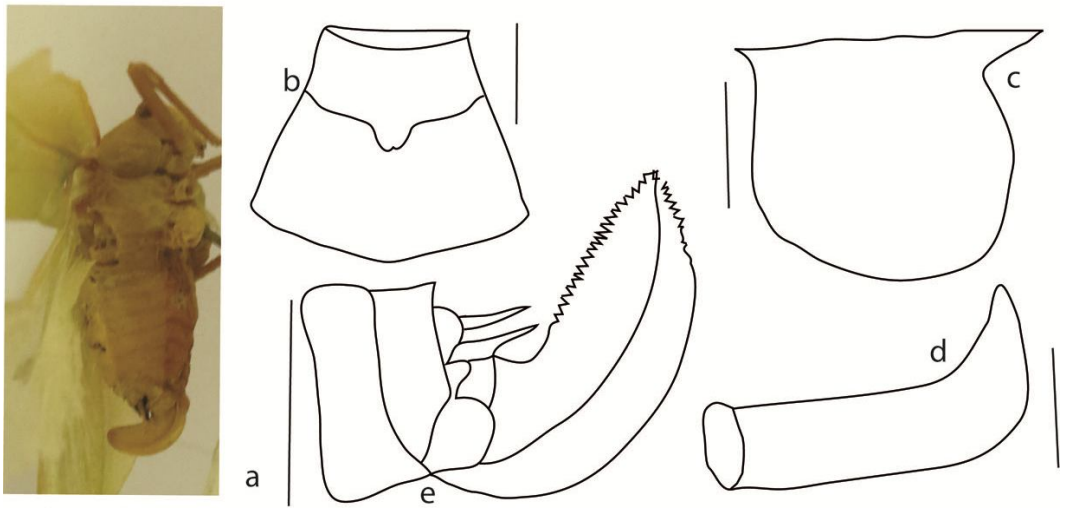

Fig. 5. *Trignocorypha angustata* a-c, male; a, adult DV; b, adult LV; c, male genital plate; a-e female; a, adult DV; b, pronotum DV; c, pronotum LV; d, cercus; e, ovipositor LV.
Scale bar: 4 mm.

widened anterior to or at the middle, markedly narrowed apically. Wings longer than tegmina. Meso and metasternal lobes elongate, divided by acute notch, pointed apically. Fore coxae with small spinule; all femora almost flat on lower side. Ovipositor short, strongly flattened, bent upward, with fine serration on the entire upper margin and the apical part of lower margin; apex of ovipositor roundly obtuse. Cerci of male reaching apex of subgenital plate slightly curved and conical.

KEY TO THE SPECIES OF *TRIGONOCORYPHA* OCCURRING IN PAKISTAN

1. Fastigium of vertex slightly divided by middle sulcus, tegmina wide and without a pale band in its basal half .... *T. unicolor* Stål
--. Fastigium of vertex completely divided into two by middle sulcus; tegmina narrower than with a slight notch beyond the middle of anterior margin and a narrow pale band in its basal part ..... *T. angustata* Uvarov

Trigonocorypha unicolor Stål 1873
(Fig. 4)

Description

Body green in color, large in size. Fastigium very low, wide triangular, wider basally than antennal pedicel, pointed anteriorly and almost in contact with frontal apex at a single point, on upper side grooved or with lateral fringe. Pronotum with flat, slightly concave disc; lateral carinae straight conspicuous, divergent posteriorly, with fine serration. Posterior margin of pronotum rounded, without elevated fringe (Fig. 4d,e) Lateral lobes of pronotum quite vertical, flat, forming distinct angle with the disc, slightly rounded posterior margin; humeral notch sharp but of moderate depth. Cerci in male elongated, slightly curved and reaching apex of the subgenital plate. Cerci in female small with minute hairs. Ovipositor short, strongly flattened, bent upward, with fine serration on the entire upper margin and the apical part of lower margin, apex of ovipositor roundly obtuse (Fig.4c). Stridulatory organ well exposed on both tegmina. Wings are larger than the tegmina.

Material examined

The material has been collected from following districts of Pakistan.

Sindh: Sukkur, Khairpur, Ranipur, Larkana, Thatta, Karachi, Badin, Mirpurkhas, Hyderabad, Tando Allahyar, Dadu, Jamshoro.Balochistan: Barkhan, Lasbela, Quetta.

Remarks

This species is recorded for the first time from this area from different localities. This species clearly distinguished from all other species found in *Trigonocorypha* genus due to its typical structure of pronotum. Previously this species was recorded by Bei-Bienko (1965) from the U.S.S.R.

Trigonocorypha angustata Uvarov 1922
(Fig. 5)

Description

Body green or yellowish green in color. Fastigium of vertex, triangular with middle sulcus broad and deep. Anterior margin of pronotum slightly sinuate (Fig. 5b,c). cerci of male reaching apex of sub-genital plate, slightly curved, conical basally, in apical part narrowed, bent slightly inward, apex abruptly pointed, width very small pointed spinule. Cerci of female slightly curved, conical basally in apical part narrowed bent slightly inward apex abruptly pointed. Subgenital plate of male small, posteriorly narrowed, part of subgenital plate with fairly deep notch occupying; however, less than ¼ of length of plate ,base of notch round, lober apices obtuse with very small, inconspicuous round or slightly elongate style, subgenital plate of female short, triangular, ovipositor short, bent sharply upward. Ovipositor short bent sharply upward (Fig. 5e).

Material examined

Sindh: Jamshoro, Chakar Khan Goth 12.vii.2012 1♂ (A.P. Waheed and S. Riffat)

Balochistan: Lasbela, Uthal 31.x.2012 1♂ (Waheed A.P. and Qurban M.),

Khyber Pakhtunkhwa: Mansehra, 15.xi.2011 1♀ (Riffat and Wagan)

Remarks

This species was described by Uvarov (1922) on the basis of single female from Persian Gulf. Its male was also described by Uvarov (1929) while

Bey-Bienko (1965) described 2 males and 1 female from Southern Iran: Bunder-Abbas 1 male Bampur Southeastern Iran. Our specimens are smaller in size as compared to Uvarov (1922, 1929) and Bey-Bienko (1965). It is possible that our specimen might be proved subspecies as holotype is not examined, therefore, we are unable to designate this as subspecies or species.

Tribe Holochlorini Brunner von Wattenwyl 1878

Description

Body large; pronotum with deep humeral notch on lateral lobes; tegmen wide ,fully developed ;wings longer than tegmen; fore coxae with long soine, femur with spinosa on lower side ;fore tibiae, mid\tibiae with longitudinal groove on upper side, tibiae widened basally; posterior opening of tympanal organ, oval, membranous exposed; anterior opening concealed by swelling; in from of wide slit externally; terminal abdominal tergite (♂) with tubercles; subgenital plate of male with styles; ovipositor not shorter then pronotum, varying in shape, fully developed. A single genus with single species studied and given below:

Genus *HOLOCHLORA* Stål, 1873

Description

Body large or average size. Head smooth dorsally, fastigium low, compressed, pointed anteriorly, not bordering on frontal apex, with dorsal groove. Pronotum smooth dorsally, flat behind the lateral lobes, moderately convex or even almost cylindrical on remaining part, without traces of lateral carinae; posterior margin regularly rounded, without convex or very slightly thin ridge. Lateral lobes of pronotum high, connected roundly or at roundly obtuse angle with the disc , slightly higher than long, with round lower margin; humeral notch conspicuous. Tegmina long, protruding far beyond the hind femoral apices, narrowed basally; median part moderately widened, with sub parallel sides; apex slightly or moderately narrowed. Ovipositor short, wide, much less than half as long as hind femora, strongly curved, with rough lateral surfaces; apical part with finely serrate margins; upper margin with oblique sub apical incision; base strongly thickened, with marked protuberance forming transverse convexity.

Holochlora japonica Brunner von Wattenwyl 1878 (Fig. 6)

Description

Body green, moderate large in size, eyes oval wide, vertical diameter equal to the sub ocular distance; pronotum slightly (Fig. 6d,e) thickened at the anterior half, lateral side of disc bending roundly downward, posterior half flat, without additional transverse groove or with slight one behind v-shaped transverse. Posterior margin of pronotum with thin inconspicuous moderately higher than long. Cerci of female (Fig. 6,c) slightly curved, uneven gradually tapering to a pointed apex. Ovipositor (Fig. 6,f) with darkened apex, upper value with sharp black serrate lines on the lateral surface.

Material examined

Khyber Paktun Khwa:Mansehra, 15.xi.2011 2♀ (S. Riffat and M.S. Wagan)

Remarks

The material at hand generally agreed with the description of Bey-Bienko (1965) but our specimen in smaller in the size. Latter investigation with addition of more materials might be offered some other variation.

Tribe Elimaeini Brunner von Wattenwyl, 1891

Diagnosis

Antennae, pliable, thin; pronotum conspicuous humeral notch on lateral lobes; tegmen not wide, but fully developed; wings longer than tegmen; fore coxae lack spines or with a small spinule; fore femora compressed laterally with longitudinal upper carina; lower side groove, serrate or with a large spine; fore tibiae with longitudinal upper groove; with spines on the posterior margin ; tympanal openings concealed by swellings in from of wide slit externally; subgenital plate of male with deeply bifurcate.

Genus *ELIMAEA* Stål, 1874

Diagnosis

Head with vertical frons. Antennae thin, pliable. Pronotum with conspicuous but not deep

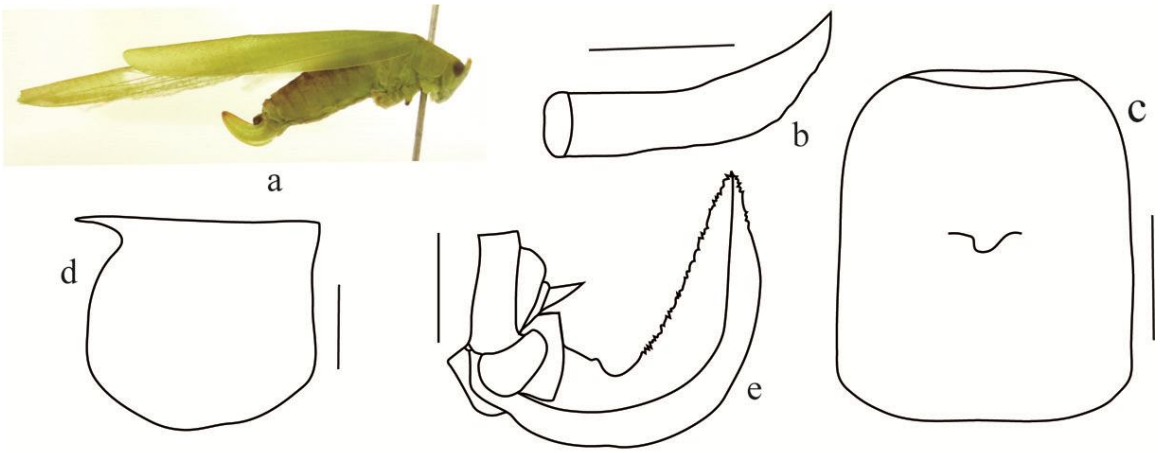

Fig. 6. *Holochlora japonica* a-e, female: a, adult DV; b, cercus; c, pronotum DV; d, pronotum LV; e, ovipositor LV.
Scale bar: 4 mm.

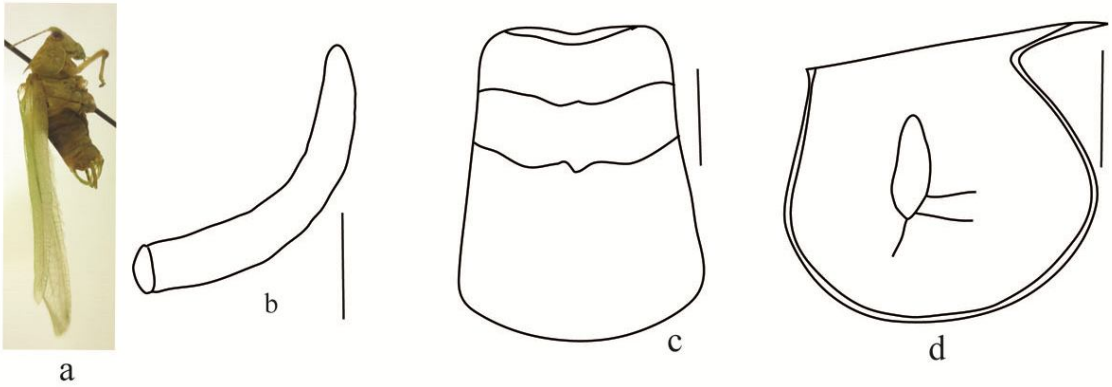

Fig. 7. *Elimaea* sp. a-d male: a, adult LV; b, cercus LV; c, pronotum DV; d, pronotum LV.
Scale bar: 4 mm.

humeral notches; lateral lobes short, not longer or only slightly longer than high, with entirely or largely rounded lower margin. Tegmina with conspicuous longitudinal and cross veins, fairly narrow, with subparallel sides and straight posterior margin; anterior area and often other areas with fairly homogeneous sparse cross venation. Wings longer than tegmina. Cerci of male long, thin, curved.

Elimaea sp. (Walker, 1869)
(Fig. 7)

Description

Head with vertical frons. Antennae thin, pliable. Pronotum with conspicuous but not deep humeral notches; lateral lobes short, not longer or only slightly longer than high, with entirely or largely rounded lower margin. Cerci of male long, thin, curved.

Material examined

Sindh: Karachi, Gulshan-e-hadeed 23.xi.2011 1♂ (A.P. Waheed and S. Riffat)

Remarks

This species near to *E. fallax* B. Bienko on the basis of characters studied whereas in measurement our specimen is smaller when more material will be available it will possibly to correctly identify the species.

ACKNOWLEDGEMENT

This study was supported by grants received from Pakistan Science Foundation Islamabad for Research project (No PSF/S-SU/BIO (423) is highly acknowledged.

REFERENCES

AHMED, F.U., 1980. *Survey of grasshopper in arid and semi arid region of Pakistan*. Final.Rep.PL - 480 No.P.K-ARS-20 (FG-Pa-21). 500 pp.

BEI-BIENKO, G.Y., 1965. Fauna of the U S S R Tettigonioidea. *Orthoptera,* **2**:360 pp.

BRUNNER VON WATTENWYL, C., 1878. *Monographie der Phaneropteriden.Brockhaus*, Wien, pp. 401.

BRUNNER VON WATTENWYL, C., 1891. Révision du system des orthoperes et description desEspeces rapportees par M. Leonardo FEA de Birnamie. Ann. Mus. Civ. Nat. Genova Ciacomo Doria **33**: 1-230.

BISBY, F.A., ROSKOV,Y.R., RUGGIERO, M.A., ORRELL, T.M., PAGLINAWAN, L.E., BREWER, P.W., BAILY, N.J. AND HERTUM VAN, J., 2007. S*pecies 2000 & I TIS Catalogue of Life: 2007 Annual Checklist*. Reading, U.K.Available from: http://www. Catalogueoflife.org/ annual-checklist /2007(Date of access June 2007)

CIPLAK, B., 2003. Genus *Festella* (Orthoptera: Tettigoniidae) with description of *F. rammei* sp.n. *Entomol. News*, **111**: 299-306

GARAI, A., 2002. Orthopteroid Insect from Pakistan. *Esperiana, Schwanfeld*, **9**: 431-447

INGRISCH, S., 1990. Grylloptera and Orthoptera s. str. from Nepal and Darjeeling. *Zool. Staat. Muen. Spix.,* **13**:149-182.

INGRISCH, S., 1996. Orthopterous insects from North Pakistan. Results of the research trip of H. Hacker and L. Weigert in autumn 1988. *Esperiana,* **4**: 231-244.

INGRISCH, S. AND SHISHODIA, M.S., 1998. New species and records of Tettigoniidae from India (Ensifera). *Bull. De-La. Soc. Ent. Suisse,* **71**: 355-373.

INGRISCH, S. AND SHISHODIA, M.S., 2000. Contribution to the Tettigoniidae fauna (Ensifera) of India. *Mitteil. Münch. Ent. Gesell*., **90**: 5–37.

INGRISCH, S., 2002. Orthoptera from Bhutan, Nepal and North India in the Natural History Museum Basel. *Ent. Basil.,* **24**: 123–159.

JAGO, N.D., 1997. Crop-centred integrated pest management in grasshoppers and Other Orthoptera. In: *The Bionomics of Grasshoppers, Katydids and their Kin*, (eds. S.K Gangwere, M. C. Mulalirangen and M. Muralirangen), CAB International, Oxford, pp. 443-480

KOCAREK, P. AND HOLUSA, J., 2006. Recent expansion of bush-cricket *Phaneroptera falcata* (Orthoptera: Tettigoniidae) in northern Moravia and Silesia (Czech Republic). *Scrip. Facult. Rer. Nat. Univ. Ostraviensis,* **163**:207-211.

LIU, C.X., 2011. Brief summary of Holochlorini (Orthoptera: Tettigoniidae: Phaneropterinae), with description of seven new species from China. *Zootaxa,* **2931**: 35-52.

RAGGE, D.R., 1956. A revision of the genera *Phaneroptera* Serville and *Nephoptera Uvarov (Orthoptera: Tettigoniidae),* with conclusion of zoogeographical and evolutionary interest. *Proc. zool. Soc. London,* **127**: 205-283.

RAGGE, D.R., 1961. A revision of the genus *Ducetia Stål* (Orthoptera, Tettigoniidae) *Bull. Br. Mus. Nat. Hist. (Ent.*), **10**: 171-208.

REDTENBACHER, J., 1891. Monographie der Conocephaliden. *Verh. zool. bot. Ges. Wien*, **41**: 315-362.

SAMWAYS, M.J., 1989. Insect conservation and landscape ecology: a case-history of bush crickets (Tettigoniidae) in southern France. *Environ. Conserv.*, **16**:217-226

SULTANA, R. AND WAGAN, M.S., 2012. Review of genus *Hieroglyphus* Krauss 1877 (Hmiacridinae: Acrididae: Orthoptera) with description of one new species from Pakistan. *Pakistan J. Zool.*, **44**: 43-51.

SULTANA, R., YAWAR, S.W. AND WAGAN, M.S., 2013. Orthopterian biodiversity of desert (Thar) Sindh Pakistan. *Pakistan J. Zool.*, **45**: 299-304.

SERVILLE, J.G., 1831. Audinet. Revue methodique de Orthopteres. *Ann. Sci. Nat*., **22**:134-162.

SHISHODIA, M.S., 2000a. Short and long-horned grasshoppers and crickets of Bastar District, Madhya Pradesh India. *Rec. Zool. Surv. India*, **98**: 27–80.

SHISHODIA, M.S., 2000b. Orthoptera (Insecta) fauna of Andaman and Nicobar Islands. *Rec. Zool. Surv. India*, **98**: 1–24.

STÅL, C., 1873. Orthoptera nova-Ofvers. *Vetensk.-Akad, Forhandl*., **4**: 39-54.

STÅL, C., 1874. *Recensio orthopterorum. Revenue critique des Orthopteres decrits par Linne, De Geer et Thunberg.* 2. Norstedt and Soner, Stockholum 121 pp.

UVAROV, B.P., 1922. Record and description of Orthoptera from S.W. Asia. *J. Bombay Nat. His. Soc*., **28**: 351-370.

UVAROV, B.P., 1929. Studies on the Iranian Orthoptera I. Some new or less- known Tettigoniidae-Eznegodnik Zoologicheskogo. *Muz. Akad. Nauk SSR*, **31**: 623-639.

VICKERY, V. R. AND KEVAN, D.K.M., 1983. A monograph of the Orthopteroid insects of the Canada and adjacent regions. *Lyman Ent. Mus. Res. Lab. Mem.,* **13**: 681-1462.

WAGAN, M.S., 1990. *Grasshopper (Acrididae) of Sindh*. Pakistan Science Foundation, Islamabad, pp. 110.

WAGAN, M.S., 2008. Preliminary studies on long horned grasshopper (Tettigonioidea) of Sindh. *Pakistan Congr. Zool.*, **28**: p 69 (Abstract).

WAGAN, M.S. AND NAHEED, B., 1997. *Taxonomy of the Acrididae of the Punjab*. Final Technical Report PSF. Project S-Su/Bio (198) 158 pp.

WILLEMSE, C., 1933. On a small collection of Orthoptera from the Chungking district, S.E. China. *Nat. Maandblad*, **22**:15-18.

YOUSAF, M., 1996. *Taxonomic studies on grasshoppers and locusts of Pakistan.* PSF. Final Technical Report, pp. 158.

(Received 2 November 2013, revised 26 November 2013)